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

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TABLE OF CONTENTS
Keynote abstracts: 1
Platform abstracts: 2
Poster abstracts: 145
Poster corner abstracts: 491
Keyword Index: 506
Author Index: 512

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
Bernhard 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 and they are entering the environment continuously. In freshwaters, antibiotics can reach concentrations up to mg/L, but more commonly they occur in the low to sub ug/L range. They selectively target bacteria and thus there is an increased likelihood for impacts on environmental bacteria populations at levels well below that for effects on aquatic vertebrates. However, current environmental risk assessment (ERA) frameworks of antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of 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 Medicines Agency guidelines 2006) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species; and 3) how a PNECR relates to the PNEC derived for surface waters (PNECSW) using standard ecotoxicity testing. This presentation will describe (i) the output of this analysis of protection goal data and (ii) how the wider pharmaceutical industry are addressing concerns with antibiotic residues associated with manufacturing operations.
Platform Abstracts

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

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


In order to develop a more complete understanding of spray drift to improve the regulatory basis for representation in risk assessments, a set of SETAC workshops known as DRAW (Drift Risk Assessment Workshops) are underway to facilitate a range of efforts: Assemble and interpret a database of the spray drift trials for boom sprayers; Develop a programme of trials to more fully characterise drift influences; Use this information to develop proposals for standardized protocols for drift characterization in the field Develop an enhanced role for mathematical modelling as a higher tier risk assessment option; and Expand and reinforce the toolbox of regulatory risk mitigation measures. This presentation will focus upon; Database development and study design. The workshop database currently comprises 56,001 data points from a wide range of studies, providing a rich, complex basis for supporting a range of different research efforts. Beyond the detail 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 future research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have been focussed upon evaluations of two models that have been used within a regulatory context in the EU: IDEFICS and the SSAU Arahle 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. Lopéz, BASF SE; Z. Guo, Bayer Crop Science Division; M. Lamshoef, Bayer CropScience AG / R&D; M. Reitz, H. Hesseler, Syngenta Agro GmbH; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; P. Sweeney, Syngenta; P. Volz, BASF SE; S. Webb, Syngenta Ltd; B. Zillgens, 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. After that, 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 FOCS 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. TSCF should be derived from the uptake measured in the plant (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 EUREPGUF workshop (York, 2013) 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

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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 design. 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 preferred study scenarios and recommendations on the use of publicly available monitoring data have also been included. Also general recommendations on well installation and sampling procedures have been provided. Methodology has also been developed for assessing the relative vulnerability of agricultural regions and the vulnerability of specific sites for use in study design and site selection. The work of SETAC EMAG-Pest GW is still in progress but the goal is to finish by mid-2018.

4 Effect of the Freundlich exponent on the finite penetration depth in a homogeneous Freundlich-SF0 learning system

J. Boesten, Wageningen Environmental Research

A novel model is used in the EU regulatory 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 PELMO groundwater scenarios which use weather series of tens of years and include crop development and heterogeneous soil profiles. The sensitivity of the PELMO leaching concentration (evaluated at 1 m depth) to the parameter describing the curvature of the Freundlich isotherm (i.e. the Freundlich exponent N) as derived from simulations with these models shows a sharp decline with decreasing Freundlich exponent with the concentration going down to a submolecular level. This is counterintuitive and difficult to understand. Explanations may be found by studying a simplified version of these sophisticated models, i.e. a assuming a homogenous soil profile with pesticide properties that are constant with depth and assuming a constant water flow rate and a constant volume fraction of water (further called ‘simplified Freundlich-SFO system’). Previously it was shown that a pulse of pesticide applied at the soil surface in this simplified system has a finite leaching depth beyond which no pesticide molecule passes. Simulations of a pulse of 10 kg ha(-1) for a few FOCUS groundwater scenarios were compared to this effect on the percentage leached with this simplified model and qualitatively these effects were found to be similar. Next it was shown that this finite penetration depth after infinite time in the simplified Freundlich-SFO system increases slowly when N increases from 0.5 to about 0.85; however, when N approaches 1, this finite penetration depth goes to infinity. This was expected because this finite penetration depth does only occur in a system with a Freundlich isotherm and not in a system with a linear isotherm. It was checked by inspection of a concentration profile of one of the FOCUS groundwater scenarios that these scenarios also show a finite penetration depth for low N values at the end.
5 Bespoke monitoring to support Tier 4 FOCUS groundwater assessment
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Data generated from this bespoke groundwater monitoring programme will offer a solution to address the non-relevance case of pinoxaden metabolites from an exposure side. 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 pinoxaden use, groundwater less than 10m bgl, no confining layers, and no influential 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 minitank of two pinoxaden applications before 2016 with groundwater levels with an average of 2.9m below ground level. Sampling began in 2015 from 84 down hydraulic 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 vulnerability is made. The modelling approach should allow extrapolation of the modelled vulnerability to be extended to member states outside of those where the wells were installed.

6 Long-Term Trend of Aquatic Pesticide Risk
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European Union member states aim at reducing ecological risks exerted by pesticides. For this, reliable trends of indicator 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 sale 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 accurate 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 risk indicator SYNOPS-TOX (R²: 0.36), SYNOPS-TREND (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 relationships SPEARcontigu. 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. Celisse, 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 significantly delay in approaching equilibrium 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 rate. The delay constant format commonly applied to fish bioaccumulation from water of concentration Cwater, Cwater is not unique and often requires a sensitivity analysis to establish the uptake and loss rate constants and k5 is kBCF where BCF is the bioconcentration factor. The characteristic time for uptake and loss t is L2/kBCFk5. Slower uptake and loss will occur if the partition ratio KBCF is large, and the fish must contact KBCF-L 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 depuration phase. Mackay et al. [1] modeled bioconcentration and toxicity of superhydrophobic chemicals D4, D5, and D6 using a biotype model for fish. Due to the very high hydrophobicity (log KBCF=10³ for D5) and very low water solubilities Cwater must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be about 2000 days, to get Cwater=2 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/air partitioning data in which the onset of a hydrophobic delay (HD) is approximated where log KBCF=4 develop. They also suggested that 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 KBCF=10³. 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] Environment 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?
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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 passive dosing for the study of partitioning and paraffin compounds to examine 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). Biomagnification of D. magna was observed after 48 hours under different exposure concentrations. APCL-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 MCCP, had a similar silicone-water partitioning coefficient as a restricted SCCP – Huelis 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 criteria for assessing bioaccumulation and ecological risk. These compounds are generally composed of two cyclopentane units 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 (δ15N) and carbon (δ13C) to estimate trophic position/carbox 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 values observed being in the pelagic ecosystem. The TMFs measured for the three cVMS materials were all 99% of the uncertainty for cVMS TMF values in Lake Pepin was explained by uncertainty at the base of the food web (89%) and at the top of the food web (11%). By comparison, PCB-180 had a TMF of 2.2 in the evaluated food web, indicating biomagnification. TMFs for the cVMS chemicals and PCB-180 were determined using a Monte-Carlo probability analysis technique, and the likelihood that the values exceeded unity was less than 0.5% for all three cVMS compounds and >99.5% for PCB-180. This evaluation indicates that D4, D5, and D6 do not biomagnify in the benthic–dominated Lake Pepin aquatic ecosystem, a food web which does demonstrate biomagnification of the legacy contaminant, PCB-180.

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

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

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

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

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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 odontocetes 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, melan and mandibular fat, and 2) Physiologically based toxicokinetic (PBTK) modelling of PCB 153 and PBDE 153 to compare bioaccumulation of lipophilic compounds in lipids with different lipid composition and purpose (echorolocation 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 melan with increasing age. Nevertheless, the model showed the highest levels of PCB 153 in mandibular fat, followed by melan 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, life time 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 critique is that these proposals do not account yet for 'correlations'. We distinguish between two meanings of the term ‘correlations: correlated sampling: when applying Monte Carlo sampling for propagating uncertainty data for a comparative LCA study, the sampling can be either dependent (correlated) or independent (uncorrelated). Independent sampling implies that process data for the product alternatives compared are sampled independently from the same random drawing of parameter values resulting in identical data sets for this shared process; correlated data points: a 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 Henrikkson 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 possibilities and limitations of also including data correlations into LCA uncertainty assessments. Practical application of this
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 characterization factor estimated with USEtox. The physico-chemical and ecotoxicological properties applied in both models were all estimated. Their reliability was derived from the prediction accuracy of the estimation models used (EPISuite, ACD Labs, ECOSAR). A Monte Carlo analysis with 1000 iterations was then performed, combining the uncertainty and variability of the different parameters, to determine the spread in ChFs. The ChFs derived by this approach spanned nearly 4 orders of magnitude (95% Confidence Interval (CI)). The wide span of the ChFs’ 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the 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.

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 these results is limited 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 conditions. A combined parametrical and scenario analysis 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.

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 Inventories (LCIs) 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 spatialized elementary flows (EF), called LCI spatialization. However, integrating regionalization requires additional effort on data collection and treatment for LCA practitioners and database developers. Thus, prioritizing the regionalization effort on the most sensitive data (input data with uncertainty having the highest influence on the resulting uncertainty) would ensure an optimal use of resources to reduce LCA results uncertainty. This research work proposes a procedure to prioritize regionalization efforts based on global sensitivity analysis (GSA) to reduce the spatial uncertainty of LCA results. We applied this procedure to all the activities of two economic sectors (biofuel production and passenger land transport) defined in the ecoinvent database v3. The regionalized impact methodology IMPACT World+ is used to assess environmental impacts. Statistical tests are then used to derive sectorial recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. Those 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 concerns 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.
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 Holtmee 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 high-resolution hybrid quadrupole - Orbitrap MS (QExactive™Plus, Thermo Scientific) with a heated electro spray 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 ‘kmcl’. Four clusters were suggested for the data set representing: A: EOCs from treated wastewater input of the two wastewater treatment plants (WWTB), B: EOCs specific for first WWT 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 the river course, highlighting differences in point-sources and areas governed by diffuse input and identifying points of complex mixtures of mixtures (e.g., first WWTB), Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

20 Tracing sewage-derived contaminants from mainland towards the ocean by high resolution mass spectrometry
P. R. Martin, University of Cadiz / Physical Chemistry; A. Chiaia-Hernandez, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Biel, R. Baena-Nogueras, University of Cadiz / Department of Physical Chemistry; J. Hollender, Eawag / Environmental Chemistry

The ocean is the ultimate sink of most of the organic synthetic compounds produced and consumed by humans. Among the different pollution sources affecting this environment, discharge of treated and untreated sewage from mainland is of high relevance due to its continuous input, high volume and poor efficiency of conventional wastewater treatment plants (WWTB) 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 WWTB 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 WWTBs in the area (Jerez de la Frontera, 250 000 inhabitants), adjacent surface river and coastal waters, and oceanic waters at different depths (down to 400 m) taken up to 50 km away from the coastline. Solid phase extraction followed by liquid-chromatography high resolution mass spectrometry were used in combination with statistical tools (e.g., principal component and cluster analyses), specific vendor and open-access software, and orthogonal data sets were used to tentatively elucidate patterns 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., sucralose), some of them (e.g. sulfates) identified in the environment for the first time. The list of compounds reflected here not only shows many of the substances that can potentially escape from wastewater treatment but also constitutes a first step towards a more detailed characterization of the chemical exposure in the marine environment.

21 Pharmaceuticals, personal care products (PPCPs), and artificial sweeteners (ASWs) in river and groundwater from the Ganges River Basin, India
B. M. Shafiq, Research Associate, Environmental Chemistry; M. Asaduzzaman, Member of Emerging Organics; P. Noll, Head of Environmental Chemistry; M. Biel, R. Baena-Nogueras, University of Cadiz / Physical Chemistry; J. Bečanová, Graduate School of Oceanography, University of Rhode Island, Narragansette, Rhode Island 02882 / Chemical Oceanography; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; L. Nizzetto, NIVA

Pharmaceuticals and personal care products (PPCPs) and artificial sweeteners (ASWs) are environmentally relevant emerging organic contaminants. 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 saccharose. 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 detected in groundwater in lower than those in developed countries, still, their instantaneous loads in the Ganges River were comparable to those in rivers from developed countries. The presence of PPCPs and ASWs in the surface and groundwater can be interpreted as a consequence of inefficient wastewater management in the basin, which pose a concern for human exposure.

22 Data-dependent fragment ion search for detection of sartans and related compounds in wastewater and surface water
B. Zouna, IDAEA-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

The presence of polar contaminants like angiotensin II receptor antagonist pharmaceuticals (sartans) in the aquatic system is directly linked to human impact. Like other xenobiotics, they can be metabolised in the body with enzymes such as cytochrome P450 (CYP), UDP-glucuronosyltransferase (UGT), and glutathione 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 up until the compounds and their TPs have been identified in the samples from developed countries that 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 biodegradation 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 quantification of these compounds in surface and ground 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 river and freshwater samples pre-fractioned by ELISA
R. W. Jacobson, R. Hofmann, BMM Institute Federal Materials Research and Testing / Department of Analytical Chemistry Reference Materials / 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
bioconcentration modelling, an equation was derived that predicts the amphibian present. By combining existing concepts, including interspecies correlation In this presentation, a model to predict acute dermal toxicity of plant protection CropScience / Ecotoxicology

population assessments (I)
Wildlife ecotoxicology: laboratory dosing studies to field monitoring program. [28x210] efficiencies by the treatment technologies applied. Finally we prop

techiques combined with prioritization techniques including substance properties non

program tripled in the last decade. The water utility aims to prioritize their service
during drinking water production for specific compounds. Water utility Vitens

soil. The susceptibility of the groundwater aquifers to these 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 assessment, not only the impact of oral and dermal exposure routes. Informative field studies are very difficult to perform with these organisms and risk mitigation options – if available - could usefully be included in risk assessment as an alternative to full-scale field studies. Practical mitigation options need to be developed and adapted for local environments to be most effective. (1) EFSA PPR, 2017 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.2017.4792. [2]EFSC. 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 39/1

27 Ecotoxicological assessment of Caretta caretta (Linnaeus, 1758) in the Mediterranean Sea using an integrated non-invasive protocol S. Casini, University of Siena / Scienze Fisiche della Terra e dellAmbiente; I. Caliani, M. Giannetti, L. Marsile, D. Coppola, N. Bianchi, T. Campiani, 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 assessment, not only the impact of oral and dermal exposure routes. Informative field studies are very difficult to perform with these organisms and risk mitigation options – if available - could usefully be included in risk assessment as an alternative to full-scale field studies. Practical mitigation options need to be developed and adapted for local environments to be most effective. (1) EFSA PPR, 2017 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.2017.4792. [2]EFSC. 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 39/1

25 An interspecies correlation model to predict acute dermal toxicity of plant protection products to terrestrial life stages of amphibians L. Welge, P. Janz, BASF SE, Crop Protection - Ecotoxicology; P. Sowig, Bayer CropScience / Ecotoxicology

In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial amphibian life stages from (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and bioconcentration modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD_{50}) from standard acute toxicity values (96-h LC_{50}) for fish and bioconcentration factors (BCF) in fish. Where possible, fish BCF values are correlated to a 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 LD_{50} values from acute dermal toxicity experiments with 15 different species of anuran amphibians, comprising 15 different plant protection products. The developed ICE model can be used in a screening approach to estimate the acute risk to amphibian terrestrial life stages from dermal exposures to plant protection products with organic active substances. Applying this method has the potential to reduce unnecessary testing of vertebrates.

26 Overview of the EFSA Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; P. Adriaanse, Alterra Wageningen University and Research Centre; A. Albrecht, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology, P. Berny, VETAGRO-SUP / Toxicology; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece; M. Ortiz Santalarieta, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; C. Topping, University of Aarhus; S.M. Weir, Queens University of Charlotte / Biology; F. Streissl, EFSA / Pesticides Unit; R. Smith, School of Applied Sciences, University of Huddersfield Concerns have been raised that the current risk assessment schemes may not sufficiently cover the risk for amphibians and reptiles exposed to intended uses of plant protection products (PPP). To address these concerns, the 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 2015; 13(8): 3897

Overview of the EFSA Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2015; 13(8): 3897-3898 and a chlorine pattern. The compound is cetirizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20 % of the overestimation we found initially with the CBZ antibody. The LC-ELISA for SMX displayed a series of unidentified peaks in the ELISAGram. Careful analysis of the fractions led to the identification of N-acetyl-sulfamethoxazole, an SMX metabolite which is present in the samples. With estrone, interleukin by polar matrix compounds eluting early could be identified.

Designing a risk based monitoring program for groundwater sources for drinking water production – based on target and suspect screening combined with clustering techniques R. Sjörs, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Brunner, B. Bajema, Vitens; P. Bauerlein, KWR / Analytical and Environmental Chemistry; M. de Jonge, Vitens; Y. Fujita, M. Schrik, KWR Watercycle Research Institute; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health

Drinking water utilities heavily invest in monitoring occurrence of chemicals in drinking water sources and produced drinking water. Worldwide, drinking water regulation prescribes drinking water limits for a limited number of chemicals, the EU Drinking Water Directive (EU DWD) for example lists drinking water limits for 26 organic and anorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and bioanalytical methods. The EU DWD 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-say 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 presented here is the start 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)

HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazine (CBZ), an anti-convulsant and anti-depressant, sulfamethoxazole (SMX), an antimicrobial for humans, and estrone (E1), a hormone and estradiol metabolite have been studied by this LC-ELISA approach. Immunoassays had been developed for all compounds but overestimations of wastewater concentrations were frequent, with CBZ even at a constant level (+ 30 %) that did not result from the considerably high reactivity to CBZ (10,1-epoxide (ca. 70 %) or 2-hydroxy-CBZ (14 %). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30 – 40 min. run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were reconstituted in 0.1 M glycine pH 2.5. For TOP-ESI-MS applied on a specifically “positive” fraction revealed an exact mass of m/z = 389,168 and a chlorine pattern. The compound is cetirizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20 % of the overestimation we found initially with the CBZ antibody. The LC-ELISA for SMX displayed a series of unidentified peaks in the ELISAGram. Careful analysis of the fractions led to the identification of N-acetyl-sulfamethoxazole, an SMX metabolite which is present in the samples. With estrone, interleukin by polar matrix compounds eluting early could be identified.
carcinogenic PAHs in blood and DNA fragmentation as well as between Cd in carapace and GGT in plasma. We measured a very sharp band with a molecular weight of 59 kDa in skin sample that can be attributed to CYP1A1, not investigated earlier in this species. We also evidenced as the youngest animals showed significantly higher DNA fragmentations, BChE inhibition and increase of GGT, these alterations can be potentially related to their coastal habits. Older specimens showed the highest levels of erythrocyte nuclear abnormalities which may indicate a lower health and toxicological stress. This study contributed to expand the knowledge about the ecotoxicology of C. caretta in the Mediterranean, the non-invasive protocol could also be applied to other marine ecosystems and other sea turtle species, and implemented with new endpoints in the near future.

28 Sucking clans or hunting sequences - consequences for walrus health H. Routti, The Norwegian Polar Institute; S. Bourgeon, University of Tromsø / Department of Arctic Marine Biology; B. Diot, UIT Arctic University of Norway; N. Duaie, Norwegian Institute of Public Health; A.T. Fisk, University of Windsor / Great Lakes Institute for Environmental Research; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; L. Hanssen, M. Harju, NILU / Norwegian Institute for Air Research; K.M. Kovacs, C. Lydersen, Norwegian Polar Institute; I. Nymo, Norwegian Veterinary Institute; C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment; S. Scottor, M. Tryland, UIT The Arctic University of Norway; G.D. Villanger, Norwegian Institute of Public Health

The walrus (Odobenus rosmarus) is an ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and 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 low 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 Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ15N values in red blood cells and in blubber were positively correlated with δ15N in HILIC compounds, 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 concentrations of Pb, Cd, and to PCBs. The concentrations of δ15N in red blood cells and δ13C in blubber showed a significant positive relationship with body mass and age of the studied walruses. These findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

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

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

31 Regulatory improvement in the assessment of environmental risks from veterinary medicines; a European Perspective J. 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; a European Perspective
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 mesocosm studies have been considered in the Guidance on the Aquatic Risk Assessment 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 mint farms
R.G. Ovesen, Danish Environmental Protection Agency; H. Bekgaard, Kopenhagen Fur

Bicreticide 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 mint farms. A scenario has therefore been developed, where emission of a.i. from mint farms is calculated based on either amount applied or measured concentration in straw. Default values have been estimated from regulation and general practices in mint production in the Nordic countries, where Denmark has the highest production of mint in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are treated. Each mother will bear 5.55 cubs/year according to Danish regulation [4]. The number of “breeding females” (BF) is 1 mother+5.55 cubs. The number of nest boxes that is treated/BF may be calculated as follows: 1 animal/nest box before separation and 6.55/2 animals (3.275)/nest boxes after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw may be from up to 50 BF/ha per hectare (ha) per year based on regulation in the Nordic countries. Emission according to application pattern: \[ Y = \text{Q}_{\text{a.i.}} \times \text{F}_{\text{a.i.}} \times \left( \frac{N_{\text{a.i.}} \times \text{rate}}{N_{\text{a.i.}} \times \text{rate}} \right) \times B \quad \text{Eq.} \] Where \(Y\) = emission of a.i. in kg/ha/year, \(Q_{\text{a.i.}}\) = amount of product/nest box in g, \(F_{\text{a.i.}}\) is concentration of a.i. in the product in kg/g, \(N_{\text{a.i.}} \times \text{rate}\) = number of treatments before separation of adults and cubs, and \(N_{\text{a.i.}} \times \text{rate}\) = 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: \[ Y = \text{C}_{\text{a.i.}} \times \text{E}_{\text{a.i.}} \times 750 \text{ kg straw per BF per ha} \quad \text{Eq. 2} \] 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 Kopenhagen Fur on amount of straw used per BF is 50 BF per ha x 15 kg straw per BF=750 kg straw per BF 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?
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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 in households are households e.g. facades, 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 emission 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 analysed with an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMIT, DCOIT, DEET, diuron, icaridin, OIT, piperonyl butoxide (PBO), triclosan, tebucarbazone, 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, all substances have been detected in at least 10 % of the samples. Highest concentrations were measured for C12-benzalkonium chloride with an average concentration of 6.6 μg/L. Besides C12-benzalkonium chloride, BIT, DEET and icaridin 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 repellent 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 carbaryl were also detected. As these were not listed on the inventoried products, emission via treated materials such as paint, render, seals or textiles seems likely. We were able to show that biocidal active substances are emitted from the inside of households in considerable concentrations. Those emissions are not only due to biocidal products but also washing and cleaning agents, personal care products and preserved materials. For this reason, measures should not only tackle biocidal products when it comes to the reduction of biocidal active substances in wastewater.

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

37

Comparative multi-generation study of long-term effects of pristine and wastewater-borne silver and titanium dioxide nanoparticles on reproduction in Daphnia magna

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Manufactured nanomaterials (MNMs) and especially Ag- and TiO2-NPs are processed 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 solvent control (NM100K DIS), or to three concentrations of TiO2-NPs (nominal: 25 µg/L, 50 µg/L, 100 µg/L) in line with the OECD guideline No. 211. Each generation was exposed for 21 days and started with the third brood from the previous one. In all six generations the exposure with pristine Ag-NPs (NM300K) for 21 days caused a significant reduction in the mean number of offspring in daphnia compared to the control. However, wastewater-borne Ag-NPs had no effects on reproduction in any generation. In the treated adult population the 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 more realistic risk assessment of Ag-NPs and TiO2-NPs for the aquatic environment. The experiment with TiO2-NPs are in progress.

38

Development of a rapid screen to assess bioaccumulation potential: from ex vivo to in vivo using pristine and aged nanomaterials in fish

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

39

Fate and Effect of Wastewater Borne Manufactured Nanomaterials on the Aquatic Food Chain

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Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics etc. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the effluents are significant and may have an increased toxicity for aquatic organisms due to their modification during the WWT. The impact of wastewater-borne MNMs (TiO2 and Ag MNMs) on different trophic levels and their bioaccumulation within a relevant food chain (algae-Daphnia-fish) have been investigated with innovative analytical and experimental approaches. Several model WWTPs were conducted according to OECD Guideline 305A. The collected effluents were used to perform acute and chronic tests with Daphnia magna and Oncorhynchus mykiss according to the OECD guidelines 202, 211, 215 and 305. Animals were exposed to (i) effluent from model WWTPs contaminated with MNMs, (ii) untransformed effluent, manually spiked with MNMs and (iii) dilution water enriched with pristine MNMs. Tissue samples of the different test organisms were analyzed for changes in the levels of several biochemical markers [lipid peroxidation; activities of acetylcholinesterase (AChE), lactate dehydrogenase (LDH), superoxide dismutase (SOD), catalase (CAT) and glutathione S-transferase (GST)]. Furthermore, uptake and elimination kinetics of the MNMs were investigated by quantitative ICP-MS and ICP-OES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into untransformed effluents with freshly prepared AgNPs, the analysis of biochemical markers increased AgNP concentration. For nano-TiO2, no effects on the reproduction of D. magna could be shown at environmentally relevant concentrations. Only after chronic exposure to the very high concentrations of 5 mg/L and 10 mg/L significant effects could be shown. Neither nano-Ag nor nano-TiO2 showed an effect on the growth of juvenile rainbow trout after 28 days of exposure. The analysis of biochemical markers showed that several effects induced by chronic exposure to MNMs were observed. However, no general effect pattern could be identified. Total MNM levels were measured in several tissue samples in D. magna and O. mykiss following exposure via the water or food. Pristine nanomaterials showed a significantly higher uptake into the test organisms compared to supplemented and treated WWTP effluents.
and (ii) the subsequent effects of transformed particles in comparison to their pristine counterparts and make predictions challenging. In this context, the leading to an alteration in behavior release in wastewater streams and subsequently in the environment. Nanoparticles were exposed in glass beakers with 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 nanoparticles AgENMs that have been observed between certain benthic organisms and Ag-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-NPs compared to the body would otherwise be exposed in Ag-NPs. For planarians, results revealed very similar k1 values, with the highest k1 for animals exposed to ionic Ag and the lowest for Ag-NPs. 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 nanoparticles (AgENMs) are mediated, in part, by proteins and other biomolecules. Given the high affinity of thiolate ligands for silver, metalloproteins are key targets to evaluate the role of biomolecules in AgENM transformations. In turn, metalloprotein interactions with AgENMs are also central in mechanistic studies of cellular impacts of AgENMs, including toxicity, antimicrobial, and resistance mechanisms. Despite the shared preference of both silver and zinc for thiolate and amine coordination, the interactions of zinc finger domains with AgENMs is not well studied. Zinc fingers constitute a large class of metalloproteins, ubiquitous in eukaryotes, that use a combination of cysteine and histidine residues that bind Zn(II) as a structural element. Zinc finger domains within proteins typically serve as interactors and can bind DNA, RNA, proteins or small molecules to mediate cellular processes like transcription or translation. Small library of zinc finger peptides, we have evaluated the impact of Zn fingers on AgENMs aggregation and dissolution. Zinc finger peptides drive AgENM dissolution resulting in release of Ag(I) at orders of magnitude higher rates than other model proteins, including a few metalloproteins. The release of Ag(I) is central to mechanisms of cellular response and toxicity of AgENMs. Indeed, Cu(I) binds to both the apoproteins and the CoT(II)-substituted peptides; the stoichiometry of Ag(I) binding is dependent on the peptide primary sequence. Additional studies using fluorescence spectroscopy to monitor Ag(I) binding to the Zn finger peptide indicate that the Ag(I) effectively completes with Zn(II) at the metal binding site, despite the high affinity of Zn(II) for the peptide. Circular dichroism spectroscopy used to assess changes in the peptide secondary structure demonstrate that the addition of either form of silver alters peptide structure and structural perturbations are again dependent upon the peptide sequence. These results show that Zn finger peptides can mediate AgENM transformations within eukaryotic cells. In turn, for the Zn finger peptides studied here, Ag(I) is the thermodynamically favored metal despite the known high Zn(II) affinity of zinc finger domains. This works suggests that Ag(I)-substituted zinc finger domains might be relevant in the context of both silver toxicity mechanisms and silver-responsive transcription factors.

42 Fate and effects of transformed Ag and TiO2 nanoparticles aged through a lab-scale wastewater treatment system
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The increase in production and use of Ag and TiO2 nanomaterials has led to their release in wastewater streams and subsequently in the environment. Nanoparticles (NPs) can undergo transformations in environmental media such as wastewaters leading to an alteration in behavior, bioavailability and toxicity that may differ from their pristine counterparts and make predictions challenging. In this context, the overall goal of the study was to elucidate (i) the behavior and transformation of Ag and TiO2 NPs in realistic matrices such as wastewater effluents and activated sludge and (ii) the subsequent effects of transformed particles in comparison to their pristine counterparts. In this study, a laboratory-scale wastewater treatment system was established and combined with a battery of ecotoxicological assays and characterization techniques. The system contained activated sludge and was operated as a pre-denitrification system fed with synthetic wastewater spiked daily with 10 µg Ag NPs/L (PVP coated, 25 nm, nanocomposite) and 100 µg TiO2 NPs/L (nominal primary size of 5 nm, NM-101, JRC) over a period of 5 weeks. During that period the effluents were collected weekly and the excess sludge was stored for the evaluation of terrestrial toxicity. Some samples at a certain period were collected weekly and analyzed by sequential filtration and ICP-MS to determine the partitioning of NPs and their transformation products. Transmission electron microscopy and sp-ICP-MS were performed on selected samples. The effects of aged particles were assessed using a battery of bioassays including freshwater and marine algae (growth inhibition and reactive oxygen species -ROS- formation), and crustaceans, as well as in vitro models of relevance for NP toxicity assessment (RTgll-W1 cell line, effects on metabolic activity, epithelial integrity, ROS formation, gene expression). The extent of the observed effects was dependent upon the organism exposed, with bottom feeding organisms and algae being more sensitive, while the in vitro model was a good tool for environmental samples. Furthermore, the biosolids generated from the lab-scale continuous system were used for several microbial community experiments, giving some insights on the fate and potential accumulation in a model terrestrial system. Experimental data generated from the continuous-flow operation of the activated sludge system and the targeted batch experiments will be used to model the fate and the removal of NPs.

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)

Oil spill emergency response plans (OSR) 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 OSR is complete in providing for the prevention, identification, and spill response options available to protect and 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 scope from consideration of mitigation of ecological impact to include mitigation of socioeconomics 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 select 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 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.

44 Adapting the SIMA Process to Assess Offshore Decommissioning Options
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For several decades, the oil and gas industry has used the Net Environmental Benefit Analysis (NEBA) approach for oil spill response contingency planning. Recently, IPIECA-API-IOGP published guidelines on the implementation of NEBA, using a novel process known as Spill Impact Mitigation Assessment (SIMA). When applied, the goal of SIMA is to conduct an evaluation that will enable decision-makers to choose response options that will result in the best overall recovery of the ecological, socio-economic and cultural resources. One of the key advantages to the SIMA process is its transparency – it clearly shows and documents the assumptions and decisions that were used to arrive at the conclusions. In most spill scenarios, no single response option is likely to be completely effective; often, the best approach to minimize environmental impacts is to employ multiple response options. This will require consensus between key stakeholders and the various decision-makers on the benefits and
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, requiring an efficient and cost-effective tool for keeping track of the large amount of impacts of the next big marine oil spill, wherever it may happen. In this presentation, we demonstrate a convenient tool for monitoring after marine pollution disasters, using the DWHOS as a case study. In we demonstrate a convenient tool for keeping track of the large amount of impacts of the next big marine oil spill, wherever it may happen.

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 effects of stranded oil, oil sorption, microbial oil degradation, oil-affected marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of combined stressors on species and habitats, and habitat and ecosystem recovery processes. To keep order in this flow of new knowledge is an important albeit challenging task. It is essential that the lessons of DWHOS are applied globally to 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 ecosystems that have been gained from the DWHOS research, and identify some key knowledge gaps still remaining. The presentation will update a comprehensive review of 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 beaching oil spill in the Arctic, how well will the shorelne 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 were studied over a period of 2 weeks in a field test at Disko Island on the Greenland west coast. An important part of the study was to understand the removal rates in the environment and the pattern changes with period of exposure. It would be more appropriate to use a “signature” analogy when comparing oils by this approach. The weathering processes change the chemical signature and oil may have a different chemical composition to the original source oil. When we analyses such samples, we may need to ask if this is the same oil as the proposed source, or a different oil with a different signature that is also present. The steranes and terpanes although the concept of a "fingerprint" suggests this is static in time. However, it is also well known that the steranes and terpanes have a variety of compounds containing deuteriums and the pattern changes with period of exposure. It would be more appropriate to use a “signature” analogy when comparing oils by this approach. The weathering processes change the chemical signature and 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 biodegradation 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 it comes to distinguishing between sources, less may be more! We need to select the compounds we include in our analyses with care since each question may need a different approach: if we want to know if the oil is weathering, we use a suite of compounds with differential properties appropriate to the environment of the 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)

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

J. Lee, J. Ji, Yongin University

In response to the restriction of bisphenol A (BPA), bisphenol S (BPS) has been widely used in the manufacturing of polycarbonate plastics and epoxy resins as an alternative compound. BPS has been found to affect reproduction, development,
and 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 polymerase chain reaction (qRTPCR) was used to confirm the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hematopoiesis, 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 targeted to understand the role of 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 antioxidant activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fish 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 sublethal (1.1 – 1.3 μg Se/g) or 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 transcription 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 ecophysiological effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the findings of this study aim of this study to understand the mechanisms of adverse 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

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

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 an integrated approach. Here, we compare 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 organizations 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 to (1) validate a screening approach for sediment of samples (2) to offer a first in vivo toxicological profile of sediment from three different polluted sites from Gulf of Bothnia.

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

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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). Identification of the most informative endpoints and model organisms that are specific to chemical-induced apical responses in zebrafish. The study focused on fadrozole, a known inhibitor of cytochrome P450 aromatase. Thus, an excellent model substance to evaluate and validate proteomic methods with the integration of organ-specific effects. Spawning adult zebrafish groups (5 males, 5 females) maintained at 25-26°C on a 16:8 h light cycle were exposed for 21 days to fadrozole (0.0, 0.1, 1, 10 μg/L) and analysed for plasma vitellogenin content, egg numbers and organ histopathology. Livers and gonads were isolated for shotgun proteomics and qPCR to characterize substance induced specific molecular toxicity pathways. Proteins involved in steroid hormone secretion and estrogen stimulation such as vgl1, vgl3, vgl6 and lumn1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimulus, lipid metabolism, metabolic processes, TCA metabolism and calcium signalling. Our study demonstrated that the downstream induced-estrogen receptor suppression by aromatase inhibition triggered the downregulation of estrogen synthesis, which was assumed to induce the observed decrease in egg numbers and oocyte atresia with membrane folding in the ovary. We anticipate that this approach leads to the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary testing extensive.

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 have been concerned a limited amount of information 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 leading to a weak acute toxicity in fish embryos. However, internal concentration profiles of parent compounds suggest 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 use differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single hi-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMSO extraction. Zebrafish (n=32/treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5 filter portions undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polyacrylic 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 mortality and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.

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

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 befavoured, but at the same time, it is our responsibility to transmit this heritage we received from the past to the future generations. It is urgent to include cultural heritage in the value chain of sustainable development: the priority that faces the world today. Research on the threats that climate change will have on cultural heritage has been very limited until now and it has not yet generated policies designed to mitigate the impact and to develop preventive adaptation strategies. The presentation will be focused on future scenario on the effects of climate change variability on the vulnerability of cultural heritage at European level. Recommendations on the inclusion of cultural heritage in the national adaptation strategies and plans to climate change will also be discussed.

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

An anthropogenic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biologically by microorganisms, leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesise their biomass compounds, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigated the turnover of herbicides (2,4-D, glyphosate, bentazon, bentazon, bromoxynil and clodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into 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

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

59 Scenario Development for Off-field Soil Exposure and Risk Assessment
M. Wang, WSC Scientific GmbH / Dept Ecate Modelling; J. Kleinnann, WSC Scientific GmbH; T. Schad, Bayer AG / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer AG / Ecotoxicology; G. Goettitz, Bayer CropScience AG / Environmental Safety; P. Neumann, Buyer AG; S. Bub, Tier3 Solutions GmbH

In its Scientific Opinion on risk assessment for in-soil organisms EFSAs 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/off-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 PGs.

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

Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biologically by microorganisms, volatilised leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesise their biomass compounds, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigated the turnover of herbicides (2,4-D, glyphosate, bentazon, bentazon, bromoxynil and clodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into 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

14 SETAC Europe 28th Annual Meeting Abstract Book
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. Sittig, 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 (PPP) 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, PELOM, PRZM and MACRO. A numerical wash-off factor for modelling is applied, quantifying the wash-off from plant surfaces by a given amount of precipitation. Consequently, this factor is relevant for the calculation of predicted environmental concentrations (PEC) for the compartments soil, groundwater, and surface water. In case a measured wash-off factor is not available, a default value is to be applied. An increase of this default value from 0.5 cm⁻¹ to 1 cm⁻¹ has been proposed by EFSAs, which results in more exhaustive wash-off from the plant surface. Generally, the extent of rainfall-induced displaced substance depends on several factors. An ECJ 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 potential of 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
L. Padilla, Stone Environmental, Inc.; A. Del Signore, D. Sprenger, L. Weltje, BASF SE / Crop Protection Ecotoxicology; M.F. Winchell, Stone Environmental, Inc.; J. Stone, BASF SE

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 substance in organisms or biodegradability in the environment. 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 foodweb model with time-varying inputs to test the effects of regional and local-specific agricultural settings. Modelling results included both the daily time series predictions of organism concentrations for the six trophic levels and the uptake and elimination rate constants calculated from organism sub-models. In total, nine FOCUS scenarios were simulated and compared (five drainage scenarios with MACRO and four runoff scenarios with PRZM) and dominant organism uptake pathways were identified. The approach may be used to refine log Kow (based screening bioaccumulation and biomagnification evaluations for regulatory purposes.

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

Agricultural activities can involve the use of plant protection products (PPPs) and the use of such chemicals can occur near surface waters bodies, thus creating a potential for adverse effects on aquatic ecosystems. Due to the spatio-temporal variability of chemical applications and of the processes regulating their fate and transport to surface waters, ecosystems are often exposed to pulses of contaminants. In certain environmental scenarios, such as small mountain watersheds, where runoff fluxes are particularly rapid due to steep slopes, exposure peaks can be shorter but much higher. Monitoring campaigns are often inadequate or too expensive to be carried out and modelling tools are therefore vital for exposure assessment and their use is encouraged by current legislation. However, currently adopted models and scenarios (e.g., FOCUS for PPPs) are often too conservative and/or “static” to accurately capture exposure variability, and the need for more realistic and dynamic tools is now one of the major challenges for risk assessment. In a previous work, the new fate model DynAPlus was developed to improve pesticide fate predictions in cultivated mountain basins. The model was successfully evaluated against chlorpyrifos water concentrations measured in the Novella River (Non Valley, Northern Italy), where more than 1000 ha of apple orchards surround the river and Institute of Bioeconomy Research; P. Horney, Julius Kühn Institut; D. Daehmlow, Julius Kühn-Institute / Institute for Strategies and Technology Assessment; B. Golla, Julius Kühn 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 PRZM5 and VSFMOD 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. Data is acquired and carried out 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 selection time period.

Hydrophobic Chemicals and Mixtures: Reliable Investigations

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on their Environmental Fate and Effects (II)

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

Higher tier biodegradation laboratory tests in soil, sediment and/or surface water

Ecological chemistry; Ecology IME; E. Vaiopoulou, European Petroleum Refiners Association; D. Mayer, Technical University of Denmark / Department of Environmental Engineering; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

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

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 (UVCBs). The dosing of such mixtures in environmental experiments and tests can be challenging and there is an urgent need for new methods to provide stable concentrations and defined composition of these mixtures in aquatic fate and toxicity testing. Passive dosing from a silicone rod has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of Kow and Koc. This study aims to extend the applicability of the novel passive dosing method to hydrophobic multicomponent substances and UVCBs (i.e. complex mixtures). The method is straightforward: a silicone rod is loaded by direct addition 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 UVCB mixtures, 2) reproducibility and optimized passive dosing kinetics for one petroleum substance and one essential oil and 3) the performance and characteristics of the passive dosing method compared with more traditional dosing methods.

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

Biodegradation 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 Tetradin and DDT was conducted on model soils with different texture, organic carbon and microbial activity. At sampling dates the headspace air of the samples was stripped off through the Tenax tube using a vacuum pump. The Tenax tube and the 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% (N=90) for Decano and 104% (N=90) for Tetradin with a variation (between the individual replicates) < 11% for both studies suggests that obtaining a complete mass balance with the new test setup was reproducible. It was observed that radioactivity adsorbed on Tenax (100% parent), was higher in the soils with lower OC content suggesting that sorption of the chemical affecting its volatilization and hence degradation. Thus, how to deal with the volatilized parent fraction while calculating degradation kinetics is still a part of ongoing research.

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

The key objective of this study was to test the applicability of a unified modelling approach across the spectrum of OECD degradation tests and newly developed experimental test setups 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-labelled HOCs (triclosan, pentachlorophenol—PCP, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil or in novel passive dosing setups, in the presence of a single degradator strain. Overall, a high degree of agreement between model predictions and empirical data was shown by adjusting only the ratio vmax / K, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of vmax / K values was shown for the selected substances (0—55 mg C-d1), indicating that both limited bioavailability and intrinsic recalcitrance can explain HOC persistence. This study represents a first attempt of using a unified modelling approach for predicting biodegradation of HOCs across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including the formation of intermediate transformation products; (ii) determining (de) sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.
distances, and do not include any local PCB sources on Svalbard. Total PCB deposition history to the core and surface snow shows that amounts have not declined in net amount since the mid 1950s. The peak flux in the surface snow and to ice core layer is 18.5 - 19 pg cm^-2 yr^-1. Average 5-day air mass trajectories from peak flux periods beginning in 1998 show more frequent 5-day air mass trajectories from Russia, and from Europe south of 60°N latitude, particularly extending into the U. K., relative to 1989-1998, which had 5-day trajectories ending in the far north of Russia and Norway. The surface snow PCB distribution profile is dominated by PCB 110, 70+74, 101, 95, 11. Combined, these five congeners represent ~27% of PCB. The upper-most ice core sample is dominated by PCB 95, 52, 101, 110, 70+74, which represent ~42% of PCB. The most apparent difference between the two profiles is the lower amount of dichloro- and trichloro- congeners in the surface snow. The indication is that the more volatile congeners in the dichloro- and trichloro-homologs are depleted to surface snow shown in Figure 1A, but are volatilized back to the atmosphere during periods of higher summer air temperature. The percent of PCB-111 throughout the samples ranges from 0.90-3.4% and is present in all samples dating from 1957. It is the dominant congener among mono- and di-chloro PCBs. This PCB congener has very low sorption to polar soils and is not retained in the soil column. For the first time. Organic UV stabilizers are of emerging environmental concern due to their large use in personal care products like cosmetics and sunscreens. The pathways of products containing this pigment. The source of PCB-11 to Lomonosovfonna is uncertain, but could be waste incineration facilities in Europe where it has been found in flue gas.

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

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 re-evaluated in the near 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 100 °C. The extracts were solvent-changed to methanol, reduced in volume to 150 µL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an APPI-source 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 (I)

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

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 LCA results. The main task of this work was therefore to 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 compared when to site-generic scores and (iv) irrespective of the geographic locations, regionalization improved human health impacts. 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 indication of substantial differences in the assessment 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 Ken 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.

Considering space debris related impacts within the LCIA framework

Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s disposal. Volume occupation by debris and dead space may lead to a decrease of the orbital resource availability enhancing the risk of collision/ breakup 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 relevance of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

Implementing ozone formation effects due to poplar plantations for biomass production: An impact assessment

Implementing ozone formation effects due to poplar plantations for biomass production: An impact assessment

TheClean Space Initiative.

Given this situation, there is an opportunity to make the link between space debris concerns and eco-design of spacecraft (satellites & launchers) using the LCIA 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 LCIA 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 disposal. Volume occupation by debris and dead space may lead to a decrease of the orbital resource availability enhancing the risk of collision/ breakup 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 relevance 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.
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. Escoïla 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. Toreisi, Kruger A/S; H. El-talawy, Aarhus University / Department of Environmental Science; I. 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: diflonef is recalcitrant in sludge systems, while it can be degraded with half-lives of 2-4 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 were hitherto believed to be recalcitrant (like diflonef) could easily be degraded in relatively short time periods. For single compounds degradation pathways for biofilm systems are discussed and compared to other systems. – While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfatation pathways. Interestingly enough, it was possible to reach high removal rates for otherwise persistent ozonation-by-products such as macrolide N oxides while avoiding back reactions to the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diflonef.

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

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

Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g. algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one anticonvulsant using laccase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,3-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) 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 E. 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 investigations 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 can be envisaged on assessing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

79 Evaluation of macrophyte mediated biodegradation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays S. Terzić, Rudjer Boskovic Institute / Division for Marine and Environmental Research; P. Kostanjevski, I. Križman-Matašić, I. Senta, Rudjer Boskovic Institute; T. Jurina, Faculty for Food Technology and Biotechnology; N. Udikovic-Kolić, Rudjer Boskovic Institute; J. Ćurko, Faculty of Food Technology and Environmental Technology; M. Matošić, Faculty for Food Technology and Biotechnology; J. Lončar, I. Mihalićević, T. Smital, Rudjer Boskovic Institute; M. Ahel, Rudjer Boskovic Institute / Division for Marine and Environmental Research The aim of the present study was to investigate the transformation of three prominent representatives of macroalgal antibiotics (azithromycin - AZI, clarithromycin - CLA and erythromycin - ERY) in model biodegradation and ozonation experiments. The study included determination of the kinetic parameters 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 μg/mL) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (Bacillus subtilis), while toxicity test was performed with the freshwater green algae Desmodesmus subspicatus. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was smaller. The capability of the sewage treatment processes in removing antibiotics 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 to the environment is increasing. Constructed wetlands (CWs) and bioreactors are used for pollution treatment. However, conventional techniques based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) are very often only available in high-tech laboratories. The cost-effective methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of CECs, including transformation products (TPs), in sewage and sludge using a fully automated 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 50 ng \(\cdot\)L\(^{-1}\) 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) (609±6 mg L\(^{-1}\), 493±11 mg L\(^{-1}\) and 434±11 mg L\(^{-1}\)), were maintained for 40 d (<4 times the SRT) to achieve representative steady states. The maximum REs of ibuprofen, naproxen, salicylic acid, triclosan and propylparaben were 91±1%, 28±7%, 83±5%, 85±0% and 85±15%, respectively. COD concentration only affected clearly ibuprofen and naproxen REs. This pointed out oxidation as an important removal mechanism for those compounds. In contrast, salicylic acid and triclosan REs slightly increased at lower COD loads. For propylparabens, 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 R. Chitongo, Cape Peninsula University of Technology Cape Town South Africa / Chemistry; B. Onoemo, Cape Peninsula University of Technology / Faculty of Applied Sciences; G.S. Olatunji, Cape Peninsula University of Technology / Chemistry There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The carbonyl-second-stage sewage treatment is better described in the removal of pharmaceuticals from wastewaters in African countries is also not fully known. There is scarcity of information concerning the utilization of grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHL). This study therefore aimed at monitoring of the three antibiotic residues in selected surface water samples. Activated carbon from grape slurry and biocarbon were synthesized 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 transect and storage tank of the Diep 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 mechanisms of the contaminant by activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate these carbonized samples using activated carbons produced 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 biocarbon was not able to adsorb the antibiotics on activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

82 Biodegradation of organic micropollutants in constructed wetlands: comparison of design and operational parameters P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; Y. Zhang, Southern University of Science and Technology / School of Environmental Science and Engineering; L. Tao, Nottingham Trent University / School of Animal, Rural and Environmental Sciences; L. Zhang, C.A. Arias, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove these 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 removal processes and fate of organic micropollutants in different types of CW systems. Five different experiments have been conducted in biofilm microbial community function. The plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and iohexol. Phragmites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
Effects of PAH exposure on fuelling ability in a long distance migratory shorebird

K. Bianchini, University of Saskatchewan - Toxicology Centre / Toxicology; C.A. Morrissey, University of Saskatchewan / Biology

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

84 PFAAs levels, oxidative status and reproductive success in great tits (Parus major) inhabiting a contamination hot-spot.

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Perfluoroalkyl acids (PFAAs) are substances which have been produced for more than 70 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 the PFAAs egg and plasma levels in wild populations of great tits (Parus major) settled along an established pollution gradient starting from a fluorochromal 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 perfluorinated compounds 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 BM, Carpenter JR, Cousins AL, Marquis MB, S. Van Leeuwen SP (2011). Perfluoroalkyl and polyfluoroalkyl substances in the environment: terminology, classification, and origins. Integ Environ Assess Manag 7: 513-541. [2] Giese JP and Kannan K (2001). Global distribution of perfluorooctane sulfonate in wildlife. Environ Sci Technol 35: 1339-1342. [3] Giese 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

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Persistent organochlorine (OC) pesticides, including p,p'-DDT, have been banned 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 pointed out the risk for raptors of lead exposure on the Tenerife Island (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 (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 (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 (Falco tinnunculus canariensis) from Tenerife Island.
analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; pg/g dw): p,p'-DDE, 152.5 ±1.7; p,p'-DDT, 0.118 ± 0.020; PCBs, 0.459 ± 0.121; HCHs (hexachlorocyclohexane isomers), 0.021 ± 0.003; and HCB (hexachlorobenzene), 0.0042 ± 0.0004. p,p'-DDE levels have remained elevated for more than 20 years and these levels were statistically associated in generalized linear models with the surface of active and abandoned cropland in a 200 m radio around the nest (+), distance from nest to urban areas and greenhouses (-), altitude (+) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p'-DDE levels, but decreased with embryo development. Proteoporphyrin 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. Sainsbury, University of Exeter / Environment and Sustainability Institute; R. Shave, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croose, The Vincent Wildlife Trust; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. 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 might thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly re-colonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

88 Poster spotlight: M0035, M0036, M0083

Environmental risk assessment in time and space - new approaches to deal with ecological complexity

89 The threshold option, the recovery option and landscape modelling P. Thorbeck, 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, stresses and the dynamics of production are not always straightforward. 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 the questions on the relevance of effects in the risk assessment specific worst-case assumptions. In both example compounds metabolism and excretion together with feeding behaviour mainly determined the acute and long-term risk. All of these mechanisms are not considered in the first tier risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

90 Understanding risk - a better approach to reduce uncertainty M. Wims, WSC Scientific GmbH / Dept E fate Modelling; M. Froudoulias, Dow Agrosciences / RSRA EARS

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 the questions on the relevance of effects in the risk assessment 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; C.J. Topping, Aarhus University / Department of Bioscience; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group

Species richness and population sizes in agro-ecosystems have decreased dramatically during the past decades. The current scheme of agricultural intensification resulting in landscape simplification is considered one of the main causes of this biodiversity loss, along with widespread use of pesticides. As the management of landscape heterogeneity seems to be crucial for maintaining vital populations in agro-systems, it is necessary to include the landscape component in ERA and as the important mitigation strategy. We present a methodological framework for modelling the spatio-temporal heterogeneity in agricultural landscapes. The framework has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on the population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g. arable farms) and wild areas as areas of different forest, moorland, marsh, heath and wetland cover. The spatio-temporal landscape heterogeneity refers to both crop management throughout a year, described through individually tailored management plans for each crop, and the cropping system understood as a pluriannual crop rotation. Crop management plans consist of combinations of farm activities (including pesticide treatments), as well as time windows and probabilities of carrying out activities. The temporal component also includes weather conditions and vegetation growth models for all vegetation types and crops. Such approach gives a highly realistic, updated on a daily basis, dynamic landscape with vegetation growing in response to the weather, and the pattern of farming activities related to each specific crop, farm, and field. Our methodological framework, supported with semi-automated procedures for spatial data management, makes creating highly realistic realism landscape and agricultural landscapes feasible and usable for landscape-scale risk assessment. More importantly, the presented tools allow testing in silico various scenarios of agricultural practices, including pesticide use, in differently structured landscapes. This seems at the moment the most promising strategy for elaborating sustainable agricultural practices that would allow for high productivity, whilst still protecting the agrobiodiversity. This study was supported by the National Science Centre, Poland (2015/19/B/NZ6/01939).

92 Where are the Springtails? A vertical distribution model for Collombolans V. Roeben, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research BioV; L.S. Tschoppe, RWTH Aachen University / Institute for Environmental Research BioV; T. Preuss, Bayer Ag / Environmental Safety; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Ross-Nickoll, RWTH Aachen
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 collemobolans 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 collemobolan Folsomia candida (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 different regimes while all other parameters were kept constant (25% food level, 75% of the surface). The survival, growth and reproduction simulation results of the vertical dispersal of collemobolans will be presented. A case study will be used to elucidate the importance of the vertical dispersal of non-target arthropods in effect assessment.

93 A practical application of an individual-based stickleback model in the ERA of PPPs
K. Mitranum, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences; C. Liu, Syngenta / Syngenta Environmental Sciences; S. Parker, Cefas Weymouth Laboratory; P. Thobrek, Syngenta / Environmental Safety.
Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allow for the incorporation of individual variation, 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 empirical data obtained from the published literature. 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.

94 Using the Bayesian network relative risk model to integrate molecular effects, ecological context and ecosystem services to estimate risk over space and time with plugs
K. Stankelberg, NEK Associates LTD / Department of Environmental Health; C. Mitchell, Washington State University / School of the Environment; V. Chu, Western Washington University / Environmental Science; M. Harris, Whatcom Conservation District / Institute of Environmental Toxicology; J.D. Stark, Washington State University / Dept of Entomology; K. von Stuckelberg, NEK Associates LTD / Department of Environmental Health; C. Mitchell, Washington State University / School of the Environment; V. Chu, Western Washington University / Environmental Science.
An ongoing dilemma in risk assessment is the perceived difficulty in successfully integrating scales that range from the molecular to ecological, timeframes 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 framework 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, and Tacoma, major ports, numerous refineries, paper mills, and high tech industries. The same area is also noted for intensive agriculture, urban 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)

95 Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation
M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / 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 surface of the soils as soil amendments. Earthworms are important ecological engineers in the soil ecosystem, which, on one hand, may be affected by Ag released from the amendments and, on the other hand, may influence the distribution of metals. Therefore, the aim of this study was to determine effects of Ag2S-NP application on an important earthworm driven process, i.e. bioturbation and the effect of the earthworm activity on the vertical distribution of Ag2S-NP in the top soil. Their interplay was assessed in two experiments, in presence or absence of artificial rain fall. Around 2 cm of soil treated with 10 mg Ag kg-1 dry weight soil of Ag2S-NP (28.0±0.4 nm) was applied on top of natural soil columns (10 cm) mimicking an application of 200 Mg sludge ha-1 dry weight. For the first experiment, columns were prepared with and without Lumbricus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil columns (0-2, 2-4, 4-6, 8-10, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by sICP-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 1.0±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.

96 Short- and long-term approaches to determine the fate of silver nanoparticles in the environment
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 reemission 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 (ReiSel 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag_{dig}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol induced sludge showed the highest remobilization of Ag which was below 1% of the Ag_{final} concentrations in the soil columns. The correlation between remobilized Ag_{final} and Ag_{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 retention. 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 distribution of Ag_{final} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag_{final} release to the percolate water (\(= 480 \text{ d. control} = 24 \text{ ng l}^{-1}\), Lysimeter (7 mg kg\(^{-1}\) = 56 ng l\(^{-1}\), DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. The breakthrough values for 80 nm and 20 nm Au ENPs. Preliminary results showed a trend of abundance of Ag ENP in soils why soils are a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microbiome and the root uptake (e.g. beet) needs further long-term investigations.

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

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

The attachment efficiency (\(\alpha\)) has been suggested as the most appropriate fate descriptor for transport of engineered nanoparticles (ENPs) in soils and saturated column experiments as the most accurate method to obtain \(\alpha\). Due to the complexity of the soil composition and texture, a small change in composition of the column protocol may affect the resulting attachment efficiency obtained from the results. The aim of this work is to study the effect of soil composition, flow velocity, initial ENP concentration and the size of ENPs on the calculated attachment efficiency for the specific ENP-soil systems. The \(\alpha\) values for nominally 20 and 80 nm citrate coated gold ENPs (Au ENPs), as well as 30 nm sulphonated silver ENPs (AgS ENPs) were induced in a saturated packed column existing in different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO\(_3\) 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. \(\alpha\) was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydros 1D or the relative recovery of the ENPs in the break through curves. Preliminary results show no significant differences in \(\alpha\) 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 \(\alpha\) values between the systems with varying flow rates. Furthermore, presence of air in the column affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration give higher \(\alpha\) 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 \(\alpha\) value is significantly affected. Hence, low \(\alpha\) concentrations need to be used in the column experiments to model the improvement of calculated \(\alpha\) values. Moreover, inclusion of air in the systems appears to induce artefacts that complicate determination of \(\alpha\) for specific NP-soil combinations.

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

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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 Cu-NP during anaerobic digestion, (ii) the subsequent transformation of Cu and Zn during sewage sludge composting, and (iii) whether the form of Cu and Zn affects the fate during anaerobic digestion and composting. We spiked CuO-NP, ZnO-NP, Cu\(^{2+}\) and Zn\(^{2+}\) to four aliquots of sewage sludge in four different laboratories under standard composting 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\(^{2+}\), 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 (~83% 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% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable from CuO and CuSO\(_4\) and ‘true’ dissolved Cu in the LCF fitting of the samples showed a near complete retention of Cu in the sludge and the ashes were very 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\(^{2+}\). All Zn spectra of the ashes were comparable.

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

J. Merten, Precious Metals and Rhenium Consortium eG EPMF; K. Arijis, ARCHÉ; E. Smolders, Katholieke Universiteit Leuven; D. Leveret, wca; K. Oorts, ARCHÉ

As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-access from ionic silver to silver nanofoms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanofonn with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~83% ZnS) with a concomitantly high fraction of ZnO (17%) was tested as source of ionic silver. Soil nitrification was tested according to the internationally standardised and accepted assay for testing toxicity to soil microorganisms (OECD Test Guideline No. 216). Three soils were selected falling within the P10-P90 interval of European agricultural soils for pH, organic carbon content and cation exchange capacity. Total silver in soil, and total dissolved (0.45 µm) fractions of Cu and CuSO\(_4\) were tested, returned from LCF analyses. All Cu spectra of the sludge and the ashes were very 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\(^{2+}\). All Zn spectra of the ashes were comparable.

100 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 when, unless soluble, in nano-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 homooaggregation. However, integration of this process into fate models and exposure assessment requires parametrisation and is still limited by the lack of simple, yet environmentally relevant experimental protocols. Such could be developed along the lines of the recently adopted OECD testing guideline 318 on ENP dispersion stability, currently accounting only for homooaggregation. The principles of homo- & heteroaggregation are basically the same: the probability of particle attachment is
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from heteroaggregation is the complexity added to the system by SPM in the case of heteroaggregation. In this contribution we therefore propose an approach to develop a heteroaggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogue selection. The development of such a protocol requires (1) selecting SPM analogues and heteroaggregation 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 heteroaggregation in the OECD TG 318 and will also apply for heteroaggregation. However, suitable analogues for natural SPM still need to be selected. We therefore reviewed literature for typical compositions of riverine SPM and carried out screening tests aiming at the creation of complex analogues representing relevant characteristics. Comparisons with simple SPM analogues revealed distinct aggregation behaviour, indicating the importance of complex SPM analogues for heteroaggregation.

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

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

Different types of crude oil can be identified by the arrangement of constituents, or their chemical fingerprint. In addition, chemical fingerprinting can be used to associate contaminated sediments with specific spill events like the Deepwater Horizon disaster of 2010. Mississippi Canyon-252 (MC-252) source oil, the type of crude oil specific to the Deepwater Horizon event, has been fully characterized by researchers at LSU, including pattern identification of the ion 217 and 218 hopane/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 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 region. A new multiplex-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.

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

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 870 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 to DWH crude oil intrusion into sampled areas, 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 shelly 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 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 region. A new multiplex-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.

103 Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phylum Porifera).
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Sponges (phylum 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 (spounge grounds), they provide a habitat for a diverse range of benthic organisms. Because of their importance within marine ecosystems, the impacts of anthropogenic activities such as hydrocarbon exploration and production on marine sponges must be assessed. The objectives of this study were to: (1) determine the physiological impact of crude oil and/or dispersant contaminated seawater and sediments in model sponge Halichondria panicea; and (2) characterise the effects of crude oil and/or dispersant contaminated seawater exposure on the transcriptome of H. panicea. A series of 48-hycyclic aromatic hydrocarbon (40 TPH) crude oil experiments were conducted to expose seawater or sediments contaminated with Schiehallion crude oil and/or Slickgone NS dispersant in H. panaceae. Sponge respiratory 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 descending trend in respiratory 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 understanding the sensitivity of marine sponges to oil production activities.

104 Advances in the effects of UV on oil toxicity in aquatic organisms
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The effects of UV on oil toxicity in aquatic organisms remain poorly understood. The presence of ultraviolet (UV) radiation can exacerbate oil toxicity by inducing photoproducts on marine fishes. Taken together, these data suggest that even low concentrations of crude oil can manifest outside of standard bioassay testing durations. UV sensitivity and tolerance to crude oil are associated with the presence of certain PAHs. Therefore, assessing the potential for UV to exacerbate crude oil toxicity in aquatic organisms is critical. This study utilized an experimental approach to assess the effects of UV exposure on oil toxicity. A series of experiments were conducted in which larval red drum (Sciaenops ocellatus) and zooplankton (Daphnia magna) were exposed to either a single PAH (fluoranthene) or a complex PAH mixture prepared from weathered crude oil with varying PAH and UV exposure scenarios. Red drum tests were conducted as a single pulse exposure, and daphnia tests were conducted as static renewals. Toxicity (LC50) was UV and PAH dependent in both species. In red drum tests, shorter PAH pre-exposure times resulted in LC50s that were considerably lower than LC50s associated with longer pre-exposure periods. This is likely due to lag time in the initiation of physiological metabolism/clearance mechanisms in the organism and loss of PAH from the test chamber. A similar pattern was observed in photoperiod testing for both species. Significant latency mortality was observed in daphnia exposed to UV and PAHs. We also report the effects of various UV-modified photoproducts on marine fishes. Taken together, these data suggest that even short-term, transient exposure to low concentrations of PAHs (common during a spill event) results in acute toxicity in aquatic organisms, and those effects may be manifested outside of standard bioassay testing durations.

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

24 SETAC Europe 28th Annual Meeting Abstract Book
Because the dopaminergic system, which plays a role in the brain metabolome, gene expression, behavior, hatch time, size, and concentrations of MeHg during development led to a developmental effects of exposure to maternally transmitted MeHg from mother to offspring, through large amino acid transporters with the potential to bioaccumulate and biomagnify in biota leading to potentially toxic body burdens in long-lived organisms at high trophic levels. MeHg can be actively transferred from mother to offspring, through large amino acid transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the development of a model fish system, a zebrafish (Danio rerio), to test this hypothesis. We applied MeHg to zebrafish larvae and monitored their growth and development. We found that exposure to MeHg during embryonic development resulted in decreased growth and impaired development. These findings suggest that MeHg exposure during embryonic development can have long-lasting effects on zebrafish larvae.
F1 generations demonstrate that exposure to EDCs increased growth in the parental larvae, and that androgenic treatment groups (Levo, TB) maintain this growth through the subsequent F1 generation. In the F0 adults, differences in immune response are apparent between bifenthrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifenthrin-exposed individuals relative to controls. Bifenthrin-exposed parental females have increased atriotic follicles, and developmental defects are more pronounced in F1 embryos and larvae relative to parents. Future data gathered on gonadal histology, gene expression and DNA methylation will allow us to further hone in on the mechanisms causing higher order downstream effects. Elucidation of the mechanisms contributing to these higher order downstream effects will inform adverse outcome pathways, as well as allow for the quantification and comparison of responses to established and emerging endocrine disruptors across multiple biological scales.

110 Integrated OMICS and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example
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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants in the environment. Many of them cause developmental defects in fish, and cardiovascular tissue seems to be the most sensitive tissue. The mechanisms of toxicity remain largely unresolved for many PAHs, though partial adverse outcome pathways (AOPs) exist for those that are aryl hydrocarbon receptor (AhR) agonists. Rainbow trout (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 gained at multiple levels of biological organization to reveal the mechanisms of toxic action. Changes in cardiac transcriptome, proteome and metabolome were explored over time. Physiology and function of the heart were also studied. At the whole organism level, growth, yolk consumption, and developmental defects and abnormalities were monitored. Each PAH caused a unique pattern in OMICS analyses, and the mixtures 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 cardiomyocyte 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 cardiototoxicity 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
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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 contamination. As a result, 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 emergence 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 status 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 Gnadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a protoplasmic growth and reduction of the diameter of the different stages of development of the oocytes determined for this species (n = 2332, p < 0.05). On the other hand, the collected specimens show a difference in weight and length, presenting specimens of less frequency of length in the lower third with respect to those present in areas with less intervention. These responses are associated with the increase of the values of environmental parameters towards this zone. The results of this study indicate a gradient of adverse biological effects by the convergence of point and diffuse contamination 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
E. Giovannini, ASViS
113 Can the Agenda 2030 and the Sustainable Development Goals be the drivers to change the world?
M. Tamborra, European Commission - DG Research and Innovation
114 How the SDGs are being addressed in Horizon 2020
M. Recchioni, European Commission - EASME
115 Examples of EU projects related to SDGs
M. Tamborra, European Commission - DG Research and Innovation
116 Why SDGs are relevant for a large enterprise
A. Valcaldia, ENEL
117 Conclusions
E. Tonda, UN Environment / Division of Technology, Industry and Economics (DTIE)
118 Questions and answers

Mercury Biogeoosciences - 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 bound to particles. Gaseous elemental Hg can be transformed to gaseous oxidized Hg (GOM) by a variety of atmospheric oxidants. Once generated, GOM is readily deposited to ecosystems. Understanding the chemistry of GOM is important for predicting deposition velocities, availability in ecosystems, and potential for conversion to methylmercury. Methylmercury is a subtle neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR-RMAS), and an air Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KCl denuder- results in underestimation of GOM concentrations by 2 to 13 times. In addition, thermal desorption profiles of GOM compounds collected using nylon membranes indicate that different chemical forms exist in the atmosphere. Data collected in urban areas, in the marine boundary layer, and at high elevation indicate that GOM compounds present are influenced by oxidants present in the air.
Different oxidized forms are produced in the free troposphere, marine boundary layer, and due to local oxidants in urban areas. Understanding atmospheric chemistry of GOM is important for developing instruments that will accurately measure GOM, and helping guide policymakers in developing solutions for reducing Hg emissions and contamination of ecosystems.

120 Evaluating spatial dynamics and species variation on mercury and selenium molar ratios in Northeast Atlantic marine fish communities A.M. Azad, NIFES / Contaminants and biohazards; S. Frantzen, B.M. Nilsen, A. Dunker, National Institute of Nutrition and Seafood Research / Contaminants and biohazards; L. Madsen, National Institute of Nutrition and Seafood Research / Seaweed in modern marine M.S. Bank, Institute of Marine Research / Contaminants and biohazards; A. Maage, NIFES / Monitoring Programme Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effects of Selenium (Se) and Mercury (Hg) are both important for the transfer in the food chain, with the highest concentrations found in macroinvertebrate samples. Our results show that Hg, MeHg, and Se are bioaccumulating in the food web. Our research focused on the examination of the effects of probable nutrient limitation, mercury methylation in seawater under probable nutrient limitation, and marine microorganisms in seawater.

123 Effects of probable nutrient limitation on the relationship between mercury and marine microorganisms in seawater I. Živkovic, V. Fajon, J. Kotnik, Jozef Stefan Institute; M. Solc, J. Lasic, G. Kupslic, Institute of Oceanography and Fisheries; M. Orduž, University of Split; F. Matic, B. Grbec, N. Bojanic, Z. Ninčević-Gradan, Institute of Oceanography and Fisheries; M. Ordulj, Institute of Oceanography and Fisheries. Effects of probable nutrient limitation on the relationship between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, alongside with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-metric multi-dimensional scaling, principal component analysis, Pearson’s product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation.

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?

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Passive sampling with thin polymer sheets is increasingly recognized as a superior alternative to regular sampling with monolithic resins with respect to both its low risk of non-polar chemicals in sediment porewater. For deducing true freely dissolved concentrations in the aqueous phase from measured polymer concentrations, the compounds are required to reach thermodynamic equilibrium between the polymer and the water phase. However, for in-situ deployment in stagnant sediment equilibration times are beyond practical time scales. The spiking of passive samplers with performance reference compounds (PRCs) has therefore been introduced as a way to deduce equilibrium concentrations from the release of PRCs over the deployment period. This approach relies on the assumption of isotropic exchange kinetics between the uptake of the native compounds into the polymer and the release of spiked PRCs from the polymer. Our aim was to test whether this assumption is valid in stagnant sediments in in-situ and ex-situ conditions, considering different types of sediment and concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passive samplers of multiple thicknesses and spiked with PPRCs 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 additional 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-component model (release). The results showed that both in the field and ex-situ data uptake and release kinetics were not identical. In addition, the ex-situ experiment revealed that PRC release kinetics is also dependent on the initial PRC spiking concentration. In conclusion, the data question the usefulness of PRCs for passive sampling in sediment, as the use of polymers of multiple thicknesses can produce results that are free from biases caused by anisotropic exchange kinetics.

126 Sediment toxicity of chlorpyrifos: whole sediment bioassay vs. silicon disc passive dosing

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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 in a series of studies on whole sediment-spiked silicon rubber (ESR) chips to 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 from 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 

127 Implementing desorption extraction methods into bioavailability-oriented bio remediation

P. Rosada, IRNAS CSIC / Agroquimica y Conservacion del Suelo; J. Garcia, Instituto de Recursos Naturales y Agrobiologia de Sevilla CSIC; M. Cantos, IRNAS CSIC; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo

Regulators are starting to consider bioavailability within retrospective risk assessment frameworks for organic chemicals, however, implementation is not straightforward because the developments of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and their contaminants 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 20h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integ Environ Assess Manag, 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retrospective 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 disposable transfer plates, PAH-spiked soils) were evaluated. The soil, oil- and water was spiked with PAHs up to 12% of the total spiked chlorpyrifos amount within 1 month. SPME beco more elaborate 28d whole sediment tests. Also, at lowest tested toxic dosing assay with sensitive first instar midge larvae provides valuable and realistic insight in the toxic potency of insecticide contaminated sediment compartments. 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.

128 Prediction of very slow biodegradation of PAHs in soil and validation in a pilot of 25 years

R. Rietra, Alkerta and Wageningen University / sustainable soil management; J. Harmens, 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 landfills and one depot) within the Netherlands. On these fields dredged sediments were landfarmed. 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 up to 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorption fractions can be measured. Tenax applied at 20°C gives the fast desorbing fraction (applied at 60°C). The slow desorbing fraction is measured. The phase in the residue represents the very slow desorbing fraction. These are the same fractions as considered in the approach of Ortega-Calvo et al., (2015). In the soil, desorption makes the PAHs bioavailable and if conditions allow biodegradation (sufficient oxygen and water), this will occur. Using results measured in stored original sediment the different bioavailable fractions were measured and using a model with three first order derations (fast, slow and very slow) the really observed degradation curve could be predicted. Moreover, the fractions measured in present soils, shows that biodegradation will continue, however with a very small slow rate. Experiments applied in the nineties of last century had already shown that risks measured with bioassays were already not measurable after 6 years of landfarming. After 25 years the PAHs concentrations were 10 mg/kg d.m. or lower which made the soil reusable within the Dutch legislation.
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 percentage of available contaminants of the soils under composting 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

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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 it is biological activity that often prevents plants from fully utilizing the added nutrient in the soil. In this study plant species were exposed to Toluene and Phenol after undergoing 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 (TRI)), an anticonvulstant that prevents seizures and relieves nerve pain (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinyon Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they were produced from tree species that often require removal because they are considered invasive or due to insect infestations. Corn was used as the test plant because of its commercial value and has been grown with reclaimed water in the past. After the 28 day growing period, it was found that there was no negative impact of the biochars on corn growth. Once the plant tissue analysis and sorption studies are completed, the impact of biochars on contaminant uptake will be evaluated along with the use of PPBCs and compost to PBC treatments. Extraction and analysis of the plant tissue is being conducted along with the sorption/desorption experiments. Final results expected by December 2017.

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

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

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Available freshwater consumption indicators for use in LCA and water footprint studies implemented in LCA software are based on either a volumetric approach of the water consumed (what we called first generation of indicators) or on stress indicators which we called second generation of indicators. The first generation only performs an inventory and thus a partial footprint assessment according to ISO 14046, while the second generation shows limitations in describing the consequences of a lack of water at the endpoint. To date, no LCA method comprehensively distinguishes water masses (e.g. surface water and ground water) and water transport (e.g. water transport to and from surface water). Thus, 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 couple water consumption and environmental impact. In this work we propose a new framework for the development of 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 couple water consumption and environmental impact. In this work we propose a new framework for the development of global characterization model that makes such developments operational in LCA.
quantity 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 patterns of water consumption on ecosystem quality. We propose a new functional LCIA model based on freshwater fish habitat 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) midpoint indicator for river fish species 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 watershed and sub-watershed. 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 therefore preferable to find a tool for quantifying a 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 Schaef er model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catches, consumptive losses 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.

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion A. High, Montpellier SupAgro / LBE ELSA; J. Langlois, Université Paul-Valéry Montpellier 3 / CEFE UMR CNRS ; Université de Montpellier Université Paul-Valéry Montpellier EPHE Université PaulValéry Montpellier Montpellier cedex France; P. Fréon, IRD, emirrus scientist

Biotic natural resources have received little attention by the LCA community and this tempers the use of LCA for fish based food and feed products. Current LCA methods do not assess the impact of biotic depletion on biotic stocks 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 utility of the CF. A CF is used for quantifying a 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 Schaef er model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catches, consumptive losses 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 B. Lieselot, R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; T. Van Linden, Flanders research institute for agriculture, fisheries and food / Technology and Food Science Unit; I. Roldán, CSIC / Department of Sustainable Organic Chemistry and Technology The growing demand for food and feed is putting 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 (SOC1; indicator 1) are used to indicate the long-term effect of agricultural land use on soil. This can result in biomass productivity losses (BPL, indicator 2). At endpoint, we propose additional land requirements (ALR, indicator 3) as indicator, which corresponds to the area needed to produce the yield that has been lost. To calculate 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, N are used to quantify SOC stocks and yields, respectively. CFs are developed for several rotation systems in Flanders. Though, the elaborated framework is generally applicable and allows the calculation of CFs for other regions. Thanks to the use of an achievable reference situation and a distinction between land management strategies (good, bad and standard practices), the indicators can be a useful tool to strive for a more sustainable agriculture.

136 Poster spotlight: MO093, MO094, MO106

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

137 Fouling scale WWTP balancing with passive samplers offers new insights in xenobiotic elimination processes T. Galle, Luxembourg Institute of Science and Technology; C. Koehler, M. Bayerle, D. Pittois, Luxembourg Institute of Science and Technology LIST; A. Christen, J. Hansen, University of Luxembourg / Faculty of Science, Technology and Communication

Calculating elimination rates for full scale wastewater treatment plants is very challenging because it requires the knowledge of mixing regimes to match inflow to outflow 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 a balance between 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. Normalization with carbamazepine and lidacline 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. Sarker, S. Montemurro, IDAEA-CSIC / Environmental Chemistry; D. Barcelo, IQAB-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 (1 O2), 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 TP s 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 16 pharmaceuticals at concentrations of 1 μg/L and exposed to artificial light in a sunlamp simulator. UPLC-MS/MS was used to identify photo-TPs. Simultaneously, 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

A. Del Río Costa, CSIC - Spanish National Research Council / Environmental Chemistry; M. Vila-Costa, B. Zonja, IDAEA-CSIC / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry; D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry

The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (H2O2), in the effluent (E20) and in the anaerobic digester sludge (AND). 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

S. Kikukawa, Université de Sherbrooke / Civil Engineering

In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems, which has affected the potential recycle and reuse of wastewater for domestic or industrial usage. Selection appropriate treatment approach has played an important role not just to reach discharge limits, it is also important to decrease the human footprint in the environment. Some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of oxidizing reactive ionic to reactive iodine, when they can play roles to degrade recalcitrant pollutants in wastewater. The resulting iodine represents a powerful antimicrobial compound. The aim of this study is investigating the potential of acetophenone and phenolic organic contaminant acetaminophen as mediator in a laccase mediator system to generate disinfectant iodine. The stability of reaction can be changed depending on the pH, temperature and multiple compound existence and system optimization is required to stabilize iodine synthesis. In this study, two different free laccases and insolubilized as cross-linked enzyme aggregates have been tested. All the kinetics synthesis is investigated with different KI (0.001-100 mM) concentration and different rLacc (5, 10, 30 and 40 Unit/L) for 5 hours. Compounds were injected in distilled water as well as in the influent and effluent samples of wastewater treatment plants to see synthesis of iodine while the micropollutants have been removed in Laccase Mediator System. In the experimental sets, removal of persistent compounds were determined by UPLC-HRMS method. The recomposed laccase mediator system (CMS) showed a substantial effect of iodine measured by focol coliform tests. 0.35 maximum mML iodine concentration could be synthesized during experiments. During iodine production, while phenolic compounds' concentrations were decreased (50% acetaminophen removal in real effluent wastewater treatment plant), removal of non-phenolic compounds such as naproxen were also observed (50%). The results have shown that the biocatalytic generation of I2 was possible using laccase-mediator system. Iodine production was affected by the initial laccase activity and mediator concentration. Laccase catalyzed bactericidal activity in municipal wastewater was also assayed without the addition of any mediator assuming that wastewater already contains mediators such as acetaminophen. Using this system, non-fecal coliforms present in the tested wastewater were removed.

141 Halogenated methanesulfonic acids in drinking water - Identification, standard synthesis, and analysis

D. Zahn, Hochschule Fresenius / Chemistry and Biology; A. Harloff, Hochschule Fresenius, University of Applied Sciences; R. Meusinger, TU Darmstadt / Chemistry; T. Frömel, Hochschule Fresenius, University of Applied Sciences; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology

Persistent, bioaccumulative, and toxic (PBT) substances have been monitored since the 1960s. PBT substances are usually not well water soluble and tend to adsorb to sludge, soil and other particular matter, and thus spread slowly in the environment. However, as a consequence of their high environmental stability, they can eventually reach even remote areas like the arctic, and pose a threat to apex predators due to their ability to accumulate in the food chain. Persistent, mobile, and toxic (PMT) environmental contaminants, however, do not accumulate in the food chain, but are much more mobile in aquatic environments, and thus, they spread faster throughout the environment. The aim of this study was to identify halogenated methanesulfonic acids (HMSAs) as novel water contaminants and estimated the concentrations of the most prevalent congeners to be in the 100 ng/L range for some drinking water samples. Accurate quantification, however, was hindered by the lack of commercially available reference materials. Thus, we synthesized chloromethanesulfonic acid, dichloromethanesulfonic acid, bromomethanesulfonic acid and bromochloromethanesulfonic acid as well as 3 trifluoromethanesulfonic acid (as internal standard) and included these analytes in a sample pre-treatment and hydrophilic interaction liquid chromatography – tandem mass spectrometry (HILIC-CMS/MS) method dedicated to the analysis of very polar water contaminants. With this method, we monitored chlorinated and brominated MSAs throughout six drinking water treatment plants and in several tap water samples taken from high population areas in different countries.

142 Poster spotlight: MO272, MO273, MO274

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

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European Commission Joint Research Centre / Bioeconomy unit; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

The European Inventory of Existing Commercial chemical Substances (EINECS) lists over 100,000 chemical substances used on the market. Over 16,000 chemical substances have been registered in REACH since 2008. In comparison, only ca. 3,000 substances have been declared in the life cycle impact assessment (LCIA) to express their potential toxic impact on human health (cancer and non-cancer effects) and freshwater ecosystems. Because of human activities, those pollutants may enter the environment in several different ways: they are emitted to air from the combustion of materials, released through wastewater from industries and households, applied to soils together with manure and pesticides, etc. Compared with the traditional approach of analyzing 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 inorganic chemicals. The strengths of this approach are manifold, including the use of high quality and robust emission database for the defined periods, the use of established models and methods to extrapolate the data, and the transparency and reproducibility of the methodology. The results show that the emissions of toxic substances differ significantly between countries and regions, and that the human health impacts are most significant in areas with high population densities. The results also highlight the need for further research and development to improve the accuracy of the emission inventories, and for better integration of the data into risk assessment and policy-making processes.

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

T.B. Beussisseur, INRA; E. Loiseau, IRSTEA; S. Caurla, INRA

Economic modelling is increasingly used in Life Cycle Assessment (LCA) to perform consequential LCA for the environmental assessment of product and services. Economic models can also provide significant improvements for assessing the 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 aggregation of economic and environmental models differ: the economic models are usually at a regional level, while the environmental models are generally at a national level. This paper aims to identify the challenges and opportunities associated with the combination of economic and environmental models. It presents a case study on the French forestry sector, where a combination of economic and environmental models was used to assess the environmental impacts of regional policies. The study shows that the combination of economic and environmental models can provide valuable insights into the environmental impacts of regional policies. However, it also highlights the need for further research to improve the integration of economic and environmental models and to increase the reliability of the results. The case study demonstrates the potential of combining economic and environmental models to assess the environmental impacts of regional policies, but also the need for further research to improve the integration and reliability of these models.

146 LCA_WIND_DK: temporarily, geographically and technologically-sensitive life cycle inventories for the Danish wind turbine fleet


The environmental performance of a wind turbine is usually calculated as the ratio of the life cycle impacts of the manufacturing phase to the life cycle impacts of the energy production phase. The temporal context is considered through the evolution of the electricity mix used for manufacturing wind turbines as well as the evolution of recycled content in materials over time. The spatial dimension is also accounted for with geographical parameters determining the amount of material required, such as the distance from shore and sea depth for offshore installations. Additionally, the supply chain is adapted to select the relevant origin of the material and energy suppliers. Finally, the approach considers the registered electricity production for past and present wind turbines and assesses the future production from site-specific weather re-analysis data and power curves. Denmark, where wind power contributed to 45% of the gross annual electricity production in 2016, is a prominent choice to demonstrate the benefits of such comprehensive modelling based on spatial, technological and site specific LCAs. The approach generates a life cycle assessment for each of the 11,000 wind turbines that compose the Danish national fleet over the 1980-2030 period. The results, through the on-line tool, are showcased as a map, where the individual performance of each of the past, present and future wind turbines can be consulted, as well as the performance of the whole fleet at a given year.

147 Assessing environmental impacts of individual households: A large-scale bottom-up LCA model for Switzerland

A. Froemelt, ETH Zurich; R. Buffat, ETH Zurich / Institut of Cartography and Geoinformation; N. Heeren, S. Hellweg, ETH Zurich / Institute of Environmental Engineering

Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur over the whole life cycle of a product and service. Assessing these impacts is therefore of utmost importance. Therefore, assessing environmental footprints of households is an important basis to identify environmental policies. This study aimed to develop a comprehensive regionalized bottom-up model for Switzerland that is able to assess the environmental impacts induced by individual households. The purpose of this model is to provide a virtual platform for detailed scenario analysis which shall support effective political decision making on different scales. Three existing bottom-up models were merged: a building stock energy model, an agent-based transport simulation and a household consumption model. All of them were tested and evaluated beforehand. The physically-based building energy model establishes
simplified energy balances for each residential building based on spatially and temporarily resolved climate data, building characteristics and 3-D 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 processes 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, districts, regions and different consumption areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from potential policy measures to the development of refurbishment programs to future mobility solutions such as autonomous vehicle systems.

148 Poster spotlight: MO109, MO110, MO113

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

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

A. Gergs, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change; S. Classen, K. Lademann, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

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

150 Robust implementation of TKTD models with Bayesian inference

V. Baudot, Université Lyon 1; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology

The application of toxicokinetic-toxicodynamic (TKTD) modeling proved to be of particular interest in strengthening the Environmental Risk Assessment (ERA) of chemicals compounds (e.g., REACH dossier accounting for toxicity of industrial discharge, evaluation of impacts of Plant Protection Products (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 toxicodynamics covering alteration of cells and organs functioning that can eventually lead to a toxic effect at the organism level (e.g., mortality, reduced reproduction, abnormal behavior) then affecting the population dynamics. For survival analysis of organisms in response to a chemical stressor, the General Unified Threshold model of Survival (GUTS-IT), which has recently been 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. The GUTS-IT model has been extensively tested using outdoor aquatic mesocosm studies, and has been recently extended to the TKTD framework of Survival (GUTS-IT), which has been recently extended 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, districts, regions and different consumption areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from potential policy measures to the development of refurbishment programs to future mobility solutions such as autonomous vehicle systems.

151 Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?

K. Dahlhoff, University of Copenhagen / Department of Plant and Environmental Sciences; G. Bellisia, European Food Safety Authority EFSA; E. Neira, N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

The azole fungicides propiconazole and prochloraz are known to enhance the toxicity of pyrethroid insecticides like α-cypermethrin during co-exposure. The development of these synergistic actions in the waterfally Daphnia magna have recently been modelled using toxicokinetic (TK) and toxicodynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to test the same GUTS-IT 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 recovery cycles. To assess the possible synergistic interactions with the azoles and α-cypermethrin were 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-modeling will uptake and elimination rates of the individual compounds in C. riparius be measured to parameterize the TK-model before linking the internal concentrations to the observed ecotoxicological effects. We hypothesise 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 azole exposure concentration. The preliminary results indicated time-dependent synergistic interactions in C. riparius as previously observed in D. magna, but also a higher sensitivity of C. riparius towards the fungicides with 168 h EC₅₀-values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µmol L⁻¹ for propiconazole and prochloraz, respectively. This is surprising as previous non-published data indicated that C. riparius has an approximately 10 fold faster initial elimination rate of the azoles compared to D. magna. We expect that our TKTD models will be able to explain these kinetic differences and how they relate to the observed toxicity. We further hope to make this model available for the diverse communities to test the observed interactions. We further hope that models can predict survival of organisms at the population level is exemplarily examined. For this purpose, an 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 (habitual 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.

152 Integration of temperature-dependent TKTD kinetics in individual-based population modelling - A case study with Chaoborus crystallinus

T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

The toxicokinetic-toxicodynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD kinetics in individual-based TKTD models. For 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 hope to make this model available for the diverse communities to test the observed interactions. We further hope that models can predict survival of organisms 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 recently extended to the TKTD framework of Survival (GUTS-IT), which has been recently extended 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, districts, regions and different consumption areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from potential policy measures to the development of refurbishment programs to future mobility solutions such as autonomous vehicle systems.

33 SETAC Europe 28th Annual Meeting Abstract Book
Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.

153 Assessing lethal and sublethal effects from time variable exposure for different life stages with the DEB model: an example for a Pythriod in rainbow trout

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Ecotoxicology

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-7D modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stage tests (ELS): a standard Tier 1 study with constant exposure and a Tier 2c study under time variable exposure. Observed effects differed in these two studies. Under constant exposure, severe mortality and significant growth effects were observed while under peak exposure, no effects on survival were observed, and only negligible effects on growth were found. The model was successfully calibrated using the constant exposure experiment, and then accurately predicted the effects observed in the peak-exposure assay. The modelling approach is a useful tool for the assessment of adverse effects from 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 length, because beta-cyfluthrin is fast metabolised from the fish and the fry have high energy 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 UMRI SEBIO ECOT; R. Beaudouin, INERIS / Models for Ecotoxicology and the internal METEO

To improve environmental risk assessment, mechanistic models predicting the impacts of toxicants on populations such as individual-based models (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 including the organism's uptake, elimination, metabolism which are difficult to build. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teleost fish is relatively well 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 set of experiments in control conditions, different ways of integrated temperature and disruption, test. These experiments are used to test the ability of the model to simulate different early life stages with the DEB model: an example for a Pythriod in rainbow trout. 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.

155 Atmospheric Microplastics: A novel method for the identification of microplastics in the inhalable size range.

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Microplastics (microP) are a class of persistent omnipresent contaminants found in aquatic, atmospheric and terrestrial environments. Current investigations focusing on atmospheric microP have not identified microP fibres >50µm in size. For atmospheric microP to have the potential to directly impact human health, research must now focus on the presence of microP in the inhalable size range (<10 µm). We present a novel analytical method compatible with the Multi-vial cyclone sampler (MVCS), for assessing whether microP down to an inhalable size range are airborne. An automated Raman Spectral Imaging (RSI) protocol has been developed for chemical analysis sampled, and 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 particles is particularly difficult because of their physicochemical properties (low solubility, a wide range of molecular weights, etc.) and potential contaminations sources in the laboratory. For these reasons, different approaches should be considered to find a standardised protocol for the determination of MPLs and NPLs in the environment. In this context, this study was focused on the investigation and practical comparison and combination of different analytical tools for the quantitative analysis of MPLs and NPLs using:

1) 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 ionization (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 studied 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 allows obtaining qualitative and quantitative information about the whole spectrum of polymers, which may be present in the environment.

157 Uptake, egestion and accumulation of microplastic in mussel after an experimental exposure

B. Fernández, Instituto Español de Oceanografía / Marine Pollution and Biological Effects Department; M. Albertos, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area. Fisiology and Ecotoxicology of Bivalve Molluscs Department

Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingestion. Field and laboratory studies have reported that MP are ingested by mussel. Once ingested, MP may be egested through defecation,
158

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


Tire and road wear particles (TRWP) as environmental contaminants have received interest since the 1960s[1]. TRWP have adverse effects on human health[2]. Multiple cities in the EU are violating legal threshold values for atmospheric pollution to which TRWP contribute. Therefore, financial penalties as well as consequences like vehicle bans in metropolitan regions are discussed. TRWP can be regarded as microplastics, because the rubber component of TRWP is mainly polymer (natural and synthetic). With regional differences, the contribution of TRWP to the microplastics emissions to the environment can reach up to 60%[3]. Analysis of TRWP is challenging because of the high variance in compositions of the marker substances. Established analytical methods suffer from unspecific marker compounds, small sample size or low sensitivity[4-6]. The topic of this presentation is the analysis of TRWP using the recently developed method TEG-DC-MS (thermal extraction desorption gas chromatography mass spectrometry)[7]: Sample materials are heated in a thermogravimetric analyzer. The decomposition products are purified with nitrogen through a heated coupling device to a solid phase adsorber. After the adsorber is loaded with an excerpt of the decomposition products, an auto-sampling robot transports the adsorber to a thermal desorption-GC-MS for further analysis. Rubber materials were provided by TUC, Sigma Aldrich and Avokai. The tire samples included used and unused materials provided by TUC, Umweltforschungszentrum Leipzig (UFZ) and former BAM projects. A bitumen and an asphalt material, provided by BAM were analyzed. As tire-free matrix materials, BAM refilled sediments and bitumen were provided by Umweltbundesamt (UBA) were chosen. Environmental samples with expected contamination were obtained from i) tire wear particle enrichment using density separation followed by ii) combustion and iii) pyrolysis. 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 02WRS1378H) and BWB for provision of samples.

160

Are we speaking the same language? Towards a definition and categorization framework for environmental plastic debris

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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 using a common language would be beneficial, 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 definitions and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea on where consensus may be easy to achieve and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.

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

161

Behavioral and physiological responses of bicolor damselfish and mahi-mahi to oilfactory cues following crude oil exposure

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In fishes, olfactory cues provide information about predators, prey, and conspecifics that is crucial to survival; however, olfactory sensory neurons are directly exposed to the environment and are susceptible to damage from aqueous 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 ionization detector. The oil-exposed mahi-mahi avoided a consistent chemical alarm cue, while exposed conspecifics did not avoid the cue (p < 0.001). Control mahi-mahi did not distinguish between seawater and crude oil, however oil exposed mahi-mahi spent a greater proportion of time in crude oil than the control fish (p < 0.01). Moving forward, an electro-olfactogram technique will be used to measure the generator potential from the olfactory epithelium of bicolour damselfish and mahi-mahi to detect the response to olfactory cues following oil exposure. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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

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

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

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

164 Impacts of Oil Exposure on Mahi Embryos

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

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

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

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

Crude oil from the Deepwater Horizon spill of 2010 has been shown to have a number of cardiotoxic effects across life stages, species, and levels of organization in marine fish. Over the last decade, the use of the mahi-mahi (Coryphaena hippurus) to study these cardiovascular impairments has been particularly important, since this pelagic species is both ecologically and economically important, since this pelagic species is both ecologically and economically important in the Gulf of Mexico. Mahi exposed to environmentally-relevant crude oil concentrations have shown compromised intact animal performance, including reductions to maximal swimming speed and maximal metabolic rate. In addition, in-situ studies have revealed a ~40% reduction in cardiac output following oil exposure in mahi. Although cardiotoxic effects have been widely reported, the mechanisms underlying these impairments remain unknown. In the present study, we examined the impacts of crude oil on isolated mahi heart cells to better understand these mechanisms. Contractility of mahi ventricular heart cells was measured via sarcomere shortening using an IonOptix cell recording system. The first objective was to examine cardiomyocyte contractility over a range of crude oil exposures. The second objective was to examine the impacts of crude oil contractility over a range of stimulation frequencies representative of heart rates observed in mahi (~100-180 beats per minute). Exposure to crude oil was found to significantly reduce heart cell contractile function, but was not found to be dose-dependent in the tested range of concentrations (3.0, 6.4, and 12.9 ug l−1 50% PAH). Exposure to crude oil was also found to impair contractility over a range of stimulation frequencies (1.5, 2.0, 2.5, 2.5, 3.0 Hz; 3.6 ug l−1 50% PAH). In addition to contractility, other mechanical aspects of cell contracture function were also examined. Efforts to assess the role of circulating catecholamines (adrenaline) as a potential protective mechanism against these impairments is currently ongoing and will also be presented. This research was made possible by a grant from The Gulf of Mexico Research Initiative. 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 in a pufferfish species: a panel of microRNAs (miRNA) and messenger RNAs (mRNA) were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition, mRNA expression of KCNH2 was also regulated and pathway analysis with GO terms 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 /APPLEEE; R.J. Rocha, Department of Biology & CESAM – University of Aveiro / Department of Biology and CESAM; C. Quintaineiro, Department of Biology & CESAM – University of Aveiro; A.M. Santos, University of Aveiro / Department of Biology & CESAM; M. Monteiro, Aveiro University / Biology Early life stages of marine vertebrates have been scarcely used in ecotoxicity testing. The Senegalese sole (Solea senegalensis) is a common flatfish species in the 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 flattened shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic pollution, 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 directly 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. senegalensis, namely of UV radiation and of the organic compounds 4MBC, Carbendazim, Linuron and Triclosan, which have potential endocrine disrupting and larval stage of development. While fundamental inhibition the compounds 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 various 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 mRNAs were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition, mRNA expression of KCNH2 was also regulated and pathway analysis with GO terms 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).

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; L. Hupert, P. Anton; University of Liverpool / Institute of Integrative Biology; K. Schirmer, Eawag / University of Zurich, 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 the currently available methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Oncorhynchus mykiss, RTgill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that 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. However, in spite of significant advances in computational models, 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.
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 mode 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 chemicals, 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
F. 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 Biobational Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Biobational 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, including chemical risk MoAs. In the specific risk assessment system, the detection of MoA-related endpoints has been discussed to improve its predictive capacity for acute and chronic fish toxicity, and for human developmental toxicity. We hypothesized that using a battery of endpoints in the zebrafish embryo test would allow to differentiate between baseline toxicity, formation of methemoglobin, neurotoxicity, heart rate inhibition, and developmental toxicity. Therefore, we compared the toxic ratios and endpoint-specific effect concentrations (EC50) of 12 compounds representing 5 broad MoA groups with 2, respectively 4 (neurotoxicity) compounds per MoA. In order to compensate for differences in the toxicokinetics and mortality, the effect concentrations were normalized by the LC50 of each compound. It was shown that the toxic ratio and effect concentrations for behavior, heart rate inhibition and chorda malformations were able to differentiate the selected compounds according to their anticipated MoA. Using a threshold for the normalized effect concentration a decision tree was developed that allowed to assign a MoA to a compound. A major bias of the selected approach could be the variability associated with visual phenotype assessment – which may depend on the experience and accuracy of the observer. Therefore, we developed a software named FishInspector that enables a more unbiased assessment of malformation using images of zebrafish embryo. Using the software and a system for automated positioning of zebrafish embryos we compared the phenotypes of 25 compounds with known developmental toxicity outcome in rats and/or rabbits. In contrast to the previous analysis, we applied a different normalization approach based on the most sensitive endpoints. The analysis indicated that the developmental toxicity observed for inhibitors of cyclooxygenase may not be related to the pharmacological MoA, given the diverse phenotype patterns observed for this class of compounds.

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. Berny, 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. Cronin, 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. Taggart, 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 local 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 overall assessment of the impacts of human activities beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

183 Identifying ecosystem services-based protection goals.
J. Malby, Y. Pan, The University of Sheffield / Dpt of Animal Plant Sciences

There is an increasing interest in the use of ecosystem service-based approaches for assessing the risk of environmental contaminants to ecological systems. Ecosystem functions become ecosystem services when they are utilized and valued by people. Therefore, the first step in implementing an ecosystem services approach to ecological risk assessment is to identify what portfolio of services are required, by whom and where they should be protected. But what preferences should 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. Romijn, Bayer CropScience AG

Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents ie Effects of pesticides on Non Target Terrestrial Plants, Non Target Arthropods and Soil Organisms. Whilst each of these Scientific Opinions makes proposals for SPGs, the European Commission and Member States should agree on the on SPGs before they can be taken forward to be used in the Guidance Document development phase. The purpose of this paper is to provide industry input for consideration and discussion during this process. In an earlier EFSA Scientific Opinion it was recommended by EFSA that Specific Protection Goals (SPGs) should be based on the principle of Ecosystem Services utilising 6 dimensions: ie biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (< 7%) without robust scientific justification. The use of 7% Suggested there was data to support it but in fact it was still a 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 to be based, it is recommended that an expert judgement qualitative approach adapting the EFSA Ecosystem Services approach. The predicted impact any of 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. kangaroo species) of species potentially affected, and the frequency of occurrence.

185 Protection goals for non-target terrestrial plants: Is in-field protection of beneficial weeds achievable?
J. Davies, Syngenta / Environmental Safety; L. May, A. Russell, A. Seville, D. Stock, Syngenta

EFSA’s Scientific Opinion addressing the state of the science on the risk assessment of plant protection products for non-target terrestrial plants (NTPTPs) 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 provides ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, The Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weed. However, to be effective, options for 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 NTPTPs, 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 conserve species and promote wellbeing. To this aim, 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 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 the aquatic Protection Goal. This is defined for 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 biodegree aquatic communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect natural and trait-based effects, and those that preserve the biodiversity of aquatic 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-ITI

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 designs. With this contribution we explore different approaches to quantifying effects on microbial communities, discussing the need for care to control for contaminants and 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 Health Technology, Como; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; O. Uhlík, University of Chemistry and Technology Prague; E. Zane, F. Arjmand, Università La Sapienza / Chemistry; A. Caffaro, 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 biostimulation activity of plant species and treatments for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant-controlled plants 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 Phialophora arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest increase in soil microbial activity after 3 months from planting. Microbiological analysis revealed that 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, A. Aulenta, Università La Sapienza / Chemistry; P. Ciampi, C. Morosini, University of Insubria / Department of Chemistry; M.P. Papini, A. 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. During the period of exploitation, petroleum spills may result in severe environmental problems, hence requiring the development of improvement 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 during 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 reactor (“bioelectrochemical well [1]”) has been realized and operated in a continuous-flow regime using first toluene and then a mixture of BTEx as model contaminants. The performance of the bioelectrochemical reactor was characterized in terms of degradation rate and yield. GC-MS analysis was also carried out in order to shed light on the “electrogenic” pathway of contaminants biodegradation. This study was financially supported by Fondazione Cariplo in the framework of the project BEvERAGE BioElectricRemediation of Groundwater plumes (2015-0195). [1] Palma E., Daghio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Microbiotechnol., 2017. doi: 10.1111/1751-7915.12760.

190 An innovative bioelectrochemical reactor for in-situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons E. PALMA, CNR-IRSA; M. Daghio, A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences; M.P. Papini, Università La Sapienza / Chemistry; F. Aulenta, National Research Council / Water Research Institute (IRSA)

Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plumestar™), regeneration together with an electron donor to create an in-situ adsorption/biologically-reactive zone was deeply investigated and finally adopted as the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than one year appear particularly encouraging. A very good reduction rates within only a few weeks were observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.
Gram-positive bacteria, associated to Mycobacterium, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-PAH removal identified members of the recently described order Immunodialsolbacterales and members of Sphingobium as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of Sphingobium showed major phyotypes associated with the anaerobic sulphate reduction, while members of Immunodialsolbacterales 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 increased activity during the late incubation phase, when degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

New frontiers in Life Cycle Inventory data collection and modelling

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microorganisms at the single cell level.


The flux of volatile organic compounds (VOCs) from the subsurface was estimated using 14 dynamic chambers, by measuring with a canister the concentration of vapours collected over a period of approximately 6 hours. Before starting the measurement, the achievement of steady-state conditions inside the chamber was assured by purging at least for 4 chamber volumes an inert gas. The measurements sampling points were repeated in 4 seasonal campaigns. The obtained results highlighted that the traditional methods based on the application of a non-reactive diffusive model with the concentrations measured in the soil and/or groundwater can lead to an overestimation of the emission rates of BTX from the subsurface in some cases up to 4 orders of magnitude. Furthermore, the BTX 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.
temporally differentiated LCA performed with real-time high frequency data and present a methodology for the on-line assessment of the shift in the performance of WWTPs. The implemented methodology performs a DEA-based benchmark coupled with LCA to evaluate the environmental impacts linked to the operation of a WWTP. A web application of the system is currently being developed using the Shiny R package. It will enable plant managers to calculate and visualize LCA results in real time by modifying customizable parameters.

196 Enhancing Land Use Change modelling with IO data
J. Schmidt, Aalborg University / Department of Planning; M. De Rosa, BONSAI / Agroecology
Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (iLUC) modelling in LCA since 2011 as part of a crowdfunded project. Recently, the model has been integrating into the multiregional hybrid Input-Output model EXIOBASE, thus providing an unprecedented level of detail in iLUC modelling. Differentiation between use of land among regions of the world is based upon information on potential land productivity in different locations. The IO data allow identifying the land supplied by each country to meet production needs and the land uses trade. The agricultural and land use module in EXIOBASE make use of FAOSTAT data, which provide time series on area and production per crop. The data allow modelling the global supply of land to the global market for land, distinguishing between land expansion (land transformation) and land intensifications (increased production per unit of land). The land transformation and intensification LCA activities are populated with data on carbon stocks of different land use types in all countries, and time series of fertiliser use in all countries. The current version of the model (version 4.3) includes the following elementary flows: emissions of CO₂, NOₓ, NO₃, NH₃ and resource inputs of accelerated denaturalisation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCIA) model. Overall, the results show that for most 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
S. Mathé, ENSCM / ITAP-ITAP ELSA; P. Roux, Istéa / ITAP ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istéa; 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 – Istéa - UMR ITAP
Fishe rwater comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water qualities 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-P) 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 variabilities in classification and terminology of water sources and users have been harmonized. A database (WSmix database for different users) for each WSmix 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
B. Darlinger, L. Küling, Blond Consultants
From performing individual Life Cycle Assessment (LCA) studies for specific products, the field is moving towards automated LCAs for full product portfolios and tool and database development. This ongoing evolution is a result of the increased quality and availability of background databases as well as an increased acceptance of LCA as the measurement and monitoring tool for environmental impact. However, a point has been reached where existing LCA software and data structures have become a limiting factor for further development. Therefore, we would like to present our recent developments regarding database and tool development for LCA purposes. Existing LCA software frameworks have become limiting in our database development, because they only have a limited set of calculation features and interfacing capabilities. Also, the data structure of existing LCA software has proven to be limiting. For example, there is no explicit distinction between a process, products/substances, and exchanges. This can result in loss of valuable information. Therefore, we have decided to develop our own database infrastructure and accompanying calculation and import/export modules, that provide enhanced flexibility. This allows for more freedom, we can now make our own choices on how data is stored, what types of analyses can be performed and how this information is presented to a user. In addition, we see a trend where LCA analysts are becoming more and more interested in advanced tools that utilise Life Cycle principles. For Agri-footprint 2018 we are therefore developing a completely new framework in a Python/Django environment that aims leverage the past developments of Blond 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: TU997, TU998
Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment
200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alaniärä, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science
Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and ibesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L, for temazepam and ibesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (scototaxis to measure anxiety and activity responses) and in the field (downstream dispersal using PIT tags). We found no evidence that either pharmaceutical treatment affected behaviour in the laboratory scototaxis assay. In contrast, fish exposed to the high and low doses of temazepam dispersed faster downstream when compared to control fish. Ibesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the model fish tissue of fish in the field, which results provide evidence 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
M.G. Bertram, Monash University / Biological Sciences; M. Sarrisat, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.B. Wong, Monash University / School of Biological Sciences; I. Weephs, Monash University / Melbourne School of Engineering; E. Callihan, Monash University / Department of Earth Sciences; D.A. Laidig, Monash University / Department of Applied Physics; M. Palme, Monash University / Department of Chemistry; M. Karjalainen, Monash University / Department of Zoology; S. McQuillan, Monash University / School of Biological Sciences; E. McCallum, Umea University / Department of Chemistry; N. Allard, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science; E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alaniärä, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science
Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and ibesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L, for temazepam and ibesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (scototaxis to measure anxiety and activity responses) and in the field (downstream dispersal using PIT tags). We found no evidence that either pharmaceutical treatment affected behaviour in the laboratory scototaxis assay. In contrast, fish exposed to the high and low doses of temazepam dispersed faster downstream when compared to control fish. Ibesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the model fish tissue of fish in the field, which results provide evidence of measuring how pollutants affect ecologically relevant behaviours in the field alongside standard and efficient laboratory assays.
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:s), 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 known to cause altered development, reproduction and morphology in various non-target species, relatively little is known about the potential of HGP:s to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24h) field-detected levels (average measured concentration: 16 ng/L) of 17β-trenbolone—a potent growth-promoting veterinary pharmaceutical repeatedly detected in freshwater systems—on a suite of ecologically important behaviours in female eastern mosquitofish (Gambusia holbrooki). We found that fish exposed to 17β-trenbolone were more active and exploratory in a novel environment (i.e. maze arena), while boldness was not significantly affected. Further, when tested for sociability, exposed fish were again more active and exploratory, and spent less time associating with a shoal of stimulus (i.e. unexposed) conspecific females. Lastly, when assayed for foraging behaviour, exposed fish spent a greater total amount of time within a foraging zone containing an array of prey items (chironomidae larvae) than did unexposed fish, entered this zone more frequently, and were more likely to feed. Further, a grazing rate of chironomids on three microalgal species, independently. Therefore, although treatment-induced increases in foraging behaviour were dependent on female size. Taken together, these findings highlight the potential for sub-lethal levels of veterinary pharmaceuticals detected in the environment to alter sensitive behavioural processes in wildlife across multiple contexts, with possible ecological and evolutionary implications for exposed populations.

Selective grazing behaviour of chironomids between three microalgal species under pesticide pressure

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

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 (WWTPs), representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine is prescribed as a treatment for anxiety, stress and depression, but it is not known if exposure to such WWTPs could induce indirect effects on behaviour. In this research, which was designed to compare 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.
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 vasconstriction, which in birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause subtle changes to behaviour and physiology that are not predicted to impair the capacity of wildlife to respond appropriately to environmental changes.

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

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

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

There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains largely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the German Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as benzotriazol, the available quality standards were collated or predicted from reliable QSAR models. Results showed that organic chemicals are likely to exert long-term effects on sensitive species in more than 5% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC in consecutive years as well as from various substances. The monitoring programs considered in this study often include only a subset of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is rather the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analysed two data sets on 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

L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiZ Ecotocx / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Zijp, RIVM / Centre for Sustainability, Environment and Health “Big data” are a potential goldmine for studying and contextuali- ngs. This study presents 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 (P) fraction (mP–EC50) of specific mission (t) impact factor (P, i.e., “Species Sensitivity Distribution” (SSD). Early work 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 target-specific threshold values. That is, we determined the “taxon-specific mP–EC50 beyond which species abundance starts changing when toxic pressure increases, 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 assembly 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 do improvements 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 for monitoring long-term changes in environmental quality starting from 1991 onwards. This sustained improvement for macroinvertebrates coincided with a 10-fold drop in ammonia, halving of biodegradable organics, (BOD) and improvement in dissolved oxygen associated with the conversion of the Swindon plant from trickling filter to nitrifying activated sludge. There were no dramatic changes in metal concentrations over the key early 1990s’ period unlike the main sanitary determinants. Whilst there was no change in overall flows, winter water temperatures downstream of Swindon rose over the course of the 30 year monitoring period. We could not identify relationships between the macroinvertebrate community 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, NH4 below 0.6 mg/L and NO3 below 6 mg/L we can expect no deleterious long-term effects. In contrast, the recovery of 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

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

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 body 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

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

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

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

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

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

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

Workshop findings will be presented and will later be published in the form of a SETAC “Summary document” and a series of manuscripts to be submitted to a SETAC journal.

213 Modifying factors for nickel speciation and toxicity in seawater

W. Chen, Wilfrid Laurier University; S. Sherman, Wilfrid Laurier University / Biology; J. McGregor, Wilfrid Laurier University / Department of Biology; R.C. Santore, Windward Environmental, LLC; T. Blewett, University of Alberta; G. Merrington, WCA Environmental Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining and processing activities. Determining Ni speciation is vital to understanding and predicting Ni toxicity and ultimately for bioavailability-based nickel risk assessment. Application of existing freshwater bioavailability based approaches for nickel in salt water predicts negligible binding of Ni to dissolved organic matter, but there are several examples of toxicity tests in natural seawater that are protective compared to artificial seawater control samples. Determining Ni speciation was the objective of this study. The first objective was to determine the source of this protective effect (2) how geochemically wide-spread protective saltwater sources are, and (3) to be able to predict Ni speciation and toxicity, are the objectives of this project. As a test of Ni toxicity protection by ligand complexation in salt water media, defined solutions of artificial seawater (ASW) containing different model compounds (i.e. citric acid, EDTA, L-tryptophan, glutamic acid, and histidine) were titrated with Ni to determine Ni speciation. In Ni toxicity, Ni speciation was determined in real saltwater samples of diverse geographic origin from the east coast of the United States and Canada. The divalent Ni free ion in saltwater was quantified using Ion Exchange Technique (IET) with Ni measured by Graphite Furnace Atomic Absorption (GFAA). The measured Ni⁺² values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni⁺²] agreed very closely with model predictions. In the same defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni]) and free Ni concentrations from IET ([Ni⁺²]). If the Ni toxicity is explained by [Ni⁺²], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc.

214 Acute bioavailability models for nickel: Development and regulatory application

K. De Schamphelein, Ghent University (UGent) / Applied Ecology and Environmental Biology; P. Van Sprang, I. Vercaigne, ARCHE; A. Peters, wca; C. Luffen, NPERA; E. van Herwijnen, UGent Chronic bioavailability models for nickel are well-established. For example, the Annual Average Ni Environmental Quality Standard (AA-EQS) under the European Union’s (EU) Water Framework Directive (WFD) is based on normalization of chronic Ni ecotoxicity data using chronic Ni bioavailability models. Acute Ni models have been developed for invertebrates, fish, and algae, but the relationship between acute ecotoxicity data and Ni bioavailability is not well established. Given that acute Ni toxicity can vary by greater than 17-fold for aquatic invertebrate species tested in variable water chemistries, normalization of acute Ni ecotoxicity data is a necessary consideration for the determination of Maximum Allowable Concentrations (MAC) under the WFD. The goal of this study was to test if the existing acute Ni bioavailability models can be used to predict acute Ni toxicity to both model and non-model species and to demonstrate how they can be applied to derived MAC values. Acute Ni ecotoxicity data (eight species from 13 different studies) were identified from the literature. Data were accepted for analysis if acute Ni toxicity for a species was tested in >2 test waters differing in physico-chemistry.
Acute Ni bioavailability models (3 invertebrate models, 2 algae models, and 1 fish model) were used to evaluate the ecotoxicity data. To simplify the normalization process, an “average animal” bioavailability model was developed using a weighted average of parameters for existing models. Because crustaceans are typically among the most sensitive organisms to Ni exposure, and because the fish model did not capture pH effects on acute Ni toxicity to crustaceans very well, an “average crustacean” model was developed, using a weighted average of parameters for the 3 crustacean models used to construct the “average crustacean” model. Both the “average animal” and “average crustacean” models reduced intraspecies variability considerably among the available Ni ecotoxicity data. For example, the “average animal” model predicted 98% of the 193 individual acute ecotoxicity data points within a 3-fold error, and 90% within a 2-fold error. The “average crustacean” model performed similarly to the “average animal” model clearly showed a better ability to predict the effect of pH on Ni toxicity to cladocerans. The models were applied to an acute Ni ecotoxicity dataset to derive bioavailability-based MAC for European water bodies with typical ranges of water chemistry.

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

A. Husson, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Leemakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descotes, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University / Geosciences Hydrodynamics and reactions team (HR); W.J. Adams, Red Cap Consulting; R. Gensemer, GEI Consultants; B.A. Stubblefield, Empirical Investigations into the Toxicity and Bioavailability of Microorganisms, Watershed and Sediments, 2016.

Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: REACH requirements necessitate the production of data to demonstrate the bioavailability of the uranium in porewater for all mineral phase mixtures of the 4 mineral phases (3.3% Kaolin/ 3.3% Smectite/3.3% (FOH) and 90% Ferrihydrite (FOH)/ 90% Q and a mixture of the 4 mineral phases (3.3% Kaolin/3.3% Smectite/3.3% (FOH) and 90% Q) spiked with uranium at two different concentration levels. During a ten days’ exposure experiment, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomid larval Sediment to porewater partition coefficients (Kow) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Accumulation factors were found for quartz followed by Ferrihydrite (9) and Smectite (8) and the lowest for the mixed composite sediment (1). DGT labile uranium porewater concentrations account for 70-100% of the uranium in porewater for all mineral phases except the quartz, where Cdet only accounts for 10% of the uranium in porewater. Uranium accumulation on the DGT units is correlated with the accumulation in the chironomids. Results obtained by models implemented in code (CHEMLIB) were used to model the uranium sorption behaviour and chemical speciation in the aqueous phase. These results are compared with the proposed regulations by IGSN on uranium bioavailable chemical species.

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

B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; W.J. Adams, Red Cap Consulting; R. Gensemer, GEI Consultants / Ecological Defense Group; R.C. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium REACH Consortium. Implications for implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: The generation of large amounts of ecological toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and AL toxicity. This study presents the requirements and the process of data describing the chronic toxicity of regulated chemicals to a variety of aquatic organisms. To address possible data gaps in the Al database, a series of chronic toxicity tests were conducted with freshwater organisms. Aluminium toxicity is a function of its speciation and this is a function of water pH. Previous chronic toxicity tests with Al were typically conducted under acidic test conditions and few studies have been conducted at pHs more typical of natural surface waters. The studies reported here investigated the chronic toxicity of Al at pH 6.0 to 8 freshwater species. The species tested were the great pond snail (Lymnaea stagnalis), a rotifer (Brachionus calyciflorus), an aquatic oligochete (Aerolosoma sp.), a midge (Chironomus riparius), an amphipod (Hyalella azteca), an aquatic plant (Lemna minor), and two fish, the fathead minnow (Pimephales promelas) and zebrafish (Danio rerio). Chronic test durations ranged from 48 hours to 35 days. The most sensitive species was the zebrafish (10% effect concentration (EC10) of 98 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 chronic tests with Ceriodaphnia dubia, fathead minnows, and the algae (Pseudokirchneriella subcapitata) suggest that modifying factors such as pH, dissolved organic carbon (DOC), hardness, and temperature have a large impact on the bioavailability and toxicity of Al to aquatic organisms.

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


The irreversible effects that the environment has suffered due to anthropogenic activity has reduced the availability of water for living beings, both in terms of quantity and quality. Industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystems. The impacts of mining activity on aquatic ecosystems have been widely documented, reporting the deterioration of water quality, the impact of biodiversity, as well as the release of heavy metals of potential accumulation in organisms and subsequent biomagnification through the food chain. Although it is known that non-technical mining activity affects the environment, it is necessary to identify and prioritize those factors related to mining activity that have a greater impact on the ecosystem (regression, cyanation, and amalgamation). The identification of these factors would allow environmental control authorities to prioritize management actions focused on those parameters with the greatest impact, thus mitigating the impact of this activity on aquatic ecosystems. To illustrate this, the present study conducted in the Ponce Enriquez area seeks, through the construction of predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams in the study area. In order to determine the environmental quality of the sites visited, the application of the BMWP / Col index was used, which is based on the structure of the macroinvertebrate community present. Additionally, a set of environmental variables of water and sediment quality were used to build a model of ecological predictive models that, by the construction of predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental condition of the rivers in the improve the environmental condition of 30% of the stations sampled. (Ca

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

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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 aquatic ecosystems. The determination of microplastics is hampered due to 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 aquatic environmental sample. The results from initial tests confirm the general applicability of individual techniques to, firstly, sample and, secondly, detect plastic sizes and polymer types. To obtain representative results, a sampling strategy is needed to concentrate plastic particles. Crossflow ultrafiltration is applied to concentrate microplastics from 100 into 0.5 L and yields in a reproducible particle recovery of 54 ± 2 %. Microplastics are detected using FTIR-microscopy which is limited to a minimum particle size of 28 μm. For microplastics field- flow- fractionation, that reveals information on the particle sizes, and pyrolys GC-MS, that is used to identify the polymer types, are

SETAC Europe 28th Annual Meeting Abstract Book
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoplastics. The pre-concentration by crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 µg L⁻¹ in an aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microwavedigestion method for the analysis with FTIR-microscopy. By this, the results of spectrometric 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 traditional and microplastics and microplastics particles and fibres.
F. Schmidt, M. Schmiedler, Eawag Swiss federal Institute of Aquatic Science and Technology; D.M. Mitran, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Risk and Management Research on particulate plastic (nano- and microplastic particles and fibers) and their distribution in the environment has intensified in recent years; but truly quantitative analysis, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Syntesizing 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 three orders of magnitude lower than single polymer 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 quantitation studies, even at the bench scale, have remained elusive in part due to the interactions with organisms at trace concentrations. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

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

221 Soil and sludge: A time and cost-effective method for extracting microplastics from complex, organic-rich environmental matrices
R. Hurley, NIVA - Norwegian Institute for Water Research; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; M. Olsen, Telemark University College; L. Nizzetto, NIVA. There is very little existing data on microplastics in organic-rich substrates such as soil or sewage sludge. The organic components, as well as the complexity of the solid matrix, complicates the extraction process. No standardised methodology has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. The methods testing procedure was split into three phases: 1. Effect of reagents on test polymers; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extractions surveying the incorporation of 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 and 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 new methodology is 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 processes
A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, Norwegian Institute for water research; M. Olsen, C. Vogelsang, NIVA Norwegian Institute for Water Research. Incorporation of anthropogenic particles into sludge has been highlighted as a major route for the transport of pollutants into the environment. Here we present the results of a nationwide 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 – 8 837) or 1.176 889 particles m⁻³ (470 270 – 3 394 274). Particles from sludge consisted of beads (37.6%), fragments (31.8%) fibres (28.9 %) and glitter (1.7 %). Most of the particles were clear in colour (41%). Ten percent of the overall particles extracted were tested using FT-IR. All particles (n = 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 temperature treatment processes that dominate (particulate) plastic fate, transport and interactions with organisms at trace concentrations. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

223 The Influence of Weathering on the Sinking Behavior of Microplastic in Freshwater and all Surface Waters
H. Arg, NGI / Environmental Technology; L.B. Olsen, D. Issler, NGI; N. Berroaguz, NGI / Environmental Chemistry; S. Wongsoerdjo, X. Shen, E. Toorman, KULeuven. 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

L. Tofull, CNR / Institute of Atmospheric Pollution Research; S. Canepari, Sapientia University of Rome / Chemistry; M. Catrambone, F. Marcovecchio, M. Giusto, CNR / Institute of Atmospheric Pollution Research; S. Pareti, CNR / institute of atmospheric pollution research; T. Sargolini, CNR / Institute of Atmospheric Pollution Research; E. Perrino, CNR Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research

We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM$_{2.5}$ and PM$_{1.0}$) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and week-ends during a 6-week winter period and a 4-week summer period (Special Observation Periods – SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-Term Sampling) consists in twelve 1-month PM$_{2.5}$ samplings carried out by using very low flow-rate samplers. It was envisaged to obtain a general picture of the effect of the above parameters during a whole calendar year. Both sampling schedules were applied to six indoor and four outdoor sites, all inside or around the same building. At each site and for both schedules the sampling were simultaneously carried out on Teflon, quartz and polycarbonate filters. Teflon filters were used for the determination of the collected mass (by gravimetry), of the elemental content (total content by energy dispersion X-ray fluorescence, bioavailable and residual fractions by inductively coupled plasma mass spectrometry), of anions and cations (by ion chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). After the analysis, the PM$_{2.5}$ mass was determined 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$_{2.5}$ in urban sites under industrial influences in northern France

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PM$_{2.5}$ have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The city of Northern France is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of Europe means that this area is subject to major transportation activities by road and also by sea. In this context, the objective of this work was to acquire a better knowledge on the exposure level to major species and metals in PM$_{2.5}$ and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using Dinafilter® DA80 high volume samplers between November 2010 and April 2011 in three medium cities located in northern France, Dunkerque (Dk, coastal urban and industrial site), Boulogne-sur-Mer (BL, coastal and urban site) and Saint-Omer (SIO, inland urban and industrial site). PM$_{2.5}$ composition was analyzed for major elements, trace elements, and organic compounds. Additionally, an NMF (non-negative matrix factorization) model was used to identify the sources. For this, the source profiles were identified in Dk and SIO using differential emissions and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM$_{2.5}$, such industrial sources were the main contributors of metals at the two sites.

226 Estimating the contribution of deposition in the total exposure to PAH's 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 sources for PAHs in soil and crops. Our aim was to determine the proportion of the overall burden of environmental and dietary exposure to PAHs that is attributable to deposition in order to derive save deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Expo, a software tool that allows to model lifetime exposure, integrating exposure through multiple pathways. Model simulations were based on recent yearly average concentrations in air and particulate matter (PM$_{10}$) 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 the 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 equalled the TDI. Simulations were run for 16 priority EPA - PAHs + benzo[a]fluoranthen. 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 exceeded the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for B[a]P are required to confirm these results. (The authors thank the Flemish Agency for Health and Care for their support)

227 A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air microcontaminants

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Air quality is currently assessed by monitoring a few pollutants involved in the different pathways. Model simulations of downwind of several industrial processes may remain insufficient to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposition to many bioactive micropollutants, which can also interact with each other. In this way, in vitro bioassays might be relevant biomonitoring tools to assess the air quality, as they integrate these “cocktail” effects. Furthermore, the pulmonary exposure to semi-volatiles endocrine-disrupting compounds (EDCs) may cause hormonal disruptions observed in human, especially indoors where they spend 80 % of their time. By using cellular bioassays, we have previously shown that bioactive EDCs tend to concentrate indoors, especially in the gaseous phase. The concomitant chemical analysis of a wide range
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 day nursery 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 various selection criteria for the quantified target EDCs in the different subfractions (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 bioassays 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
H. Eitremhøyer, University of Pittsburgh / Civil & Environmental Engineering; W. Collinge, M. Bilec, University of Pittsburgh / Civil and Environmental Engineering
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, improved air tightness (tightness) can result in increased 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 quantified target EDCs, which are spatially resolved data. The heterogeneity in ventilation type along with the negative effects of deficient heating and aged mechanical systems had indoor air quality levels distinct; however, the counterintuitive findings implied that green and naturally ventilated buildings underperform when compared to some of 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., PM₁₀, O₃, NO₂) before increasing outdoor air volume. Natural ventilation systems are typically designed to 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 suggest a complex relationship (CO₂ and HCHO levels overnight). In this given case, the use of occupancy sensors did not allow proper flush-out of indoor environments and interior 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 its chemical components. The low-cost, automatic and self-powered device assures long-term (1-2 months) collection of PM on membrane filters, suitable for subsequent chemical analysis. The device was used during the study focused on the concentration of PM₁₀ mass, ions, levoglucosane, polycyclic aromatic hydrocarbons (PAH) and elements. It showed very good performance in terms of repeatability of the samplings, which is the essential characteristic to build a reliable network. The samplers have been employed, for the first time, to evaluate the spatial variability of PM₁₀ mass concentration and its main chemical components in the area of Paris, a urban/industrial hot-spot sited in an intramountain depression of Central Italy. Lichen transplants have been exposed at the same sites of the samplers in order to evaluate the potential of lichens as biomonitor for PM spatially resolved analyses. The meteorological conditions of

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
P. Cubrů, ENTEP, IRSTEYA LON; A. Devaux, INRA-CNRS / UMR LEHNA USC INRA IGH ENTEP; K. Abacci, H. QUEAU, N. Delorme, L. Gamaro, IRSTEYA LON / UR MALY Laboratoire Ecotoxicologie; S. BONY, INRA - CNRS / UMR LEHNA USC INRA IGH ENTEP; a. chaumont, IRSTEYA / UR MALY Laboratoire Ecotoxicologie
Since the 80's, 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 gametes of the sentinel species Gammarus fossarum, and impairment in embryo production. However, such a link was not observed after exposure to complex mixtures in the field at more environmentally realistic concentrations (2). Taking advantage of the availability of biomarkers measured in multiple scale in this species, from the molecular level (primary DNA damage, global DNA methylisation) to physiological one (feeding rate, molting success, vitellogenesis) and life history traits (growth, fertility, embryonic survival), along with the possibility to conduct rearing culture in the lab (time to puberty about 4 months), the objective of this study was to assess whether biomarker responses revealed in adult gamarids 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 uncontrolled 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 is currently in progress. References (1) Forbes VE, Calow P, Sibly RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994. (2) Lacea E, Geffard O, Goyet 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 synergistic effects of two fungicides in two aquatic invertebrates
Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; A. Risch, Eawag, Environmental Chemistry; C. Vignet, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; D. Fedrizzi, Eawag Swiss federal Institute of Aquatic Science and Technology; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry
Numerous micropollutants have been detected concurrently in aquatic systems, but little is known about the mixture effects of micropollutants 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 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 azoxytrob in both species 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 prochloraz in both species, which are likely to contribute to the lower bioaccumulation levels identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-hexoxyacylate group of azoxytrob 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.

SETAC Europe 28th Annual Meeting Abstract Book
and H. azteca, respectively. The LC50 of oxoazostrobin alone were 157 and 200 µg L⁻¹ in G. pulex and H. azteca, respectively. Prochloraz significantly decreased the LC50 of oxoazostrobin in both species. Video-tracking of the locomotory behavior suggested that prochloraz induced hyperactivity in G. pulex, but not in H. azteca. Overall, results suggests H. azteca comprise more diverse biotransformation reactions and G. pulex tended to be more sensitive than H. azteca toward prochloraz effects.

232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb, H. Arambourou. Inverte Lyon / Freshwater system, Ecology and Pollution Research Unit; M. Delorme, K. Abbaci, Inverte Lyon / UR MALY Laboratory Ecotoxicology; N. Delorme, K. Abbaci, Inverte Lyon / UR MALY Laboratory Ecotoxicology; P. NOURY, Inverte Lyon / Ecotoxicology; R. Tutundjian, Inverte Lyon / E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSIC / Environmental Chemistry; I. Fuerst, Institute of Environmental Assessment and Water Research IDAEA CSIC. V. Debat, MNHN / Institute of Systematics, Evolution and Biodiversity Gammarus sp. (Amphipoda) are widely distributed across European freshwater systems. In the present study, we evaluated the effect of a fenoxycarb exposure on Gammarus sp.. More specifically, i) we assessed the sensitivity of the embryo stage, ii) we identified embryogenesis’s sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among three Gammarus sp. species. Fenoxycarb is a growth regulator insecticide, analog of the insect juvenile hormone, used for pest management and for veterinary purpose. This study demonstrated that 5 and 50 µg L⁻¹ fenoxycarb can alter embryonic development of G. fossarum. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L⁻¹ fenoxycarb strongly altered the pre-copulatory behavior in G. fossarum and a 50 µg L⁻¹ exposure prevented the production of viable embryos. These results highlighted the deleterious effects of the insect growth regulator fenoxycarb on gammarid embryogenesis and reproduction, which could have severe repercussions on population dynamics. The response to the toxic exposure was dependent on the study gammarid species which underlined the importance to consider species with broader phylogenetic representation to better assess insect growth regulator effects.

233 Adaptation of Gammarus pulex to agricultural insecticide contamination in streams N. Shahid, Helmholtz Centre for Environmental Research UFZ-J.M. Becker, Helmholtz Centre for Environmental Research UFZ / System-Toxicology; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Toxicology Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the toxicity of pesticides because of metabolic acclimation and increased tolerance. If the genetic 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 reacclimatized from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below considerateable 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 antifouling bioicides in a changing world: combined management of nanotechnology and biocontrol species V.L. Ferreira, University of Aveiro / Biology Department and CESAM; M.D. Pavlaki, University of Aveiro / Department of Biology; M. Monteiro, Aveiro University / Biology; F. Maia, Smallmacte - Small Materials and Technologies, Lda.; R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Tedim, University of Aveiro / Department of Materials and Ceramic Engineering; A.M. Soares, University of Aveiro / Department of Biology & CESAM; A. robinson, Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK 2 School 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, Lumbricus rubellus, Dendrobaena octaedra, Apporectodea caliginosa and Ancythias 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) A. Robinson1, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology; A. robinson1, (alerob@cenv.uea.uk), S. Short1, E. Lahive1, P. Kille1, D. Spurgeon1 Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK 2 School 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, Lumbricus rubellus, Dendrobaena octaedra, Apporectodea caliginosa and Ancythias 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) 236 Multiple exposure to pesticides and other emerging pollutants – problems and solutions for healthy ecosystems and humans M. Santen, G. Ungherese, Greencare 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 support biodiversity. In the past decades Greencare has been involved in several investigations on persistent chemical like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic-chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on bees and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the
context of Greenpeace’s detox campaign have found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polyfluorinated chemicals show that PFASs (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 carried out a first wave of river monitoring and snow 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 PFASs analysis in wastewaters, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and regulations are required. The use of pollution 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 PFASs 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 PFAS pollution is gathering pace and with 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.


237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework
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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 may not individually cause an adverse effect. They provide 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 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 DEMEAU, FP7 Science4Water). This innovative combination could contribute to safeguard the safety of conventional wastewater 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 presumptive tools to regulate emerging contaminants, Australia, US (CA), Canada, RIVM, EAWAG, KWR, UFZ, EU-JRC and EU- DG-Env, WHO and GWRC), these bioanalytical tools need to be more comprehensively validated and benchmarked across the entire water cycle and against human and ecological health outcomes before they can be adopted in regulatory frameworks. A critical next step will be to derive further EBT for an expanded scope of bioassay endpoints. Several strategies for the derivation of EBT have been proposed but there remains a lack of acceptance and harmonization across the field to allow better acceptance of these innovative water quality and safety frameworks. Covering a wide range of issues including water quality and quantity management and the management of water-related risks, the OECD is endeavouring to capture science as policy recommendations that derive from its past and recent work on water in a single, consistent and action-oriented policy. By hosting a collaborative task-force or expert working group including GWRC experts and gathering international organizations such as WHO, UNESCO and the OECD we can get to benchmark these new effect-based trigger values, and contribute to the water cycle by targeting Water effect-based guidelines. Complementary tools could be developed for use by such Science to Policy interface as a supportive action to better explain and disseminate the associated benefits for stakeholders as citizen towards their health protection, municipalities and local authorities, water professionals and institutional bodies.

238 Chemicals of emerging concern (CEC) in the water cycle – a regulatory perspective
M. Helmecke, Umweltbundesamt (UBA)

Environmental authorities increasingly need to address the challenge of contaminants of emerging concerns found in the water cycle. The German Environment Agency has assessed entry points 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 framework to achieve good environmental status. However, there are challenges regarding the inclusion of new approaches to a comprehensive risk assessment using effect based testing (NP) in the regulatory frame. This perspective will show how 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 unique opportunities to detect and determine the dynamics and effects of micropollutants 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 European NTS framework or an approach to establish an NTS framework (http://www.norman-network.com/?q=node/236) and NORMAN Digital Sample Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptox.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 of as-yet-unknownediated 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 neo-emergence of “emerging pollutants” in the environment, enabling a pro-active approach to environmental risk assessment 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 levels
B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Alt-Aissa, Institut National de l'Environnement Industriel et des Risques (INERIS); P.A. Behnisch, Biodetection Systems BV; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; F. Brison, INERIS / Ecotoxicology Unit; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; W. Busch, Helmholtz Centre for Environmental Research - UFZ GmbH / Bioanalytical Ecotoxicology; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research,
241 Chemical gene interactions for associating contaminants with biological effects

A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; D. Martinovic-Weigelt, University of St. Thomas / Biology; G.T. Anley, D.L. Vulcan, 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. The TDMG has been evaluating the potential influence of wastewater treatment plant effluent into small creeks (case study of small Thai tributaries in Switzerland). In many cases the proposed EBIs were able to differentiate wastewater from surface water and EBIs for different bioassays gave very consistent results indicating the benefit of a common derivation method. However, the limitations due to limited effect data availability and limitations of the existing lists of EQS, the proposed generic methods to derive EBIs is a first step to harmonise existing approaches and explore various different options of a large diversity of in vitro bioassays commonly applied for water quality assessment.

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

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

1H-1,2,4-Triazole (124T) is an ubiquitous occurring small molecule which originates from natural sources like soil microorganisms (Fungi, Actinomycetes). 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. The study has confirmed the wide range of sources of 124T and showed that it is currently not 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 prerequisite for reliable and justified regulatory conclusions.

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

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1H-1,2,4-triazole (124T) is an ubiquitous occurring small molecule which originates from different anthropogenic sources in the environment or from biotic or abiotic degradation of triazole-fungicides. In addition, 124T potentially originates from natural sources like soil microorganisms (Fungi, Actinomycetes). Information about the natural background abundance of 124T in forest top soils of German origin is important for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, at two of these ten sites the development of the 124T residue background level was investigated over the period of one year. The background abundance of 124T in the samples ranged from 0.10 to 1.9 μg/kg in oak forest top soils, from 1.0 to 2.1 μg/kg in pine forest top soils, and from 0.10 to 1.2 μg/kg in spruce forest top soils. In the selected beech forest top soils the background abundance of 124T was below 1.0 μg/kg. The background abundance of 124T in beech and spruce top soil samples taken from April 2012 to February 2013 showed fluctuations over time. These variations could not be associated to seasonal changes. Single values ranged from 0.10 to 1.8 μg/kg in the beech top soil samples and from 0.10 to 2.1 μg/kg in the spruce top soil samples. Overall, a background abundance of 124T could be detected in all forest top soils that are currently not possible to distinguish between anthropogenic 124T sources (e.g. fertilizer additives, metabolites of triazole-fungicides, breakdown product of commodity chemicals) could be excluded. This indicates that the measured 124T residues originate from natural sources in the environment.
Challenges of a groundwater monitoring study design for a substance with multiple sources: determining risk for groundwater from 1,2,4-Triazole formed from fungicides used in arable crops in Germany

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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, and where applications of 124T-containing fertiliser and other potential sources could be reasonably ruled out. Existing wells from authorities’ or water producer’s monitoring networks were sampled in the studies, thus capturing a range of scenarios for leaching risk in real-world agricultural practice. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitable samples. This was followed by 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 practise. 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.pesticidevslng.dk), which comprise five agricultural fields and some control till fields in Denmark. The monitoring began in 2014 and is still ongoing. 1,2,4-triazole is monitored in groundwater and in 1 m depth in water collected from tile drains and suction-cups. The known applied sources of 1,2,4-triazole in PLAP from 2014 to 2015 are the fungicides tebuconazole, epoxiconazole and prothioconazole, which the latter according to the EFSA conclusion only forms minor amounts of 1,2,4-triazole by degradation in soil. These pesticides together with other triazole-fungicides have been applied to the PLAP fields several times since 1999. The applications of tebuconazole and epoxiconazole have not resulted in unacceptable leaching of the active substances to the groundwater. Monitoring of 1,2,4-triazole in PLAP showed detections in groundwater, and some of the detections exceeded 0.1 µg L⁻¹ (max. 0.26 µg L⁻¹). Due to the high background levels of 1,2,4-triazole before application of these triazole-fungicides, it was not possible to fully relate the detections to the specific application of fungicides, as there may be unknown sources like other triazole-fungicides used before 2014. A general decrease in the concentration of 1,2,4-triazole with depth, however, indicates a surface applied source.

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 Deq/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 two 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 detectes of 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. Of 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 µg/kg. 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-fungicide 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 trifluoracetate 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 trifluoracetate (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, TFA is produced by the biodegradation product of several pesticides. During a screening of surface waters in south-western 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.

The result of this study demonstrate that ozonation of a high concentration of TFA 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 Tênax or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 14C-labelled chemicals. Examples and applications of these approaches will be summarized. They include desorption extraction (Environ. Sci. Technol. 45:3019-3026, 2011; Environ. Sci. Technol. 48:10869-10877, 2014), passive sampling and dosing methods (Environ. Toxicol. Chem. 27:1526-1532, 2008; Environ. Pollut. 184:435-442, 2014; Environ. Pollut. 205:378-384, 2015), constant NAPL/water interfacial area method (Environ. Sci. Technol. 45:1074-1081, 2011; Environ. Sci. Technol. 51:11935–11942, 2017), and radiorespirometry and dual 14CResidue analysis (Environ. Pollut. 159:3692–3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability and biodegradation sciences. Still today, it is difficult to predict bioavailability of HOCs, for example, solely on the basis of basic parameters such as organic matter, black carbon or clay contents of a given soil or sediment, and the physicochemical constants of the chemicals (such as solubility in water, octanol-water or organic-carbon based distribution coefficients). This limitation even remains with improved assessments through determinations of chemical activity and 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 C. Casteddu, LOREAL SA / Research and Innovation; J. Chenible, L'Oreal Research / Research and Innovation; Y. Barthel, Eurofins Expertises Environnementales / Eurofins Expertises Environnementales; J. Lharridon, L’Oréal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology 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 biodegradability in environmental media, especially for substances which do not easily reach the microorganisms. 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 P. Meyang, Newcastle University / CEGS; R.J. Davenport, Newcastle University / School of Engineering; K. Fenner, ETH Zürich/Eawag The investigation of the environmental fate of pollutants is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in bioreactive systems is still insufficiently understood, how plant performances are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arhenius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the validity of such models, by exploring the effect of short-term temperature variation on micropollutant biotransformation in an aerobic sludge community. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropolllutants (6μg/L) was monitored over time at five different temperatures (4–40°C range). The experimental kinetic parameters were compared with 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 rate. Model experiments predicted rate constants above 20°C, despite major risk assessment guidelines recommend Arhenius 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 Arhenius-behaviour over the 4–40°C range, the biotransformation processes may be linked to basic living cell function, showing sensitivity to temperature fluctuations. Our study highlights limitations in the applicability of Arhenius-based models for the estimation of chemicals fate in biological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations. 251 Findings from an international ring test for an improved marine biodegradation screening test A. Tietz, T. Aanensen, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards prioritisation 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 false positives, 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 benzoate), a negative reference compound (pentachlorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polyacrylamide), 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. Henmcke, Fraunhofer IWE - Institute for Molecular Biology and Applied Ecology / Ecological Chemistry; M. Kruse, Fraunhofer IWE - 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, e.g. 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 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 photolysis testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain inter- and intra-laboratory variation in biodegradation test outcome will also be discussed. 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 an inventory and analysis of underlying 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

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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) with 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) are different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCA and MRS are considered. The implementation of the MCI with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

256 Consistent allocation using archetypes of LCA Goal and Scope definitions

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Identifying a suitable allocation procedure is always a challenge in the modelling of the life cycle of products. This is especially true for products that are often mined or extracted from limited resources and 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 research questions for our LCA study, we implemented two tools of the LCA framework. The archetypes and scope need to be clearly defined: the topic of the LCA, the perspective, the reason to conduct the study, and potential additional functions of the product system that are taken into consideration. We present a framework that shows how the allocation procedure is dependent on different LCA approaches that are defined in the goal and scope of the LCA. Based on this framework, building blocks are derived that are used to formulate research questions. These research questions represent archetypes of goal and scope definitions. The presented framework shows that there is a relevant difference between system expansion and substitution, and that we must differentiate between process-oriented and product-oriented LCAs, which is not common practice. Furthermore, we show that all types of LCA approaches can be used to support decision-making, which is often only at.suited 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 clear. The production phase of the laptop is modified to reflect a closed loop for recovered materials. For this reason, only a limited number of materials are taken into account. The recycling scenario assumes the optimistic case that all laptops are collected. The pre-processing of the laptop is modelled assuming a manual de-pollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site, copper smelter and precious metal refining. In the third scenario, a second life of 3 years is assumed for the repaired laptop. The main environmental impact of the repair activity is the replacement of components. It is assumed the laptop requires a new hard disk drive and a new battery. No additional transport is assumed for self-repair. At end of life the laptop is assumed to be recycled, as described above. The case study presented in this paper indicates that repair of laptop’s should be considered before discarding for material recycling. The potential benefits of material recycling for high-end or closed loop applications remain limited. If the extended life is at least 2 years, the number of components to be replaced considered in this case study does not impact the decision making. The results also show that increased energy efficiency of new products has a limited impact on the overall results.
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 automated 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 iRTG systems. Hence, different nutrient mixtures can be optimized. In this sense, different literature证据 shows that half of the currently economically phosphate resources will have been used up in 50 to 100 years. To optimize P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant precipitated struvite will be used as the P source for crops in the i-RTG in two different ways: mixing struvite in the nutrient solution and by adding struvite in perlite sacks (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 R. Mey, RWTH Aachen University / Chair of Technical Thermodynamics; S. Westheus, RWTH Aachen University; J. Klankermayer, RWTH Aachen University / Institute for Technical and Macromolecular Chemistry; A. Bardow, RWTH Aachen University

Plastic packaging waste is one of the priority areas inside the European action plan for the transition to a circular economy. To establish a circular economy, a potential large-scale avenue is chemical recycling of plastic packaging waste. However, preliminary assessments of chemical recycling technologies rate them inferior compared to mechanical recycling not only from an economic but also from an environmental point of view. Based on these results, 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


In 2009 PFOS, its salts and PFOsW 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 delay of four years to evaluate 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 Atta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termites. Data on the open use and updating will be included. 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 conclusion that in phasing out a substance, it is necessary to understand the functional characteristics of the substance in that specific application and to follow a case by case approach. This enables to find alternatives and to define the proper measures. A multidisciplinary approach is indispensable in this phase-out process.

261 Experiences of "Substitution in Practice" C. Jonsson, Swerea IVF AB / Energy and Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); I.v. Veen, Institute for Environmental Studies (IVN) / University of Amsterdam; R. Meys, VU University / Chair of Technical Thermodynamics; S. Westheus, RWTH Aachen University; J. Klankermayer, RWTH Aachen University / Institute for Technical and Macromolecular Chemistry; A. Bardow, RWTH Aachen University / Chair of Technical Thermodynamics; H. Holmquist, Chalmers University of Technology; P. Leonards, VU; G.M. Peters, Chalmers University of Technology / Department of Chemistry and Chemical Engineering; S. Posner, Swerea IVF, P.O. Box 104, SE-431 22 Mölndal; A. Hanning, Swerea IVF AB

Within the research project SUPPES (Substitution of per Fluorinated compounds to Eliminate diffuse Sources), research on the substitution of hazardous chemicals in consumer products is focused on identifying feasible solutions with better sustainability performance. Such substitution model, suggesting evaluation for both technical as well as environmental and health performance, requires an interdisciplinary approach to create and/or identify feasible alternatives solutions. SUPPES SIP model include 1) characterisation of PFAS in use and for different consumer products 2) initial alternative selection based on matching function criteria and toxicity and exposure assessment and 3) final selection of alternatives underlying 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 characterization and evaluation need to be performed in different ways and not only in chemical ones. Toxicity and exposure assessment are also required to evaluate the health impacts of the substances in use. The results of the assessments are then benchmarked against a control crop, using life cycle assessment (LCA) and to define the proper measures. A multidisciplinary approach is indispensable in this phase-out process.
An analysis of the technical and economic feasibility of alternatives to lead 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. However, 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.

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

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In this talk we present the soil-ecological knowledge 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, scientific literature and reports in a data warehouse. Up to now EDAPHOBASE contains more than 50000 observations, about 30000 sites, an 140000 taxa. Data can easily be imported, quality checked, published, queried and analyzed via a web application interface. Detailed analyses can be performed with the interactive web application EDAPHOSTAT which allows species-level analysis as well as definition of reference communities. Future development of EDAPHOBASE towards a pan-European ecotaxonomic database system includes the following: (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
Europe, (3) the provision of a reference base of the ecological quality of soils and (4) the coverage of relevant needs of as many as possible European policies. Finally, necessities for practical use in common agricultural policy, circular economy and for EU transboundary issues are discussed.

267 Diving into REACH database with Rstudio to produce input data for the USEtox model for thousands of chemicals
In the context of the EU commission product environmental footprint activities (PEF) [1,2], the potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. For each single chemical, this model requires dozens of physico-chemical parameters as well as data on ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer endpoints. For PEF those data are required for thousands of chemicals using the most up-to-date information [4,5]. The EU commission Joint Research Centre has obtained from the European Chemicals Agency (ECHA) data on more than eight thousand chemicals. These data includes all the physico-chemical properties (166’926 test results), ecotoxicity (305’068 test results) and human toxicity data (41’381 test results) available in the IUCLID 5.5 database (as of May 2020). Data were downloaded using orthoganol regression. A total of 207 mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305’068 End-point study reports (ESR).

268 The effect of modelling decisions on macroinvertebrate sensitivity modelling
S.v. Berg, Wageningen University & Research / Aquatic Ecology and Water Quality Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C. Rendal, Unilever / Safety and Environmental Assurance Centre SEAC; E. Butler, Unilever; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; A. Wageningen UR / Aquatic Ecology and Water Quality Management group b Alterra.
Main challenges in modern ecological risk assessment (ERA) lie in the simultaneous occurrence of species diversity and compound multiplicity. The recent development of trait-based sensitivity models has proven to be successful in tackling this problem. However, this methodology is one of the first of its kind, and has required us to take considerable caution when interpreting results 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 the inclusion of traits or the treatment of the traits as independent variables results in models with a higher R². And finally, we take a look at the relationship between the collinearity threshold and the cross-validation error, since we expect that accepting higher collinearity results in worse models. For our dataset we find that i) using AIC as model selection criterion results in models which are better in predicting sensitivity outside the training data, ii) species-trait matching should ideally be done at the genus level, iii) the method chosen for trait prediction depends on the envisioned modelling purpose (mechanistic understanding or improved predictions), and finally, iv) that the collinearity threshold greatly determines the reliability of the resulting models.

269 New approach facing new challenges in Ecotoxicology: D counter
S. Abreu, University of Aveiro / Dep. Biology & CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DETI / IEETA
Routine tests in Ecotoxicology are simple, relatively inexpensive and rapid methods. They can be used to compare the sensitivity of various bioassays to chemical pollutants but data are globally missing for marine organisms. In addition, studies have mainly been focused on only one species under the same exposure, but toxicity exposure involving several species are scarce. D counter is an innovative device that can be used in ecotoxicology assays involving not only one, but also two or more different species, and proving separated data from each of the species coexisting under simultaneous exposure, whenever 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 (used within 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 species.. (e.g., Daphnia pulex)

270 Ceriodaphnia is euisensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements
K.A. Connors, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization
The OECD 202 Acute Daphnia toxicity test (EC 402-010) is used to determine the toxic concentration (EC₅₀) of a test substance – which represents the concentration of a chemical that causes 50% mortality in the test organism. The USEtox model for thousands of chemicals that had both D. magna and D. pulex acute toxicity data were identified (5443 studies). This orthogonal regression has a slope of 0.881 and an intercept of 0.484. As both D. magna and D. pulex are accepted OECD 202 standard test species, this inherent biological difference in sensitivity is accepted under the regulatory guidelines. A total of 193 chemicals that had both D. magna and D. cubia toxicity data were identified (5465 studies). The orthogonal regression for the acute toxicity studies has a slope of 0.847 and an intercept of 0.378. Despite the different species sensitivity differences between D. magna and D. pulex and D. magna and D. cubia, we argue that both D. magna and D. cubia should be fully accepted for regulatory toxicity requirements regardless of geographic jurisdiction.

271 Poster spotlight: TU002, TU003
K. A. Connors, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization
TU002, TU003
Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II)
272 Assessment and management of stormwater on sediment recontamination due to metal contaminants

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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 water samples 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 metal species in their oxidized states and THG. A set of four sediment samples was used to represent the percentages of clay, fine silt, coarse silt and sand, which represent particles that could be most directly related to recontamination potential. The results show that over the time the contaminant loadings decreased due to reduction in particulate contaminants while the concentrations in finer, and dissolved fractions remained relatively constant. Cu 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 silts 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 and stormwater recontamination does not add appreciably to sediment THG loads. The particle associations in stormwater along with spatial distribution in sediment traps can identify sources, contributing locations and effective remedial approaches. The implications of the study, can be the development of identification tools that give information about the potential mobility-transport of the metals during storm events, identification of contributing locations, effective remedial approaches and thus, help to propose best practices for stormwater and sediment management.

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

L. Loureiro, 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 metals. 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 in the worms, both Pb(NO3)2 and PbO, ranged from 75.6 to 81.1 mg Pb/kg dry body wt in all treatments, indicating that survival of E. crypticus was better explained from internal Pb concentrations in the worms than from total or available Pb concentrations in the soil. In general, percolation did not affect total or Pb availability in the soil for Pb(NO3)2 suggesting that the counterion might have influenced Pb toxicity when Pb salts were used in the standard toxicity tests. Thus, leaching the contaminated soils before testing or using the oxide form of metals might be good ways to get rid of the influence of counterions and increase environmental realism of laboratory toxicity studies.

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

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Presentation Type: Presentation preferred Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awual1, B. Hale2 & S. Siciliano1, 1University of Saskatchewan, Toxicrology 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 metal salt spiked soils and field metal contaminated soils. The toxicity of the oxides and minerals to soil enzymes were tested and compared to the soils. The experiment was conducted with three Canadian soils (pH: 3.5-7), three metal species, five fixed metal mixtures and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monoxygenases, beta- glucosidases, acid-phosphatases and 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 was not in agreement with the ratio of the mixture in the three soils. Here, ray toxicity was highest in the soil with a pH value of 5 and vice versa for pH 3 and 7. Generally, metal salts were the most toxic form, and the spinel minerals were the least toxic. Metal oxides were chosen as a replacement for carrying out metal mixture studies in soils because no leaching was required and it was more toxic than the minerals. Keywords: Fixed ratio ray, metal oxides, spinel minerals

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

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This study aimed to assess the effects of soil moisture content on the avoidance behaviour of the soil invertebrate species Folsomia candida (arthropod) and Enchytraeus crypticus (soil-dwelling oligochaete) in metal(loid)-contaminated soils. Two metal(loid)-contaminated soils from Central Portugal were selected as test soils (mining soil with pH~5.9, agricultural soil with pH~4.8). Avoidance behaviour was evaluated in two-section vessels for 48 h at 20 °C. Lufa 2.2 soil was used as control soil. Avoidance tests were performed at different soil moisture contents (expressed as soil water holding capacity, WHC): 50% (standard 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% for 48h 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 (no avoidance). Variation in response was observed in the test and control soils the behaviour of both invertebrate species was mainly controlled by soil moisture content. F. candida had a preference for soils moistened at 50% WHC, regardless the soils were contaminated or not. E. crypticus avoided both metal(loid)-contaminated soils in all the soil moisture combinations tested (~10-100% avoidance), except when the control soil was at drier conditions than the test soils. The present study showed that: 1) porewater metal(loid) availability in soils increased with increasing soil moisture content, especially in soils with higher acidity; 2) F. candida and E. crypticus differed in their capacity to avoid metal(loid)-contaminated soils; 3) F. candida preferred soils moistened at 50% WHC, regardless soils were contaminated or not; 4) E. crypticus could avoid metal(loid)-contaminated soils but its capacity was highly dependent on soil moisture conditions.

276 Manganese bioavailability in legacy contaminated soils by medieval metal mining activities

SETAC Europe 28th Annual Meeting Abstract Book
Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)

278 Profile of microplastics in water and sediments of Antuã river in Portugal
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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 environment. The 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 Antuã river in to water and sediment samples collected in March and October of 2016 in several stretches of the river. The abundance of MPs reached 14.3 ± 18.3 mg m−3 or 306.4 ± 472.1 items m−3 in water samples and 35.8 ± 25.7 mg kg−1 or 318.9 ± 246 items kg−1 in sediments. It shows that this river is severely 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 54:38:8%, 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 Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~1 nt) 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 carriage 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 low degradation. About 4.8 to 12.7 million tonnes of plastic waste are released into the oceans each year. Rivers and wastewater discharges may contribute significantly to the contamination of the marine environment. Despite an obvious causal link between the (micro)plastic load of inland waters and marine ecosystems, European rivers have been investigated for the presence of microplastics (MPs) only recently. However, the analytical results of different studies are usually not comparable among each other due to different methods of sampling, processing and analysis of microplastics. In Germany, five federal states initialised monitoring programmes to get a first overview on the microplastic load of inland water systems: Baden-Württemberg, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was performed in terms of microplastics in the water compartment. 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. These results revealed that up to 1.6% of the composite samples 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. Exceptions of the study, focussing 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) intrawinter (P1) and downstream (P2) of an inflow are river 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 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 shallow 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. They are often associated with wastewater treatment plants and centres of population and industry. However, the extent to which they pervade upstream catchments is comparatively underrepresented in the study of freshwater microplastic pollution. Results presented here form part of a year-long project that aims to quantify the spatial and temporal variation of microplastic pollution in rural headwaters and urban rivers that do not receive wastewater treatment effluent across England’s Midlands, as well as in atmospheric fallout. FTIR analysis of three months’ samples identified microplastic particles in 30 litre water samples taken from the headwaters of the River Trent and its tributaries. It has also been used to identify non-fibrous microplastic fragments in rural and (sub)urban atmospheric fallout. Moreover, spherical particles that resemble those used in cosmetic / personal care products have been identified in rivers that do not receive wastewater treatment effluent, some of which have proven not to be polymer-based following FTIR analysis. This brings into question the source, and chemical composition, of spherical particles that have previously been visually identified as plastic spheres likely derived from cosmetic particles. The findings of this study have identified the need for the more extensive consideration of upstream catchments and reaches of rivers that do not receive wastewater treatment effluent in the study of freshwater microplastic pollution. The work conducted here suggests that, though wastewater treatment facilities and large centres of population and industry are suitable predictors of microplastic pollution, the cumulative contribution of headwaters and tributaries are likely to influe a river’s microplastic load.

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

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

Application of our model to different particle sizes, shapes, materials and for varying particle concentrations underlines the fundamental differences between lab and field and allows the transferability between these different boundary conditions.

Air Pollution, Biomonitoring and Human Health (II)

284 Analysis of the contribution of a coal-fired power plant to PM10 concentrations in four sites in Southern Italy
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This study aims to perform a source apportionment of PM10 collected simultaneously in four sites located in the Puglia region (South-Eastern Italy). The
Air pollution toxicology: is it the right time to leave the bench for the field? A case study integrated approach

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Air pollution (AP) is recognized as the most important environmental issue affecting human health. In Europe AP is responsible for 500,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increases in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1). During the last decades several toxicological studies have investigated the molecular biology and air pollutant influence on matter (PM). These studies worked mainly with in vitro or in vivo models exposed to PM samples previously collected on filters, then detached and resuspended in suitable media. This procedure, although extensively applied, has always posed the question about the representativeness of exposed PM in comparison to airborne PM. However, the lack of exposure systems directly working under environmental conditions made this experimental set-up widely accepted. In the last years, also thanks to Nanotoxicology studies, innovative exposure modules have been proposed which are able to convey air-dispersed particles on cultured cells. The majority of the application so far reported, however deal with the exposure under laboratory condition of engineered nanoparticles or other molecules of interest. Here we report the results obtained by the use of A549 cells, the bronchial epithelial cell line, at the air-liquid-interface (ALI) under environmental condition to environmental pollution by means of an exposure module (CULTEX® RFS module). The data demonstrate that the maximal feasible exposure evaluated for the CULTEX® system is representative of the dosimetry calculated for human exposure. The toxicological evaluation evidenced the absence of cytotoxic effects and absence of significant release of inflammatory related cytokines. The data suggest the absence of inflammation induced by particles (carbon). Oxygen radicals released on the differential expression of selected genes of interest. Altogether our results show that the time is arrived to leave the warmth of the laboratory bench and to start toxicological evaluation in field campaign. Although the proposed approach still require an extensive evaluation to assess all the pros and cons we reckon that the toxicological data obtainable under really representative environmental conditions may be more representative to understand the biological processes activated by air pollution.

Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM2.5 in different Italian towns

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Children are a high-risk group in terms of the health effects of air pollution, and early exposure during childhood can increase the risk of developing chronic diseases in adulthood. The aim of MAPEC LIFE (Monitoring Air Pollution Effects on Children; Supporting public health policy project) was i) to evaluate the association between air pollution and cancer risk as well as ii) to propose a model for estimating the global risk of early biological effects due to air pollutants and other factors in children. The study was performed on 6-8-year-old children (n=1,149) living in 5 Italian towns in different seasons. Micronucleus (MN) frequency and DNA damage were investigated in buccal cells of children. Socio-demographic and lifestyle features were collected using a questionnaire. Child exposure to air pollutants was assessed analyzing PM_{2.5} (chemical composition and genotoxicity) and collecting data on air quality. In winter, the 52.7% of children showed at least one MN in cells (0.44 MN/1000 cells). A significant difference was observed among the towns. In spring, MN frequency was lower than in winter (0.22 MN/1000 cells) and the difference was statistically significant. The children living in Torino and Brescia showed a statistically significant increase in MN frequency as compared to children living in other towns. The DNA damage associated with MN in, SO_{2}, SO_{4}, and polycyclic aromatic hydrocarbons (PAHs). Season and town influenced MN. Environmental tobacco smoke and high BMI were positively associated with MN frequency, while adherence to Mediterranean diet was negatively associated. The DNA damage in children was higher in spring (179.02 0.5) than in winter (159.00 0.5) and significant differences were found among the towns. Spring data were higher than winter data. DNA damage was associated with SO_{2} and NO_{2} (winter) and with ozone (complete data-set). Season and town influence the damage. No association was observed with socio-demographic and lifestyle features. The levels of main pollutants were higher in the Po valley in winter. No genotoxic effect of PM_{2.5} extracts was observed using A549 cells while BEAS-2B cells highlighted a light DNA damage in Torino, Brescia and Pisa (winter). The Ames test confirmed the low level of biological effect and the highest mutagenicity in Torino and Brescia. In conclusion, the assessment of biomarkers of early effect in the population is useful for a complete overview of the impact of air pollution exposure and results obtained can be used to propose some guidance for...
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-dispersed spectrometry (SEM-EDS).

The receptor site is located near a steel plant in the Apulia Region, south Italy. A total of 2000 particles were measured by SEM-EDS and based on the morphology and chemical composition they have been classified into the following main groups: Alumosilicate particles; Silicon rich 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. Beside 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.

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, PM41 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 aerosols particles
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Long-range atmospheric transport of polycyclic aromatic hydrocarbons (PAHs) in fine particulate matter (PM2.5) remains a global issue, as transport models tend 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 was studied in laboratory generated α-pinene SOA experiments. Dibenzo[ghi]pDibenzo[ghi]phenanthrene (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
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Autophagy is a ‘self-eating’ system that regulates the degradation of cellular components and is involved in various biological processes including growth and development. However, despite its crucial role in organisms the regulatory mechanism of autophagy remains largely unclear, particularly in invertebrates. In this study, conserved autophagy in the rotifer Brachionus koreanus in response to cadmium (Cd) exposure was verified by measuring acidic vesicle organelles using acridine orange (AO) and neutral red (NR) staining, and by detecting LC3 I/II on Western blot and immunofluorescence. We also demonstrated activation of p38 mitogen-activated protein kinase (MAPK) in response to Cd-induced oxidative stress, leading to the induction of autophagy in B. koreanus. This was further verified by analysis of MAPK protein levels and immunofluorescence of LC3 I/II after treatment with reactive oxygen species scavengers and inhibitors specific to MAPKs. We propose a p38 MAPK-mediated regulatory mechanism of autophagy in B. koreanus in response to Cd-induced oxidative stress. This study will contribute to a better understanding of autophagic processes in invertebrates and its modulation by environmental stressors.

291 Effects of trielosan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus
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Tigriopus (TCS) is an anthropogenic pollutant that has been widely dispersed and detected in the marine environment. However, the effects of TCS in marine invertebrates are poorly understood. In this study, the effects of TCS on life cycle parameter (e.g. mortality and fecundity) along with cellular reactive oxygen species (ROS) levels, GSH content, antioxidant enzymatic activities, and mRNA expression levels of oxidative stress-induced defense genes, were analyzed using model marine copepod Tigriopus japonicus. The no observed effect concentration (NOEC) and median lethal concentration (LC50) of TCS in the adult stage were determined to be 300μg/L and 437.476μg/L, respectively. While the in nauplius stages the corresponding values were 20μg/L and 51.76μg/L, respectively.

Fecundity was significantly reduced (P < 0.05) in response to TCS at 100μg/L. Concentration and time-dependent analysis of ROS, GSH content (%), and antioxidant enzymatic activities, were measured to investigate the antioxidant and cellular defense and detoxification mechanisms in copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP302663 and CYP3037A1) are likely to have a potential role as biomarkers in response to TCS in T. japonicus. This study will be helpful for a better understanding of how TCS affects antioxidant defense and detoxification mechanisms in copepod.

292 The protective role of multixenobiotic resistance (MXR)-mediated ATP-binding cassette (ABC) transporters in biocides-exposed rotifer Brachionus Koreanus
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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 xenobiotic exposure in aquatic organisms. ABC, GTPase transporting (GTPT), 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 role 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 that the 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.
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Unravel the toxicological mode of action of pollutants to non-target keystone species may allow us to model and predict environmental risks of similar acting chemicals. OMICs technologies approaches developed in model
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated Daphnia magna clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and other three having the transporter protein gene ABCB1 mutated. Bi- and tri-allelic del TRH mutants lack serotonin and have their growth rates impaired. Bi-allelic indel ABCB1mutants had lower transcription activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoxetine indicated that effects of this drug enhancing offspring production was independent of serotonin. Acute toxicity test indicated that the transporter ABCB1 is involved in the detoxification of 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. Cockroft, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

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. Soetaert, Central European Environmental Research Institute - UFZ / Effect-Directed Analysis; 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 ten thousands of chemicals among them many non-regulated compounds with 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, Rhine and Holtemme as examples. A specific focus is given on endocrine disruption and mutagenicity. While natural and synthetic steroids were confirmed to play a key role for endocrine disruption, the fluorescent dye Coumarin 47 has been identified as a so far unknown environmental pollutant with great anti-androgenic potency in vitro and in vivo. In a water body with direct impact of industrial effluents individual aromatic 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

298 How to deal with mixtures of pollutants in water resource management? R. Ahlenburger, 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

How to deal with mixtures of pollutants in water resource management? R. Ahlenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology. M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Chemicals in the aquatic environment do not occur in isolation but as mixtures. Their compositions, concentrations and effects are highly dynamic with regard to their temporal and spatial occurrence. Current approaches of the EU water framework directive for assessing chemical and ecological quality do not reflect the emerging challenges. The SOLUTIONS project (Brack et al. 2015. STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Emerging end points. The project (expert group 2015) highlights 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 end points from different sources or complementary information 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 polybrominated 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, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; T. Backhaus, 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, DELTARES; A. Ginebre, CSIC - Spanish National Research Council / Environmental Chemistry; A. Kortenkamp, Brunel University London; J. Munthe, IVL Swedish Environmental Research Institute Ltd; J. Slobodnik, Environmental Institute; K. Toulouli, NIVA / Hydroecology and Risk Assessment; R. 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). It is based on the idea that high data outputs should be prioritised for funds 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 sufficient to protect 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 toxicological monitoring (field observations on so-called biological quality elements), 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, thresholds should be set for risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even one 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 somewhat blocked by significant data or knowledge gaps, mixture components of potential relevance need to be identified and 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
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A toolbox for the detection of ecological impacts of chemicals was developed using a statistically supported, transparent and formalized weight of evidence (WOE) approach. It integrates four lines of evidence (LOE’s): (i) predictive mixture modelling, (ii) effect-directed analysis (EDA), (iii) in situ tests, and (iv) field-based monitoring studies. A systematic and quantitative method was developed for the aggregation of multiple in situ tests into LOE III, using an aggregated response index, which we termed the “average biomarker response” (ABR). The results of the four separate LOE’s are finally integrated using a systematic decision matrix that provides the main overarching conclusions that can be drawn from a given set of data and that pinpoint to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with phototrophic biofilms (periphyton) in wastewater impacted streams. Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential ecotoxological effects by applying a toxicity-driven and WOE approaches. Based on outcomes of this LOE, we hypothesized that clear ecotoxicological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community; (ii) a subsequent upgrade of the STP plant with activated carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfres Freshwater project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

302 Questioning annual average concentrations for plant protection products - TKTD modelling of real exposure profiles
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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’s be exceeded by the Annual Average concentration. While the use of the annual average is questioned under the EU Water Framework Directive (WFD): (i) For most aquatic pollutants the high data demands for a threshold concentration are difficult to comply with. (ii) For highly toxic pollutants and Priority Mixtures of Pollutants in European Freshwaters (PMEF) 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 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 modelled for the TWA. The deviations are on average less than factor 2 for each organism group tested. In addition to mortality for crustaceans and fish, only a small selection of sub-lethal effects was considered, namely reproduction and growth. In water fleas and fathead minnows growth in in situ and downstream of the entry point of a sewage treatment plant plant effluent. These chemical-analytical data were evaluated for their potential ecotoxological effects by applying a toxicity-driven and WOE approaches. Based on outcomes of this LOE, we hypothesized that clear ecotoxicological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community; (ii) a subsequent upgrade of the STP plant with activated carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfres Freshwater project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

303 Revision of 62 Environmental Quality Standards - lessons learned
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Environmental Quality Standards (EQS) are ecotoxicologically based threshold values that aim to prevent harmful effects of pollutants on ecosystems. Similar values exist in Switzerland and the Federal Office for the Environment recently commissioned the revision of existing EQSs for 62 substances to ensure that they are based on the current state of science. This study aimed to analyse the underlying reasons for numerical changes of EQSs and to highlight knowledge gaps. As for the original EQS derivation, relevant data were retrieved from databases, the public literature, and Toxification, including in vivo assays, provided by manufacturers. The reliability and relevance of ecotoxicological data were assessed using the CRED method. EQS derivation then largely followed the EU-Technical Guidance for Deriving EQS. After the revision, 60 AA-EQSs and 58 MAC-EQSs were proposed. The EQS revision did not generally lead to either lower or higher EQSs. AA-EQSs increased in 13 cases (max./median fold change +9.6/3) and decreased in 18 cases (folds ranged from 0.001 to 50.6/1.8) and decreased in 9 cases (22.7/2.4). Most EQSs were derived deterministically, using the assessment factor (AF) method. Due to an increase in data for some
substances, the number of AA-EQs and MAC-EQs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 11, respectively. For AA-EQs derivation, AFs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQs derivation, 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 required because it is associated with the derived EQs, as evident from application of lower AFs and more frequent EQs derivations based on SSDs. This is more likely to make EQs 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 insects. Consequently, on the premise of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicology 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 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 is protective of x% of species. Although variations exist in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the threshold in the European Commission Technical Guidance for Deriving Quality Standards (TGD EQS). However, even if this guidance includes ED properties as a reason for growing concern, it does not properly recommend any specific methodological approach to consider these properties when deriving EQs values. In order to evaluate the usefulness of such a recommendation and the extent to which it should be implemented, a state of the art was conducted. For the MAC EQS derivation, AF were reduced in 5 cases and increased only in one case. 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 required because it is associated with the derived EQs, as evident from application of lower AFs and more frequent EQs derivations based on SSDs. This is more likely to make EQs 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 insects. Consequently, on the premise of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicology data from industry studies and from the scientific literature are presented.

306 The quest for consistent environmental protection: the challenge of variable water quality guidelines between regulatory jurisdictions

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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 for particular uses, such as recreational use and as a basis for setting effluent discharge permits. Historically, most regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQGs within a regulatory jurisdiction and the inconsistent environmental protection levels between regulatory jurisdictions, despite having the same protection goals. Here we will address the veracity of that perception and attempt to understand its source. There is limited consistency in environmental protection, as judged by WQG for the same trace element, across regulatory jurisdictions. The absence of robust protocols (or any protocols that can be reviewed) for the derivation of the major factor as is the inevitable lack of resource and capacity 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 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 internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is best, whether particular features are “appropriate” and can be updated and what views are unhelpful and distracting the point. There have been previous calls for increased collaboration between jurisdictions and even calls to harmonise the derivation methods with the ultimate goal of having a single global derivation process and a single set of global benchmarks. While having a single derivation method and set of benchmarks is a lofty goal it is also extremely unlikely to occur without some sort of “agreement” and collaboration. The current situation is that a single derivation process that takes the most time and effort. At least 90% of the time and effort spent on deriving an EQB is used to assess which ecotoxicity data are suitable and of appropriate quality to use. We therefore advocate that efforts should focus on these methods. Possible ways to reduce effort include: acceptance of other jurisdictions’ assessments; international acceptance of an existing method, developing a new assessment method and establishing an international archive for assessed data. Other components of the derivation process that could also be relatively easily harmonised and would have a significant impact in reducing effort will also be discussed. A realistic plan for achieving these gains will be set
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 Patraikos Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO$_3^-$, NO$_2^-$, NH$_4^+$, PO$_4^{3-}$, SiO$_4$ and chlorophyll 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, Drafonkio P, Assimakopoulou G, Kontoyiannis 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. Haffman, Macquarie University / Evolution and Ecology Research Centre; P. Steinberg, University of New South Wales / Centre of Marine Biotechnology; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; J. Potts, P. Scanes, NSW Office of Environment and Heritage; S.C. Birrer, University of New South Wales; M. Sutherland, NSW Office of Environment and Heritage; V.X. Sim, University of New South Wales; T. Lachnit, University of Kiel; S. Swarup, National University of Singapore; S. Kjelleberg, Nanyang Technological University / The Singapore Centre on Environmental Life Sciences Engineering; M. Doblin, Department of Environmental Sciences / Department of Environmental Sciences; G. Birch, Sydney University / School of Geosciences; P. Gribben, University of New South Wales; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre. Estuaries are diverse and productive ecosystems that are subject to high levels of disturbance. They are exposed to multiple stressors such as legacy contaminants in sediments and ongoing inputs of nutrients and metals via stormwater, but we still have little understanding of the consequences for ecosystem functioning. We surveyed sediment communities at four locations with large stormwater drains in Sydney Harbour, Australia. Locations were either poorly-flushed embayments or well-flushed estuarine channels. Sediment cores were collected monthly during base rainfall (<5mm/day) for 4 months from 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 phosphate. Sediment cores were also collected to assess any 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 micrometazoan 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 levels of aridity and drought are expected to stress and change 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 micrometazoans 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 micrometazoans 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 weeks of experimental conditions). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoan 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 diversity was dominated by micrometazoans 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 (p < 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (p < 0.001 Dunnet’s test). Taking into account community diversity and community structure was the most important factor causing the 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 micrometazoan and ciliate 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 polyunsaturated fatty acids (PUFA) that are needed for organisms at higher trophic levels in river food webs. This study aims to assess the effects of pesticide mixtures on periphyton quality in situ. Three streams (Höje å, Skivarpsån and M42) located in the agriculturally dominated region of Skåne (SE Sweden) were sampled in September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpsån and M42 than in Höje å. Ecotoxicity tests using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Höje å, causing an inhibition of the photosynthetic activity up to 63% and 53%, respectively. Cluster and principal component analyses based on pigments content, algal diversity and fatty acid profiles, clearly separated the periphyton from the three river sites studied. Algal biomass from periphyton of pesticide polluted streams (Skivarpsån and M42) was higher than in Höje å. The nutritive quality of the periphyton differed among streams, and fatty acids considered high-quality such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were also more abundant in pesticide polluted streams (Skivarpsån and M42). Overall, even though results from the lab show that the mixture of pesticide pollution in the studied...
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 trioclosan mixture alters soil metagenomics during degradaton 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 its consequences for soil microbial community processes are poorly understood. Estrone and trioclosan 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 trioclosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, trioclosan, and a 1:1 mixture of estrone:trioclosan, 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 trioclosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (trioclosan). The rate of degradation of the binary estrone:trioclosan 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 day 90 treatments. Soil microbial communities are adept at degrading estrone and trioclosan in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of groundwater.

313 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- and region-specific specific LCI data based on an extensive literature survey and 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 L. Passarini, 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 this study, we examine the principles and potential and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling economic function not economic indicators calculated to total cost the resulting energy savings and greenhouse gas emissions reduction. The results show that copper recycling can contribute significantly to reduce the energy requirements and mitigate greenhouse gas emissions associated with the regional copper industry. However, for three out of the four scenarios the current recycling performance seems not to be enough to close the copper cycle. Fundamental constraints are likely to limit the implementation of a circular economy unless dramatic changes occur in the current pattern of copper production, consumption and recycling at end-of-life.

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

317 The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax B. Timmermans, Alma Mater Studiorum - University of Bologna; W. Achten, Université libre de Bruxelles / Department Geosciences, Environment and Society The purpose of this presentation is to provide a short insight about a study examining the principles and feasibility of a shift from Value Added Tax (VAT) or sales tax to a Damage and Value Added Tax (DaVAT) partially based on the life cycle assessment of products and services. With this shift, goods and services that seriously harm the environment and human health will be priced up, those that have less impact will be priced down. The DaVAT system relies on three essential
318 Towards global guidance on LCIA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force T. Sonderегgger, ETH Zurich; M. Berger, Technische Universitaet Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treene Ltd.; J. Guineau, University of Leiden / Institute of Environmental Sciences; C. Helbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHITA, National Institute of Advanced Industrial Science and Technology; S. Norey, Technische Universität Berlin / Chair of Sustainable Engineering; A. P. Wassenaar, Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; 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 relative or absolute impact categories (e.g. acidification, photochemical oxidation, eutrophication, ecotoxicity). However, 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 entropy 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 newly well customized into LCIA method should be and how problems related to resource use (provisioning capacity, availability for future generations, etc.) can be best 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.

319 Poster spotlight: TU214, TU215, TU237

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

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

321 Framework for the optimal design of sustainable chemical processes A. Gonzalez Garay, R. Calvo-Serrano, G. Guillén 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. 1) Silica acts as dispersing/diluting matrix for decreasing the production of ROS, but improving the photocatalytic performances of pristine sample; 2) Silica act as reservoir for Ag+ ions, decreasing the amount of immediately available fraction and so improving the concentration range where the sample shows antibacterial properties despite to negligible cytotoxicity.


Reuse and recycling of products are key elements towards a sustainable and circular economy. Besides the circular economy policy, a non-toxic environment is being pursued as well. Care should be given to the reuse and recycling of waste streams containing substances of very high concern (SVHC). Ideally, the presence of SVHCs in the design and production phase should be prevented by applying Safe-by-Design alternatives. However, we have to realize that we are still in an era in which we are faced with numerous (legacy) SVHCs in waste streams. For these waste streams, safe ‘end-of-life’ solutions have to be found in order to stimulate the circular economy and safeguard a non-toxic environment. Within this study, we develop an extended general framework to decide how waste streams with legacy SVHCs should be managed. The framework is specifically developed for the licensing process and provides guidance to license applicants and license authorities in the Netherlands. By following the framework, it will indicate whether the recycling of a specific waste stream into a specific end-product can be considered as acceptable with respect to the SVHC content. In principle, the use of this framework consists of three steps: 1) identification of SVHCs in the waste stream; 2) a basic decision scheme in order to decide whether a more elaborate risk analysis is necessary or whether the risks can be considered as acceptable; and 3) a risk analysis. Within the risk analysis, the acceptability of recycling will be assessed by weighing various aspects, including: availability and feasibility of SVHC removal possibilities, exceedance of SVHC concentration limit values, potential SVHC exposure of man and the environment, and the traceability of the material stream (including SVHC) during the whole life cycle. This framework is a first step to improve and warrant safe and sustainable recycling of waste streams. Future adjustments of this framework will be required in upcoming years based on practical experiences of...
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 Emissions of PFAFs and alternatives from the durable water repellence layer (DWR) of textiles during use
Ly Veen, Institute for Environmental Studies (IVM) VU University Amsterdam / Chemistry and Biology; A. Hanning, Swerea IVF AB; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, 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, PFAFs have been used because their perfluoralkyl chains have the ability to repel liquids of a wide range of polarities (e.g. water and dirt repellent). DWR compounds, like PFASs and silicones, are emitted to air, as well as to rain water and washing water. During the use phase of outdoor clothing, DWR chemicals are emitted to the environment.

324 Chemicals in plastic packaging: Prioritization of hazardous substances
K. Groth, Food Packaging Forum Foundation; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences; B. Geueke, Food Packaging Forum Foundation; A. LENNOQUIST, Chemsec; H. Leslie, VU University Amsterdam / Environment&Health; J. HANSSON, Food Packaging Forum Foundation; A. VOLPI GHIRARDINI, University of Gothenburg Sweden / Department of Biology and Environmental Sciences Informatics and Statistics.

Plastic packaging is increasing globally, causing rising 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 during use, disposal, and recycling of the packaging material. Occupational exposure during plastic packaging manufacture is also relevant. One of the main obstacles to assessing the risks of chemicals originating from plastic packaging is the absence of information on the materials' exact chemical composition. In order to provide an overview of the chemicals associated with plastic packaging, we compiled the Chemicals in Plastic Packaging Database (CPP-DB), which comprises unique substances with additional substance-specific information such as usage data, physico-chemical properties and uses. The CPP-DB includes plastic monomers, additives, and other substances used during plastics manufacturing, such as solvents and raw materials, and the main non-intentionally added substances (NIAS) such as impurities, reaction by-products or degradation products of e.g. polymers and stabilizers. We ranked the substances in the CPP-DB according to their hazard for human health and the environment, using Classification and Hazard Designation (CLP) hazard categories, and also including endocrine disrupting properties and PBT (persistence, bioaccumulative and toxic) characteristics. Due to the lack of empirical hazard data for many of the substances in the CPP-DB, we also used in-silico tools to bridge data gaps. In this presentation we will use the CPP-DB to present an overview of chemicals associated with plastic packaging, their hazards for human health and the environment, and we will highlight priority hazardous chemicals for substitution. Finally, we will discuss the research needed to allow for a more robust hazard characterization and ranking.

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

Innovative nano-enabled products can overcome some issues of the traditional renovation 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 “NANOESTAR” project, a stepwise SbD framework for the sustainability assessment of nano-based products for restoration has been proposed, taking into account the current EU legislative context as well as the specific features of the innovation process in the restoration field. The proposed framework embraces the SbD concept proposed by NANOReg initiative, which uses the Cooper Stage Gate innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state-of-the-art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self-classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post-application stages, while the manufacturing stage cannot be included until the industrial scale-up has been finalised. The SbD framework is currently being applied to NANOESTAR advanced nano-based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three bioassays: acute toxicity, static aquatic toxicity, and acute aquatic toxicity, (iii) a set of tests for cytotoxicity, DNA-damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long-term behaviour of products in post-application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Recent developments in environmental risk assessment for pollinators
326 Pollinating 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 summer forage areas for a honey crop. The areas of conflict for bees in agriculture encompass the urban and rural landscapes and the insect pest management strategies. A third of the US honey bee colonies, which are responsible for crop pollination, are lost due to parasites, 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 health or pest management, there are multiple use issues. Whether it is health or the environment, these issues can be better addressed if we work together. Pesticide manufacturers must address how the end user interprets the directions for use, and the cultural practices of the products. Regulatory agencies must acknowledge the pesticide end user’s cultural practices of tank mixing pesticides, of fungicide and herbicide impacts upon pollinators, and to combine their agency efforts to protect the entire farm, not just each single crop from each single pest. Sustainable land management strategies from 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
327
A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment
A.C. R. Sharp, C. Szentes, D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit
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 species. 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 qualitative way. Effort was also made to desegregate the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining qualitative judgment. A 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 qualitative way. Effort was also made to desegregate the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining qualitative judgment.

330
Standardization of an in vitro larval rearing method for stingless bee species Melipona scutellaris for use in toxicological bioassay studies.
Brazilian stingless bees are compared. Some significant differences in susceptibility to pesticides between Bombus species have also been identified. It is concluded that there are significant gaps in current knowledge for bumble bee species on both realistic levels for some key exposure routes and cumulative exposure that are not accounted for in the current Apis risk assessment protocols.

329
Industry research and approaches to improve the bee risk assessment scheme in Europe
E. Pilling, Dow Agrosciences / REGulatory Sciences; M. Miles, Bayer CropScience UK / Environmental Safety; A. Alix, Dow Agrosciences / Risk Management; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; N. Ruddle, Syngenta Ltd / Product Safety; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; A. Sharples, FMC Agricultural Solutions; G. Weyman, ADAMA; L. Oger, ECPA
The crop protection industry recognizes the need to review the bee pollinator risk assessment based on scientific progress. However, the draft EFSA Bee Guidance Document is not a realistically feasible way forward. It is based on extremely conservative assumptions, its study requirements lack clarity and are not workable and guidelines for a number of studies are unavailable or not validated. Industry therefore believes that a revision of the assessment scheme for use by regulatory authorities is needed. Building on an analysis of the proposed developments in the EFSA Bee Guidance Document, we suggest proactive and practical approaches based on analysis of existing data generated thus far on honeybees Using the existing laboratory chronic toxicity data, a meta-analysis was carried out to identify the relative importance of each exposure route and cumulative exposure that are not accounted for in the current Apis risk assessment protocols.
Understanding human and environmental exposure to chemicals in urban systems

332 Consumption of products - a proxy for changes in chemical flows in urban areas and to the environment? E. Usedom, D. Bolinns, Stockholm University / Baltic Sea Centre; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. Löf, Stockholm University / Baltic Sea Centre

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

333 High-throughput assessment of use-phase exposures to chemicals in building materials L. Huang, University of Michigan / Dept of Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; O. Jollet, University of Michigan

Building materials have important contribution to the chemical exposure of the US population. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PiF, to assess consumer exposures during product use, i.e the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharos 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 10^10 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 characterization factors 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 T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; Y. Adjei-Kyereme, University of Toronto / Earth Sciences; C. Yang, University of Toronto / Department of Earth Sciences; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control; L. Jantunen, Environment and Climate Change Canada; M. Diamant, University of Toronto / Department of Earth Sciences

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 10s 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 data. "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 referred to the TPCH and TPhP, respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liakouridis 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 and from residential OPEs from indoor 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. Indoor 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 receptors for these molecules. Pharmaceuticals can be referred to the TPCH and TPhP, respectively. The relevance of these estimates in comparison to real world temporal variations in pharmaceutical exposure has yet to be determined. In this study we attempt to quantify and understand the drivers behind spatiotemporal fluctuations in the concentrations of pharmaceuticals in a city system. Monitoring data for 33 pharmaceuticals were obtained monthly at 11 sites in two rivers that run through the City of York, UK. This data was compared with local monthly prescription, tourism and flow data. In the smaller River Foss, a strong relationship was found between measured concentrations and prescription amounts divided by flow. This trend was not replicated in the larger more urbanised River Ouse. Analysis of pharmaceutical loads indicate that seasonal differences exist in the Ouse, but not in the Foss. Seasonal variability in WWTP removal efficiency is expected to be a factor. In-stream losses of up to 75% were found in the River Foss during summer months and all pharmaceuticals studied followed a sinusoidal loss pattern through time. Significant losses were not identified in the River Ouse. Finally a risk assessment indicated that risk quotient ratios can vary over 3 orders of magnitude (paracetamol) throughout the year and the highest risk areas are around paracetamol and loratadine, are temporally transient. Identification of exposure drivers at this unparalleled spatiotemporal scale provides important information that may help improve the accuracy of exposure models and help ensure risks are not overlooked.

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 E. Terzagh, University of Insbruck (Com) / Department of Science and High Technology, Com; M. Morselli, University of Insbruck / Department of Science
Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (III)

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. Wanja, University of Toronto at Scarborough / Physical and Environmental Sciences

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 to human 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 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. Werner, Empa Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, EMPA

Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwaters. Assessing the emissions of plastic is possible using a life-cycle oriented approach, and permits to compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in European rivers. The new approach of Probabilistic Material Flow Analysis (PMFA). The environmental flows of seven different commodity thermoplastics are estimated based on societal data. The polymers are chosen for their popularity of use and the frequency at which they are reported in the environment: low-density polyethylene (LDPE), high-density polyethylene, polypropylene (PP), poly styrene (PS), expanded polystyrene (EPS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). The probabilistic aspect of the PMFA framework permits one to account for the various uncertainty sources and give a quantitative estimate of the final confidence in the results. In a first step, the anthropogenic life cycle of these seven polymers is modelled, from production to end of life of a total of 35 product categories. Various trade flows are included, as well as the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss contributions. 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 pollution sources and the possibilities for pollution mitigation.

339 Modelling Microplastics in Rivers in the US

A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; C.M. Holmes, Waterborne Environmental

P. Wilson and H. La Porte, University of Toronto at Scarborough / Department of Environmental Sciences

Field routes to microplastics are receiving increasing attention as a major source of exposure to important plastics. However, few models and simulations have been developed to help assess their potential uptake and transfer through food chains can contribute to providing l

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

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

Plastic contamination of freshwater sediments is well documented, and whilst qualitative measurements of route-specific fluxes in sediments are known, the relative contributions of these pathways is not well known. Here, we use a combination of stable isotope and polymer-specific markers to examine the relative contributions of each uptake pathway. The results show a range of contributions, with each pathway potentially being more important than previously thought.

SETAC Europe 28th Annual Meeting Abstract Book
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 fluorocrylylyd nanopolymer (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 nanoplastic mobility and accumulation. Results indicate that pristine nanoplastics and nanoparticles transformed with waterborne exposures and from dietary uptake of a nanoplastic associated algal food source, with carboxylated and aminated 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 nanoplastics to solids constituent of the sediments. Ongoing work addresses the potential for formation of an “ecocorna” 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 a 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 (ATP); cellular proliferation (DNA); as well as enzyme (ACE) and immune response (phenoloxidase). Exposure to PE 40-48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagos 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; 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 biofilm formation on these two different microplastic particles. Therefore our results highlight, for the first time that differences in additive composition (absence or presence of a plasticizer) can lead to substantial differences in effects on aquatic species.

When ecotoxicology meets trophic ecology

343 Poster spotlight: TU149, TU150, TU151

344 Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food chain
E.L. Fernandes, University of Koblenz Landau; B. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences

Pollution is a major driver of ecosystem change resulting in alterations in food webs and functional ecosystem processes. Some pollutants such as systemic 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. 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 as emergent-pollutants risk-assessment tools
h. baveco, Wageningen Environmental Research; J. Denner, Wageningen Environmental Research / Aquatic Ecosystems; S. Faust, Wageningen Environmental Research / Aquatic Ecosystems; J. van Gils, DELTAES; C. Lindum, Stockholm University / SEAC; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team

In the context of the SOLUTIONS EU FP7 project, we applied non-steady state bioconcentration models to predict concentrations of organic compounds in fish. A foodweb perspective was taken, accounting for uptake from water as well as from food, and accounting for different trophic relationships for several fish species used for human consumption. The foodweb bioconcentration model will be applied for a large number of emerging pollutants and a large number of locations (around 25,000 sub-catchments in the major European catchments). Water concentrations at these locations are obtained from chemical fate modelling using the STREAM-EU model. As a case study, results for 24 WFD priority substances are presented here. Predicted concentrations will be input to human health risk assessment. The model also provides insight in how trophic relationships together with species and compound characteristics determine bioconcentration and thus ecotoxicological risk. The core of the foodweb model is a bioconcentration model for neutral and ionisable organic compounds (Aarno & 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

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

Because dietary uptake of fish is often a major vector of human exposure to persistent organic pollutants (POPs), much effort is directed towards a quantitative understanding of fish bioaccumulation with the help of mechanistic models. Such models require the input of the growth, feeding and respiration rates of a fish. However, often little consideration is given to the 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 rates and diets for lake trout (Salvelinus namaycush) at Lake Ontario were calculated to estimate the trophic position of lake trout and the ground dwelling spider Tetragnatha sp. and the ground dwelling spider Tetragnatha sp. to analyse their stable carbon, nitrogen, and fluorine isotope ratios.

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

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

Riparian areas in Central Europe are linked to streams via fluxes of material and organisms. Agricultural land use related stressors can differentially alter arthropod communities in water and on land, resulting in complex response patterns of aquatic-terrestrial predator prey relationships. Therefore complex response patterns may arise in terrestrial predators feeding amongst others on aquatic prey. While aquatic landscapes in most European countries have been intensified, resulting in the co-occurrence of pesticide use, habitat degradation and excessive nutrients, traditional low-intensity agriculture can still be found in Central Romania. We investigated the potential effects of land use related stressors including pesticides on aquatic-terrestrial predator-prey relationships using stable isotope analysis. We sampled spider communities and measured their intake of aquatic prey in 19 riparian areas around Cluj-Napoca, Romania. To investigate the spiders’ diet, aquatic and terrestrial prey organisms were caught. We collected the orbweb Tetragonatha 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 in turn resulting in a larger biomass of emerging insects. The 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 T. tetragnatha 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 gOOSE

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

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 sample collections) was collected at different sites along the goslee_s flyway. Resightings of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon (δ13C) and nitrogen (δ15N), 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 related to PCBs, but emerged POPs like perfluorinated substances due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs from different lakes, and not for PCBs. Protein associated pollutants (PFASs) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

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

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

Several types of legacy persistent organic pollutants (POPs), such as PCBs and DDEs, but not for POPs like perfluorinated compounds are released from multiple sources into the ambient environment and are known to negatively impact endocrine and physiological functions within exposed wildlife. Protocols to assess bioaccumulation of these persistent chemicals within terrestrial systems are far less developed compared to aquatic systems. Presently, regulatory agencies in Canada, the USA, and the EU use only bioaccumulation information for fish to assess the bioaccumulation potential of POPs to aquatic wildlife. However, there is growing evidence that some chemicals that are not bioaccumulative in aquatic food-webs do biomagnify in terrestrial food-webs. To better understand the bioaccumulation behaviour of chemicals in terrestrial food-webs, we aim to produce a food-web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk. Over 100 samples were collected from various trophic levels of the food-web including 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 δ13C and δ15N 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 54.6, 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

75

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Toxicokinetic-toxicodynamic models as new tools for environmental risk assessment

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

Today, the Environmental Risk Assessment (ERA) for chemicals is based on fitting standard dose-response (DR) models to quantitative data. Such data are usually collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (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 also assume that the exposure concentration remains constant during the experiment, which makes it difficult to extrapolate the results to more realistic scenario conditions, for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxicodynamics (TKTD) models is suggested, because TKTD models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TKTD models have many advantages in terms of mechanistic understanding of the chemical mode of action, of deriving time-independent parameters, of interpreting time-varying exposure and of making predictions for untested and variable-time exposure. Another advantage of TKTD models for ERA is that they make it possible to calculate any LC/ECx, for arbitrary effect strength x and any given exposure duration t. Nevertheless, being based on differential equations their mathematical complexity makes it necessary to numerically integrate the equations when fitting the model to data, so that in practice TKTD models are still not used, there are some attempts to allow users to fit TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘mosaic’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS) [3]. Handling GUTS models for TKTD will be then illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

351

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

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Estuaries are major recipients of run-off pesticides from agricultural and urban origin, including neonicotinoids and nano-based copper formulations. Neonicotinoids have rapidly become the most widely used insecticides globally, and have been implicated for harming pollinators and non-target species at levels below existing US EPA toxicity thresholds. With most research conducted on isolated laboratory systems, there is scant data to allow us to use TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘mosaic’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS) [3]. Handling GUTS models for TKTD will be then illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

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 repetition: new born juveniles (10-15 mg), juveniles (90-110 mg) and large juveniles (260-340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetics-toxicodynamics model (based on growth and differences between development stages) coupled with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 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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Comprehensive and efficient management of ecological risk depends on our ability to quantitatively extrapolate the effects of stressors across levels of biological organization. Adverse Outcome Pathways (AOPs) connect sub-organismal mechanistic molecular data to organismal outcomes, while bioenergetics models, such as Dynamic Energy Budget (DEB), can extrapolate from individual- to eco-levels of toxicant exposure. However, the connection between the two modeling frameworks remains a challenge. The molecular mechanisms underlying Key Event (KE) relationships defined in AOPs are often poorly known, even for well-studied compounds; thus, the mechanistic linkages between KEs and effects on DEB processes are often difficult to discern. Further, AOPs whose adenine nucleotide is lethally depleted (e.g. the P450 ROD pathway) are important for bioenergetics. We address these challenges through theoretical and empirical efforts. We connect AOP KEs to DEB processes through a model of damage dynamics. The model predicts regulated but increasing concentrations of damage as the result of toxicant exposure and also tipping points when damage outpaces regulatory feedbacks, leading to mortality (Klanjecsek et al. 2016). The connection between damage dynamics and DEB will be influenced by empirical and theoretical observations, but potential linkages include damage causing an increased maintenance cost or specific impacts on development. Specifically, we are studying the effect of DLCs on Fundulus heteroclitus (Atlantic killifish). DLCs are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through terrestrial and oceanic stressors, but the AHR pathway is understudied. The model will help to quantify this. Further, sublethal effects of DLCs are less studied, but preliminary data indicate that sublethal PCB1216 exposure leads to slower growth in larval killifish (Nacci unpublished data). Therefore, this system offers a framework to test our ability to connect effects observed at the suborganismal level to bioenergetic processes through AOP and DEB modeling. We will measure suborganismal effects of DLCs (cytochrome P450 activation & transcriptomics) along with effects on development, growth, and reproduction. We will give an overview of our objectives and methods and report preliminary findings fitting DEB models and predictions of the effect of DLCs on the bioenergetics of killifish.

354

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

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We are investigating best approaches to utilizing in vitro derived toxicity data for estimating impacts on reproduction in trout and salmon. Our goal is to facilitate development of quantitative in vitro – in vivo extrapolation (IVIVE) methods to support adverse outcome pathway (AOP) based toxicity testing. We tested a diverse suite of toxicants using cellular assays based on the female rainbow trout pituitary, ovary and liver. Each assay measures an essential reproductive endocrine function
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-hydroxytamoxifen), prochloraz (interferes with oocyte maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and trenbolone (potent synthetic androgen). A single water exposure level was tested for each chemical, guided by preliminary studies and a desire to use a maximum tolerated exposure that still allowed spawning to occur. Laboratory exposures began 10 d after the first spawning cycle and lasted until time of ovulation and completion of the second spawning cycle 12-14 months later. Trout were euthanized and total fecundity determined along with egg mass and diameter, fertility, hatching success and larval growth. Results indicated no effect on fecundity was observed except after the 60 ng/L trenbolone exposure, which caused regression of 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 atractic / 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 acanthocephalan parasites

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Fish are affected by both exposure to metals and parasites. Each of these stressors may have effects on the response of fish to the other. Some efforts have been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our previous model allows for investigating the relationship between the accumulation in the whole fish and in the acanthocephalan, but does not include the mechanisms how metals are accumulated in parasites. Physiologically based pharmacokinetic (PBPK) model has been used for simulating the organ-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 acanthocephalan Pomphorhynchus treticollis. The acanthocephalan 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 uptake/sequester 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 Ag in fish-parasite systems. For example, the model could simulate the changes in the concentration of Ag in these compartments depending on 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 the blood and in the acanthocephalan. 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 it can simulate the truly “emerging” chemicals and for large numbers of chemicals (“real world exposure scenario”). The approach is validated for well-studied substances and data-rich basins. On this basis we learn how 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 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 predication of chemical and ecological monitoring results, lend a 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 being used to predict chemical and ecological monitoring results, hence providing the means to elucidate possible chemical impact on the ecological status of European water bodies in a retrospective way. Ecological modelling provides an alternative approach to 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 model project STREAM-EU, which are applied to link exposure dynamics of a number of chemical compounds to parsimonious individual-based population models. The STREAM-EU model provides exposure concentration levels 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 pairs of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

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

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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 surface water systems, and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g. a Mixture Assessment Factor and environmental management policies such as EU Directives. 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 proactive steps, such as the EU project MARS (Mixing Aquaculture 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.

359 Unravelling the cocktail of stress: toxis and other stressors impacting on the ecological status of Europe's rivers

S. Birk, University of Dunsburg-Essen / Aquatic Ecology; V. Bremerich, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; O. E. Direct, DZ Ecotox / Centre for Sustainability Environment and Health; M.F. Sanchez, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; L. Globenik, M. Koprvsek, University of Ljubljana / Faculty of Civil Engineering and Geodesy; J. Lennm, University of Dussburg-Essen; J. Mahnkopf, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; Y. Panagopoulos, National Technical University of Athens / Laboratory of Hydrology and Water Resources Management; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; K. Stefanidis, National Institute of Public Health and the Environment; M. Venohr, Leibniz-Institute of Freshwater Ecology and Inland Fisheries Water management requires solid understanding of how multiple stressors affect ecosystem state and survival. The EU project MARS (Mixing Aquaculture and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. This paper presents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in surface water systems, and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g. a Mixture Assessment Factor and environmental management policies such as EU Directives. 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 proactive steps, such as the EU project MARS (Mixing Aquaculture 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.

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

A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Fischer, Utrecht University / Copernicus Institute of Sustainable Development; J. van der Hoek, Technical University Delft / Water Management Chemicals of emerging concern (CECs) in the water cycle have become the focus of research aimed at providing solutions for currently used additives such as phthalates, PFCs, flame retardants or nanomaterials but may also introduce new substances with negative impacts on aquatic ecosystems. Four societal sectors have been identified where major changes within the next two decades can be expected which have potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these future 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 solution-focused approach, where the same approach is taken for all chemicals, is the 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. Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (I)

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

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Climate Change Canada; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre; K. Korbel, Macquarie University; D. Lapen, University of New South Wales; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; W. Monk, Environment and Climate Change Canada; A. O’Brady, Environment Canada; N. Proctor, Environment and Climate Change Canada; K. Simpson, R. Verdonchot, Wageningen University; P. van de Linde, Wageningen University / Aquatic Ecology and Water Quality Management Group

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 experimentally obtained parameters and field data; and
8. Adjust the ecological model if needed.

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

363 Predicting the response of ditch ecosystems to multiple stressors

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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 agriculture 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 sedimentation) 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 biomonitoring data to assess the validity/predictive power of the model. We 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

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Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong link 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-contaminated ditches, they may affect the invertebrate population and community responses. To this end, we exposed caged organisms and naturally assemblaged 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 performed outdoors. We found adverse effects of thiacloprid on several population responses at concentrations that were comparable or far lower than laboratory derived LOECs as obtained from literature. These effects were less pronounced when organisms were exposed under nutrient enriched conditions. In addition, we observed significant dissimilarity between the naturally assembled communities under the influence of both thiacloprid and nutrients. These shifts were largely represented by a severe decrease in insect abundance under thiacloprid exposure. This decrease was not observed in ditches that received both thiacloprid and nutrient application. Thus, we showed 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 Macrophytovertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams

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Pesticides from agricultural usage are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide application. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Romania (Buzau County), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on biological control (bio-control). We assessed that, in contrast to pesticide toxicity, excessive nutrient and sediment input would be unrelated to agricultural intensity. Consequently, this would allow distinguishing effects from pesticides and these 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 examined 19 low-order streams across a gradient of agricultural intensity in terms of average field sizes. Pesticide concentrations were investigated using two different passive sampling methods. Firstly, we used styrene-divinylbenzene (SDB) disks to sample hydrophilic compounds, which enabled the determination of approximate time-weighted pesticide concentrations in streams during heavy rainfall events. Secondly we used polyaniline film sheets (PANI) to measure the toxicity 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 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 relation 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

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Synergistic interactions between pesticides in mixtures and between pesticides and warming may improve the efficacy of vector control. Particularly, synergistic interactions between biopesticides 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 biopesticides, 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 measured effects on larval body weight, 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 toxicity profile of the CPF-Bti mixture. For example, the presence of large DTV removed the antagonistic interaction effect on total mortality which was present in the absence of DTV and in the presence of small DTV. Our results underscore the importance of considering DTV as a factor shaping not only the toxicity of pesticides but also the interaction type between pesticides in mixtures. Given DTV occurs in all natural populations and may strongly differ between latitudes, DTV may be an important factor causing a mismatch between toxicity studies done in the lab at constant temperatures and the toxicity of pesticides and their mixture in the real world.

367

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 (CPM). 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 behaviour of plant effluents was evaluated at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation by ozone and chlorine. Highly polar PMOCs such as adamant-1-amine (Log D = -2.34), trifluormethanesulfonate (Log P = -3.35) and 3-coprocolactam (Log P = 0.15) were not removed by PAC even for very high doses. Only naphthalenesulfonate (Log P = -0.41) was fully removed for 5 mg L⁻¹ PAC. The other PMOCs i.e. aromatic sulfonates, aromatic cyanides, 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 cyanides, the 1,3-di-p-tolyglycylamide and the 1,3-di-o-tolyglycylamide, an olefinic sulfonate and an amine compound, the N-benzylendimethyamine, 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 chlorpyrifos is not the most toxic chemical in drinking water. Some PMOCs like 3-coprocolactam, halogenated methanesulfonates, adamant-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor by ozonation. The behaviour of most of these substances under ozonation is strongly different 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.

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

368

RPLC-HICILC 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 gas chromatography (GC) 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-HILIC) 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 -42. 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 strategies 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 among environmental samples like “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant effluent samples) or highly polar compounds (such as phytosterols in biological matrices) that are 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. Greco, S. Grosse, T. Letzel: RPLC-HILIC 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).

369

Removal options and transformations of persistent mobile organic chemicals during production of drinking water

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RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultrahigh-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzotriazole, 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 is true, where passage was well above 50% 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 is responsible. 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.1 If these mobile organic contaminants (MOCs) are persistent (PMOCs) against microbial and chemical degradation, their removal during water and wastewater 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. acetaldehyde, glycolaldehyde) have been extensively studied and monitored2. 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 pollutants3. 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 Arb et al. and Schulze et al. we selected 15 industrial chemicals with a high expected potential to form transformation and study behaviour during hydrolysis, biotransformation, oxidation with MnO4-, 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 elsewhere, the most prominent transformation screening data provides first information about the potential environmental relevance of the identified TPs, which can be used to prioritise 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 limited chemical application domain of regulations: An illustration using the POP screening assessment in the Stockholm Convention. Outgoing from this, we developed several proposals facilitating a harmonised POP assessment, starting from the implementation of an overall POP-guidance up to an inclusion of transformation products in the POP-assessment by all regulatory frameworks. Although it cannot be denied that a harmonisation process is ongoing, we conclude that there are still some fundamental choices to be made both at the organisational level and at policy level first to achieve the goal of a standardised PBT identification among all regulations.

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 fulfil human needs, e.g. the need for light at night provided by a light bulb. Through fulfilment of needs, human well-being is induced. The characterisation of the actual functionality hence boils down to the assessment of this well-being effect. In consequential LCA, not only the consequences related to the needed activities associated with the product life cycle should after all be considered, but also those associated with the benefit induced by the product. In the second part, we specify how a better product benefit characterisation could improve life cycle assessment and its policy support. Three advantages are specified. First, as these functional units are often not specifically defined and a product can have multiple functions, comparison is often impeded in practice. Using a respective product benefit specification allows an identical the same. A better specification of the functional unit in terms of an aggregated single score for product benefit, such as the net impact on human well-being, would permit to compare all types of products. 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 therefore perform a holistic sustainability assessment systemwise 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 dALYs. We also develop a profiling system for 6000+ food items consumed in the US that aligns publically available data from multiple databases with risk factor definitions from the GBD. Finally, for 6000+ food items we estimate the HEalth Nutritional Index (HENI), the total avoided health burden from all dietary risk factors per serving and 100 kcal. Nutritional CFs for food group and food type between -8 avoided dALYs for sodium, up to 57 avoided dALYs for omega-3 from seafood. HENI score typically ranges from -80 avoided dALYs/serving for Frankfurter sandwiches to 50 avoided dALYs/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 and HENI scores for the 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 increasing emissions of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 1/3 of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socioeconomic 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

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

Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what people eat. Our study looks into the monetary values and 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 will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategies, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the revealed reduction in 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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82 SETAC Europe 28th Annual Meeting Abstract Book
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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 adverse health impacts from the resuspension of sediments, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents. 4) Compare the avoided health impacts, i.e., the health benefits, with the created health impacts. For each considered impact pathway, we derived both central and upper bound estimates, using the disability adjusted life year (DALY) as a comparative metric. For the No-Action scenario, the health impacts are 11 and 78 DALY per day, while for the AC remediation, the health impacts are 11 and 20 DALY per day, making AC a more promising alternative. Furthermore, potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. Other studies have used geotextiles to validate efficient bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. For this study, the method was retrospectively evaluated under real-life conditions, with the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaanlärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg/AC/m²). Due to the shallow nature of the lake and its large surface area, highly dynamic sediment movements occurred over the monitoring period of 14 months. As a consequence, the AC cap was buried rapidly under a large amount of unamended sediment, leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The a priori estimated health impacts from these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying amounts of sediment (thicknesses of the overlying sediment ranged from 1 to 40 cm). Endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling Lum. variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling Ch. riparius, this effect could only be observed with minimal sediment coverage of the AC (< 5 mm). 381 Six inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement S. Abel, J. Akkanen, University of Eastern Finland / Department of environmental and biological sciences The application of activated carbon (AC) based thin layer caps is a promising and novel in-situ remediation method for contaminated sediments. The method utilizes the adsorptive capabilities of AC, allowing it to strongly bind persistent organic pollutants, thus greatly reducing the contaminants’ bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. For this study, the method was retrospectively evaluated under real-life conditions, with the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaanlärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg/AC/m²). Due to the shallow nature of the lake and its large surface area, highly dynamic sediment movements occurred over the monitoring period of 14 months. As a consequence, the AC cap was buried rapidly under a large amount of unamended sediment, leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying amounts of sediment (thicknesses of the overlying sediment ranged from 1 to 40 cm). Endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling Lum. variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling Ch. riparius, this effect could only be observed with minimal sediment coverage of the AC (< 5 mm). 382 Ecosafe nanotechnologies for environmental remediation: the NANOBOND project L. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grassi, G. Liberati, University of Siena / Department of Physical, Earth and Environmental Sciences; c. murano, University of Siena; A. Bellingeri, University of Siena / Department of Physical, Earth and Environmental Sciences; a. fiorati, Politecnico di Milano; G. Musso, f. trottta, Università di Torino; C. Punta, Politecnico di Milano
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 ad hoc measures. These potential adverse effects are usually not quantified in a manner conducive to comparing them to potential benefits and assessing overall remedy effectiveness. Focusing on the Hudson River PCBs Superfund Site remediation, this study demonstrates a novel approach to comprehensively evaluate the relative tradeoffs between population health benefits and risks associated with different remedial alternatives. The specific aims were to: 1) Assess health impacts on recreational anglers for a No Action scenario, due to bioaccumulation of PCBs in Hudson River fish, and exposure through fish consumption. 2) Determine and compare the reduction in health impact from reduced fish tissue PCB concentrations associated with different remedial options relative to No Action. 3) Investigate potential health impacts of the selected remedy from resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents. 4) Compare the avoided health impacts, i.e., the health benefits, with the created health impacts. For each considered impact pathway, we derived both central and upper bound estimates, using the disability adjusted life year (DALY) as a comparative metric. For the No-Action scenario, the health impacts are 11 and 78 DALY per day, while for the AC remediation, the health impacts are 11 and 20 DALY per day, making AC a more promising alternative. Furthermore, potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. Other studies have used geotextiles to validate efficient bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. For this study, the method was retrospectively evaluated under real-life conditions, with the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaanlärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg/AC/m²). Due to the shallow nature of the lake and its large surface area, highly dynamic sediment movements occurred over the monitoring period of 14 months. As a consequence, the AC cap was buried rapidly under a large amount of unamended sediment, leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying amounts of sediment (thicknesses of the overlying sediment ranged from 1 to 40 cm). Endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling Lum. variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling Ch. riparius, this effect could only be observed with minimal sediment coverage of the AC (< 5 mm).
been detected at fairly high levels in aquatic systems (0.33–611 ng/L), terrestrial environments (0.53–340 µg/kg), and in the tissue of organisms (4.6–23.6 µg/kg in crop tissues, 61–127 µg/kg in terrestrial invertebrates) (Chen and Ying, 2015; Kinney et al., 2006; Pan et al., 2014). Long-term exposure to the residues of pharmaceuticals could pose a risk to the ecological system and exert adverse effects on human health via food chain (Carvalho et al., 2014). Adsorption processes have a decisive role for the environmental behaviors and the ultimate fate of pharmaceuticals (Drilli and Lyberatos, 2005). However, relatively a few investigations of the sorption of organic compounds at the group level based on the dissociation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trupp, 2008; Franco et al., 2009; Kah and Brown, 2007). The main aim of this study was to explore the effects of properties of the chemical and soil on the removal of some dioxin congeners 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.

385
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 interesting alternatives to remove CLD from outdoor environments. The aim of this study was to develop an in vitro and in vivo assays to evaluate 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 vitro part of the protocol. Finally, ADOP and E20 biochars were chosen to be treated in contaminated soils. Only treatment groups exposed through amended soil with ACs presented significant decreases CLD availability, bioaccessibility (< 8%). Similar results were found using both in vitro assays. At last, concentrations of CLD in 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)

386
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 soil from the bottom of landfills and agricultural lands 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, 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 in all investigated soil samples dioxin-like PCBs were detected, however, in this case 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 was the fact that all 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.

387
Associated Health Effects of Veterinary Pharmaceutical Residues in Livestock 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 modified 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), chlorphenesin (CP), bisphenol A (BPA), 17β estradiol (E2), progesterone (P), 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, 78.62 – 85.47 %; AC, 78.29 – 94.34 %; TC, 88.35 – 92.15 %; CHB, 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 oestrogenic 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.

388
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 preoccupant 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 pesticides inputs to pristine water. Theories of pesticides can be quite expensive and inputs may not be clearly identified or collected. Developing a reliable 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 of 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 wastewaters to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important contamination 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 parathion and veterinary products, especially in low-flow period when the WWTP contributed up to 40% to the overall flow of the studied river. Storm sewers had an intermediate status, with less consequents inputs but are still significant because of lack of treatment on these effluents and a potential increase of concentration around the
discharge site. Investigation in the wastewater network identified uses responsible for introduction of some molecules like fipronil or glyphosate which is essential in order to implement actions of reduction at source.

389 Study of bioconcentration of benzophenone-3 in gill-head Bream and characterization of enantiomers

H. Ziarrusta, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; R. Montes, University of Santiago de Compostela; R. Rodil, University of Santiago de Compostela; J. Quintana, University of Santiago de Compostela; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; U. Iaguirre, University of the Basque Country UPV/EHU / CBER Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; N. Etxebarria, M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plant and Environment. The role of plants in removing organic pollutants is still not well understood. Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environments. However, the role of plants in removing organic pollutants is still not well understood. Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environments.

Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation, and owing to its hydrophobic properties, it could potentially bioaccumulate in aquatic biota, including fish (tens to thousands of ng/g). BP-3 can undergo both photodegradation or phase I and phase II metabolism, generating transformation products and metabolites. Environmental risk assessment approaches often require information on the free concentration in water, bioaccumulation factors in aquatic organisms, by-products and their toxicity in order to determine the effect of a contaminant on ecosystems. Thus, in the present work, in order to assess the uptake, distribution in different tissues (liver, muscle and gill) and bio-fluids (plasma and bile), metabolism and elimination of BP-3 in gill-head bream (Sparus aurata), a controlled dosing 14-day experiment was designed at 50 ng/mL concentration level. BP-3 was detected in all the analysed samples, with the highest concentrations at day 14. Bile concentrations were significantly higher in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ionic compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipidic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolization activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography–high–resolution mass spectrometry allowed the identification of a broad suite of BP-3-by-products in several fish and fish tissue/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified dimethylation, hydroxylation and glucuronidation as the main degradation pathways of BP-3. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the projects CTM2014-56628-C3-1-R and CTM2014-56628-C3-2-R. Xunta de Galicia (ED431C2013/36) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Science and L. Mijangos to the Basque Government for their predoctoral fellowships.

390 Phragmites australis enantioselectively uptake, translocate and degrade the chiral pesticides tebuconazole and imazalil

L. Mijangos, Nottingham University / School of Animal, Rural and Environmental Sciences; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; M.E. Casas, Aarhus University / Department of Environmental Sciences; U.E. Bollmann, Aarhus University / Department of Environmental Science; C.A. Arias, H. Brix, Aarhus University / Department of Biokemi; K. Bester, Aarhus University / Department of Environmental Science. 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 ng/L) of the chiral pesticides tebuconazole and imazalil by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a Bolden chamber 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 fractions and translocation product (TPs) in both hydroponic and plant solutions and plant tissues were measured by HPLC-MS/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 d, 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 enantoisomeric degradation was found in both Phragmites roots and shoots.

391 Effects of the non-steroidal antiinflammatory ibuprofen on growth and metabolic profiles of Vigna Unguiculata

Y. Pico, University of Valencia / Medicine Preventive; R. Alvarez-Ruiz, University of Valencia; L. Wijaya, A.H. Alfarhan, M. Alyemeni, King Saud University; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry. 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 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 5 days post harvest (DPH) and grown in nutrient solution (control, 400 mL of MS medium with 1 g of L-1 of gypsite). The seedlings were incubated in a growth chamber in the dark at 26 °C 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 Lemma gibba. Thirty-eight of the identified metabolites were already reported in a study on cell cultures of A. thaliana and 9 of them (conjugates of ibuprofen 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)

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

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Estimation and prioritization of hospital API emissions
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Hospitals constitute an important source of APIs, particularly for substances like antineoplastics and contrast agents. Measuring these emissions and their impacts is possible, but is very time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-side emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speedisk as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LCMS. Most of the estimated loads were within a factor of 10 of the measured loads. On average, estimations for Hospital 2 were more accurate than for Hospital 1, which was probably due to the use of monthly purchase data and some other small model improvements implemented for Hospital 2. APIs which are typical for hospitals (e.g., antineoplastics and contrast media) were relatively well predicted. The prioritization of the APIs based on environmental impact was substantially influenced by the availability and interpretation of toxicological data. Diclofenac ranked highest, but this ranking was determined by one particular toxicity study of which the validity is being disputed. Ciprofloxacin consistently ranked high, and to a lesser extent also paracetamol and metoprolol. Azithromycin and imipramine also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

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. Since there are currently more than 4,000 different human APIs in use, monitoring individual APIs is practically impossible. The aim of the present study was to develop and validate a model for the prediction of the environmental concentration of APIs for specific per capita consumption data. The starting point for modeling the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewerage system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g. physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.

Development of biotransformation half-life QSAIRs and PBT assessment
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A large number of pharmaceuticals and their transformation products (TPs) found are similar to those of a former study using gamma radiolysis (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 TPs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar responses to confirm the detection of new TPs, which implies their formation during WWTT. 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 WWTT effluent samples. The study was performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Württemberg.
Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress

398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines
G. Gamsjäger, Eurofins Agroscience Services Ecotox GmbH

When results of standard laboratory tests show an unavoidable high risk, aquatic higher tier tests are needed to reduce uncertainties. In case there is a high risk for aquatic plants additional species could help to reduce these uncertainties for risk assessment by performing Species Sensitivity Distribution (SSD) tests. However, it is not clear which criteria are used for selection of test species and which guideline is preferable. Therefore tests for aquatic organisms of non-standard species. Most tests were performed based on the Leucaena guideline OECD 221, the Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum spicatum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatic Macrophyte Risk Assessment Project) group (Miyashita et al. 2010). Further the proposed ring test protocol for the emergent macrophyte Glycera maxima was presented by Jo Davies et al. In addition a high number of forms and reactions of aquatic plants additional species could help to reduce these uncertainties for risk assessment. In algae or lemna plant species for risk assessment. For this purpose they were compared to a plant community model IBC-grass were observed during several years of testing. Some scenarios will be given and an introduction in the complexity of water plant testing for risk assessment will be provided. The focus will be to generate a robust test design which is applicable for most of the water plant species. A proposal for a test design in accordance to the existing guidelines and testing protocols adapted to a broad range of test species will be presented. Based on the EFSA opinion, designs will be discussed and an overview will be given how the test designs can be further adapted to provide a refined risk assessment.

399 Applying the EFSA Scientific Opinion on NTTF: Testing non-crop species and the reproductive capability of selected species under greenhouse conditions

Agriculture is dominating land-use of the EU member states by covering nearly half of the surface area. Using herbicides to weed competition in agricultural agriculture can adversely affect non-target terrestrial plants growing at field margins. According to the recent EFSA Opinion for non-target terrestrial plants (2014) one important goal is maintaining the biodiversity of plant species in the agricultural area. It is therefore recommended to include also non-crop species in the testing scheme from the list provided in OECD guideline 208 and 209. To assess the life-cycle with flowering and seed production. The objective of this study was to assess the viability of generative traits of non-crop species for risk assessment. For this purpose generative traits were evaluated if they provide more relevant information for the risk assessment. For this purpose they were compared with the vegetative traits, such as mortality and biomass production, which are currently assessed in the OECD guidelines 208 and 227. The selected non-crop species are included in commercially available seed mixtures for flowering strips. Our experimental design consists of one control and four different herbicide application rates, with 6 replicates. The field rate was considered as highest. The focus was made on the post-emergence herbicide effects. 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). Predictions of model reliability is high in the mesocosm studies the concept of recovery is even further refined risk assessment. Assessment of recovery of plants from exposure to herbicides based on monoculture dose-responses: Testing the plant community model IBC-grass with experimental data
L. Variegatus, University of Potsdam / Plant Ecology and Nature Conservation; S. Heine, Bayer Ag / Effect modelling; C. Milian, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer Ag / Environmental Safety; F. Jeltsch, University of Potsdam

Ecological models are rarely found in terrestrial plant ecotoxicology and risk assessment. Especially on community-level, the number of suitable plant models is scarce. Existing models are often not validated with experimental data, although the validation of ecological models is an important point 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 EFSA 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 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 the model can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

401 Use in risk assessment of recovery in plants from exposure to chemicals
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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, evaluating the risk of chemicals to plant species involves assessing both lethal and nonlethal effects, but little or no consideration is given to whether the effects at the population or community level are transient or persistent. Considering the ability of plants to recover after the exposure to a chemical is important when evaluating effects on populations conducting a risk assessment. For example, a young plant in a vegetative vigor study may show death damage within a day after it is sprayed, but after two weeks of growth that damage may no longer be apparent as old damaged leaves have senesced and only new unaffected leaves are visible. While it is relatively easy to design studies to assess recovery of vegetative growth in terrestrial plants, this may not be indicative of recovery of the ability of a population of plants to sustain itself. In algae or lema studies, an aliquot of cells can be transferred to untreated media at the end of a test and after several days, the growth rates of the affected groups may approach that of the controls indicating recovery. Recovery in terms of growth rate of these simple aquatic plants is likely to be indicative of a population’s ability to sustain itself. In more complex mesocosm studies the concept of recovery is even further
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, 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

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In the risk assessment for aquatic primary producers exposed to plant protection products (PPP), the endpoint (EP) corresponding to 50% inhibition of growth (EC50) is used in the first tier. The EC50s can be expressed as inhibition of the average specific growth rate (ErC50) or as reduction in biomass, calculated from yield (EyC50) or as the integral under the growth curve (EbC50). The lowest available EP among ErC50, EbC50 or EyC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ErC50s 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 ErC50) shifts thus the level of conservatism of a factor of 6.9 and 3.5 for algae and Lemna 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- to mesocosm studies (considered as surrogate reference Tier 3) are lower than the Tier 1 RACs from standard toxicity tests. The results demonstrate that the intended level of protection is currently reached in only 41% of the cases versus 69% of the cases previously. In addition, this work explores which combination of EC50 (Ec50, Ec10, Ec5 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 OCP 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 such 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 polychlorinated dibenzo-p-dioxins and -furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoralkyl substances (PFAS), 3 isolomers of hexabromocyclododecanes (HBCD), 7 polybrominated biphenyls (PBB), 24 polybrominated diphenyl ethers (PBDE), and 21 alternative halogenated fatty retardants (HFR) such as Dechlorane Plus were determined. Except for POPs 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, dioxins, 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 Sögel (forestry) and Scheyern (agriculture) 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. Schroeder, S. Nickel, University of Vechta / 2

Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss samples were collected at about 7000 sites in up to 36 countries. Most of the moss species were collected from near forest areas. Highest magnitude as those observed in coniferous shoots or deciduous tree leaves from hexabromocyclododecanes (HBCD), 7 polybrominated biphenyls (PBB), 24 dioxins and 2015 or 2016 according to the ESB protocols. Overall, 17 polychlorinated dibenzo-p-dioxins and -furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoralkyl substances (PFAS), 3 isolomers of hexabromocyclododecanes (HBCD), 7 polybrominated biphenyls (PBB), 24 polybrominated diphenyl ethers (PBDE), and 21 alternative halogenated fatty retardants (HFR) such as Dechlorane Plus were determined. Except for POPs 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, dioxins, 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 Sögel (forestry) and Scheyern (agriculture) 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).
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 historical archives in the caver environment that preserves stable isotopes and metals which allows for the determination of historical exposure to contaminants as well as any fluctuations in diet. This research provides the rare opportunity to examine two bat guano deposits from Jamaica: bat guano was heavily mined for gun powder and fertilizer and as such, there are few bat guano deposits that have been unaltered by human exploration or exploitation. The objective of this research is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the 210Pb, 137Cs, and 14C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the δ210Pb, δ137Cs, and δ14C profiles in order to determine the long-term dietary trends in the bat guano deposits. Preliminary results suggest that the 3,000-year-old bat guano deposit is tracking a change in stable isotopes associated with the agricultural history of Jamaica, specifically, the introduction of: nitrogen fertilizers, the Bordeaux mixture, and sugarcane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholesterol and stigmastanol, for example, could be evidence of fluctuations in food availability (0.3 ng/g for South). Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metal contamination has been performed. Metal pollution has been documented for North America, but there is relatively little is known regarding its biotransformation and effects in the species of dragonflies. We characterized the diet of a species of dragonfly (Aeshna pandora) from two sites, when quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (26.0 ng/g wm for North, and 9.3 ng/g wm for South). All substances, except perfluorooctanesulfonic acid (PFOS) were below quantifiable limits. The 3,000-year-old bat guano deposit is tracking the introduction of leaded gasoline. PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult dragonflies were collected and analysed for PFASs and metallic elements. The results indicated that dragonflies from farming areas had significantly lower ZPFAFs concentrations than sites located closer to industrial areas (median 2PFASs of 0.32 ng/g wm (wet mass) for North and 0.16 ng/g wm for South). All sites 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 210Pb within the bat guano deposit in association with the introduction of leaded gasoline.

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

L.P. Endeavora, University of Wollongong / School of Chemistry; A. Holland, La Trobe University / School of Agriculture, Veterinary and Environmental Sciences; and B. Bonnefille, Université de Montpellier / UMR EPOC CNRS 5805; J-Thébault, Université de Bretagne / UMR LERAT UMR 6539; P. Gonzalez, University of Bordeaux / UMR EPHE EPOC CNRS 5805; M. Baudrin, Université de Bordeaux / UMR EPHE EPOC CNRS 5805; and J. Lepel, Université de Paris / UMR 9065.

The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bivalves worldwide. In this study, we aimed (i) to study the processes by which water quality might affect freshwater mussels in situ and (ii) to provide insights into the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The renal transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals, Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect, the water body was classified into 3 age classes. In young, middle-aged and old animals, transcription levels were mainly explained by Cu, Zn and age, respectively. This suggests differences in the molecular responses of this species to metals during its lifetime that must be better assessed in future ecotoxicology studies.

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

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The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bivalves worldwide. In this study, we aimed (i) to study the processes by which water quality might affect freshwater mussels in situ and (ii) to provide insights into the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The renal transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals, Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect, the water body was classified into 3 age classes. In young, middle-aged and old animals, transcription levels were mainly explained by Cu, Zn and age, respectively. This suggests differences in the molecular responses of this species to metals during its lifetime that must be better assessed in future ecotoxicology studies.

LC-HRMS based-metabolomics to highlight biodiversity products and effects of dicyclofenac in Mytilus galloprovincialis

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

Dicyclofenac (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2015/495/EC). However, relatively little is known regarding its biotransformation and effects in the Mediterranean mussel. Environmental metabolomics affords several advantages to study both topics. The metabolome refers essentially to i) the “endometabolome”, constituted by endogenous metabolites, and to ii) the “exometabolome”, in reference to xenobiotics and their biotransformation products [1]. Metabolomics profiles acquired through mass spectrometric techniques may reveal the exposure by direct detection of xenobiotics and their metabolites (xenometabolome) investigation) and effects by the detection of endogenous metabolites which concentrations may differ from physiological levels following the exposure. The metabolome investigation using mass spectrometry, an experiment was carried out whereby marine mussels were exposed for 7 days to ethanol (< 1 %/v/v, vehicle) or to 100 μg/L DCF. Analytical methods relying on Liquid Chromatography-High Resolution Mass Spectrometry were developed to generate metabolite profiles from mussel’s tissues. The obtained profiles for both groups (controls and exposed) were compared. We highlighted DCF and 13 DCF metabolites in exposed mussels. Three of them were phase I metabolites such as...
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 tropothyran metabolism was mostly up-modulated. To our knowledge, such DCF effects on mussels have never been described despite being of concern for these organisms. Atracehalomines 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]. [1] Holmes et al., Anal. Chem. 79, 2629 (2007) [2] Wang & Croll, Aquaculture 256, 423 (2006) [3] Fong et al., Exp. Zool. 267, 475 (1993) [4] Fong et al., J. Exp. Zool. 266, 79 (1993) [5] Efosa et al., Chemosphere 173, 69 (2017) [6] Gröner et al., Chemosphere 166, 473 (2017)

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

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

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

413 Relationships Between Persistent Pesticant 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 (respectively) were assessed for the newborns (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 (VIPs) 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 Integrative Omics 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 invertebrates to its toxicants, and has been selected as a genomically 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 (Bravo500®), 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, organisms were exposed to a natural agricultural soil. To find the reproduction EC50, several dilutions of the formulation were spiked according to nominal concentrations of the active ingredient. For the mechanistic assessment of effects, and to better understand the correlations between omics information through time, organisms were then exposed to the estimated EC50 of the formulation (plus control) and sampled at consecutive time points (2, 4, 7, and 10 days). Four replicates per treatment and time point were used (32 in total). CHT exerts its toxic effects primarily through binding to thiol-rich molecules (ex. glutathione), exhibiting often a multi-site activity and the results with the formulation were very indicative of these mechanism of toxic activity. Also in this study, results point for similar effects of the fungicide formulation mechanism of toxic action involved in detoxification and excretion (also involving glutathione), normal cellular respiration and protein metabolism, leading to impairment in development and reproduction. The datasets presented highly significant positive correlations between the gene expression levels at a certain time-point and the correspondent protein products from the consecutive time-point, thus highlighting the importance of considering a time series approach when interpreting omics data and thus providing useful insights, exhibiting their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

415 Using functional genomics to find mechanisms of herbicide toxicity in Chlamydomonas reinhardtii

A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Betz, Eawag / UTOX

At present, environmental risk assessment of chemicals is limited to measuring physiologival endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best method for gene function discovery is functional genomics based on the concept of single-genome mutants. A large number of single-gene mutations (such as chemical exposure) of interest and mutants which are the most susceptible to the intervention and those that are most tolerant are found. We exposed a pooled library of loss-of-function mutants of Chlamydomonas reinhardtii to three herbicides that target photosynthesis: atrazine and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II, which leads to production of reactive oxygen species. The pooled library was exposed to the EC20 concentration of each herbicide for 3–4 days, at which time samples from the library were taken for DNA sequencing to find mutants that have become enriched or have disappeared from the culture after exposure (compared with non-exposed control). The expectation was that the functional genomic profiles of atrazine and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutants of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defense against oxidative
stressed 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. Pantí, 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, governments, and 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 other 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. Giliacci, 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 contaminants accumulation and the shorter the residence time. Better. Bioplastics do not immediately disappear upon exposure to the sea. Biodegradability depends on the concentration of the environmental stressor and on its residence time in the environment. The lower the concentration and the shorter the residence time, the better. Bioplastics do not immediately disappear upon exposure to the sea. However, biodegradability reduces the risk by reducing the stressor’s residence time. Concluding, the idea of solving the problem of plastics in the ocean just by shifting to bioplastics is groundless (bioplastics does not disappear “by magic”). However, for those appealing to incidental accidents, this may not be the case. For every very probable, biodegradability decreases the environmental risk. Materials that show full and relatively fast biodegradation may be suitable for plastic products known to wear down or become stranded (for example, fishing gear) and scatter into the sea.

**419 Biodegradable plastics: potential application in aquaculture and other applications at high risk of dispersion**
F. Deiuli Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and increasing global investments in prevention, and recovery programs. The bioplastics industry does not consider biodegradability as a license for littering in the environment. All packaging and consumer products must be recovered in some way at their end of use and, in certain contexts, biodegradability allows recovery through organic recycling. This option is contemplated by the European Directive on Packaging and it is beneficial whenever packaging is mixed with food waste (biodegradable plastic). The term “biodegradable” could be misunderstood and induce the consumer to littering. In order to avoid such problem, the biodegradable packaging is labelled “compostable” or “biodegradable and compostable”. The term “biodegradable” is only used in business-to-business communications (e.g., “biodegradable” mulch films are used by professionals who are well aware of the meaning of the term). In agriculture, tests specific to soil define mulch film biodegradation because it is the potential for soil degradation, and eco-biodegradable products are different from composting. Similarly, tests specific to the marine environment are now under development at ASTM and ISO level. Some biodegradable plastics showed biodegradation levels (as CO2 evolution) comparable to cellulose in less than 1 year using these test methods. Generally speaking, the environmental risk depends on the concentration of the environmental stressor and on its residence time in the environment. The lower the concentration and the shorter the residence time, the better. Bioplastics do not immediately disappear upon exposure to the sea. However, biodegradability reduces the risk by reducing the stressor’s residence time. Concluding, the idea of solving the problem of plastics in the ocean just by shifting to bioplastics is groundless (bioplastics does not disappear “by magic”). However, for those appealing to incidental accidents, this may not be the case. For every very probable, biodegradability decreases the environmental risk. Materials that show full and relatively fast biodegradation may be suitable for plastic products known to wear down or become stranded (for example, fishing gear) and scatter into the sea. Bioplastics hold promise for aquaculture professional applications (e.g. nets for mussels 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. Henz, 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...
Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (II)

Biodiversity patterns in the GLOBAQUA basins and their relationships with multiple stressors

D. Bahn, Norwegian Institute for water research; E. Leu, Akvatlaniva AS; F. Pettersen, Eawag Swiss Federal Institute of Aquatic Science and Technology; J. Moe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; D.O. 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 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 common active pharmaceutical ingredients on sperm swimming parameters and consequently fertilisation success. Our results indicate that increased environmental 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.

From individual traits to ecosystem functioning: natural phytoplankton populations 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 neonicotinoid pesticides and 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. Endpoints 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 concomitantly increasing 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. PI 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.

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

Biodiversity patterns in the GLOBAQUA basins and their relationships with multiple stressors

N. De Castro-Catalá, Universitat de Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; I. Muñoz, University of Barcelona / Departament of Physiological Ecology, Evolutionary and Environmental Sciences; E. Kalogjani, I. Karauzas, 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; M. Lopez de Alda, Institute of Environmental Assessment and Water Research; S. Lutz, Hennholz Centre for Environmental Research UFZ; A. Bellin, E. Stella, University of Trento / Department of Civil, Environmental and Mechanical Engineering Rivers suffer from an important decrease in species diversity compared to other aquatic and terrestrial ecosystems due to a variety of stressors related to human activities. Species play different roles in the functioning of the ecosystem, and their species losses may reduce the response capacity of the ecosystems to a stressor. The effects on diversity will obviously differ based on the type of stressors and their combination and severity, as well as on the characteristics of the local community composition, and the community tolerance to the type of stressor affecting the system. This study presents the results of the analyses of the biodiversity patterns for communities, algae, macrophytes, macroinvertebrate and fish communities related to environmental pressures. The data obtained from the field work conducted in three of the Gobaqua case study basins (Adige, Sava and Evrotas) has been evaluated according to structural biological community parameters (species composition and abundance). The most evident relationships between changes in species richness and diversity were explained by changes in hydrology (e.g. mean discharge, intermittency) and morphological changes in the basins (e.g. land uses, channel transformation). The presence of pharmaceutical products (urban pollution) and pesticides was related to lower insect richness. Also emerging compounds, despite their low concentrations, were related with a reduction in macrophyte diversity. These results open the way to compare responses in the studied basins as representative of the European reality of the combined effects of multiple stressors on biological diversity.
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 affect phytoplankton communities with respect to the responses of higher trophic levels. 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 EC10 of individual substances). The mixture included 12 pharmaceuticals and personal care products commonly detected in lakes and rivers in Europe. In addition, a mixture isolated from treated waste water effluents was used as a treatment of its own. Individual level traits (cell size, pigments), community parameters (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 3-weeks experiment. Our results, although preliminary, show that multiple contaminants and environmental stressors acting simultaneously have a dramatic 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 stressors can disrupt the capacity of natural communities to handle environmental changes.

427 The role of multiple stressors in an Alpine river and the response of the macroinvertebrate community.

The two regulatory procedures adopted in REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) to control the risks arising from substances of very high concern (SVHC) are adequately controlled. A key objective of the European chemicals legislation REACH is to ensure that the risks caused by substances of very high concern (SVHC) are adequately controlled. The two regulatory procedures adopted in REACH to control the risks arising from SVHCs are authorisation and restriction. Both regulatory instruments make use of 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 arising from chemicals’ use, insecticides, and PBTs in the marine environment, are used as specific examples. Furthermore, due to stock pollution properties of PBTs/PvPs, 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 PBTs/PvP substances, the evaluation of PBt/PvP/PV substances in SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e.

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)

PBt/PvP & PMT/PvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (II)
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 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 type of release of a PBT/vPvB substance, and to benchmarking against standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorocarboxylate 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. Nendza, Analytisches Laboratorium; S. Hahn, Fraunhofer IETM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Stewardship; A. Klink, Universität Dortmund / Desert Research Laboratory; U. Gausterer, Environment Agency Austria; A. Wiemann, UBA Umweltbundesamt / Section Plant Protection Products. 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 and ranking of PBT/vPvB is to classify a substance chemically with respect to its similarity of properties/behaviour with chemicals with known impacts, serving as points of reference for the impact evaluation. The relative ranking of PBT/vPvB substances is based on an impact score, which captures diverse properties and effects of target substances. The impact score consists of individual scores assigned to expected environmental stocks, possible effects of PBT/vPvB 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 possibility to overall stocks and possible impacts to the environment and on human health. Based on current knowledge, this grouping and relative ranking can guide the formation of concern-based categories for a possible read-across or comparative evaluation of impact potential of PBT/vPvB substances. Acknowledgement – This work was funded by the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs under Grant Agreement No. 30-CE-083072/00-26 ‘Approach for evaluation of PBTs subject to authorisation and restriction procedures in context of socio-economic analysis’.

432 Interpretation of non-extractable residues (NERs) in the persistence assessment U. Jöhncke, Federal Environment Agency (UBA) / IV 2.3 Chemicals; V. Bomnomet, European Chemicals Agency ECHA; I. Doyle, Environment Agency / Evidence Directorate; R. Horneck-Gausterer, Environment Agency Austria; A. Kapanen, European Chemicals Agency ECHA; M. Kästner, Helmholtz centre for Environmental Research Braunschweig / Environmental Risk Assessment; J.R. Peletola-Thiès, ECHA-European Chemicals Agency; L. Ribeiro, A. Schäffer, Institute for Environmental Research RWTH Aachen University; M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; S. Trapp, Technical University of Denmark DTU / DTU Environment; P. Van Elsacker, FPS Health Food Chain Safety and Environment; E. Von Voegelzen, Rijkswaterschap Centre for Substance / Centre for Safety of Substances and Products. Abstract: The aim of this ECHA project on Non-Extractable Residues (NERs) is to improve the interpretation of NERs in the persistence (P) assessment of substances, in particular biocides and REACH substances. The project outcome will be a discussion paper containing an approach proposal and a review of state-of-science on the role of NERs in the degradation assessment in soil, sediment and water with suspended solids. The work will be based on the results of scientific work carried out by the Member States, academia and Cefic/ECETOC in the last few years. The discussion paper will serve as background document for the development of the assessment of NERs under REACH and the Biocides Products Regulation (BPR). It will also be used for updating ECHA Guidance, where appropriate. Different NER fractions will be defined with regard to their potential for binding, remobilisation and hazard. Different extraction methodologies will also be presented that could be used for identifying and quantifying those different NER fractions. The applicability, limitations and potential technical challenges of those extraction methodologies will be discussed. Preliminary results have already indicated that further research on the topic is needed. The project will also include recommendations 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 J. Hogeback, Federal Institute of Hydrology; D. Loeffler, A. 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 diverse extraction methodologies for the extraction of a part or all of biogenic residues and to benchmarking against standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorocarboxylate sulfonate (PFOS).

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) so called “bound residues” of plant protection products are formed in soil as a result of degradation processes. Due to their inherent nature, analysis and further assessments of bound residues are challenging. In a recent publication (Posberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main part of biogenic residues in soil. The amino acids were liberated via a digestion of the soil with 6 N HCl at 110°C. Within this presentation we focus on the utility and applicability, limitations and potential technical challenges of those extraction methodologies. As a main result above 55% of the bound residues could not be liberated and remained bound to the soil even after such a harsh digestion step. 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 Plant Protection Products – A Synthesis, Critical Reviews in Environmental Science and Technology; 44:19, 2107-2171. [2] Eschenbach et al.. 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. Harmsen, Wageningen Environmental Research / CALM; D. Hennecke,
Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; J. Lahr, Wageningen Environmental Research; J. Deneer, Wageningen Environmental Research / ERA team

There is already a long discussion around the bioavailability and ecotoxicological relevance of Non Extractable Residues (NER) in soil. Is NER formation a decisive parameter? Should it be considered to be a hidden hazard? NER can only be established using labelled chemicals (e.g. $^{14}$C) and cannot be measured with conventional chemical analytics. But even using labelled compounds uncertainty exists about the identity of measured radioactivity. Do we measure: 1) Strong adsorption or association of the parent chemical or breakdown product with mineral and/or organic matter, 2) Mineralisation and incorporation of carbon into microbial biomass and 3) Carboxylation? The latter two are non-measurable and indiscernable parameters. The approach of Ortega-Calvo et al. (2015) has been followed, because this approach defines clear and measurable fractions. The only not measurable fraction is NER, but can be considered as a residual fraction if all others are measured. Considered are: Chemical present in the water phase, actual available, (Passive sampling or CaCl₂-extraction) A potentially available fraction in equilibrium with the water phase (Tenax ISO TS-16751); The total extractable amount, measured with a (standard) method NER is considered, but mentioned as non-measurable and also non-bioavailable. We studied three NER-forming chemicals and followed their fate in a period of 6 months after addition. An important part of the study were experiments using $^{14}$C chemicals. In first experiments formation of Non-Extractable $^{14}$C was observed for all chemicals. For the chemical Tri-NitroToluene (TNT), NER-formation was reproducible and NER formation during aging removed toxicity. By removing the bioavailable fractions directly after spiking and after aging it was also possible to remove toxicity. The experiments with and without labeled TNT clearly showed that toxicity was caused by the bioavailable chemical and not by NER. The tool developed can be used if the fate of the chemical including NER formation is obvious. With the other selected chemicals, Cypermethrin and Carbendazim, results were less clear, because there was a large uncertainty in NER-formation. The degree of biodegradation was not reproducible for Cypermethrin and unexpected losses occurred with Carbendazim. This gave a very large uncertainty about NER using non-labelled compounds. For these compounds it is not possible to draw conclusions from only a non-labelled experiments.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (I)

436 How to make LCA fit for purpose as decision making tool E. Mieras, PRe Sustainability; A. Gaasbeek, PRe Consultants / Consultancy; J. Coustillas, PRe Consultants

To understand how Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) can be improved to support decision making we first have to look at how decisions are made. One of the first distinctions that are made when it comes to decision making is between normative and descriptive decision making. The latter describes how people actually make decisions and that can be quite irrational, as also Daniel Kahnemann, the Nobel Prize Winner, argues in his book “Thinking Fast and Slow”. The first tries to define how to come to the best option, assuming that decision makers are fully rational and that the world can be modeled accurately. These are quite opposite ways of how decisions are made. The second distinction to be made is between what type of decisions are made, by whom and what the objectives are. It’s a big difference if you want to make a decision about different options for new products, determine the long term company strategy or select the most sustainable supplier. Even more so, the objectives will differ per organisation or even situation which the decision is between. Thus, overuse of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location of production is a critical factor in the planning of biopharmaceutical manufacturing.

437 Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical C. Chau, University College London / Department of Biochemical Engineering; N. Titchener-Hooker, University College London / Department of Biochemical Engineering; P. Lettieri, University College London / Chemical Engineering

6-Aminopenicillanic acid (6-APA) is the beta-lactam nuclei of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nuclei represents one of the largest production scale processes within the biopharmaceutical industry. Although numerous reports are associated with the industry are poorly understood, due to limited life cycle assessment (LCA) studies in the literature, the paper presents a LCA of 6-APA production to illustrate the burdens manufacture places on the environment as a function of manufacturing location. We make recommendations for future development of large scale biopharmaceutical manufacture by drawing on our 6-APA analysis where necessary. A case study of a manufacturing process producing 2000 Tones of 6-APA per annum has been modelled under USA operating conditions and a LCA hot-spot analysis was carried out. A process at this scale has a global warming potential (GWP) of 143,000 tonneCO₂eq/yr. which is largely caused by the high annual fossil fuel usage. The energy mix selected for the model is critical. Choosing a USA mix comprising mostly non-renewable resources provided the base case. Switching to the assured energy mix to a Brazil mix (constituting a higher proportion of renewable resources), the contribution to climate change was reduced by 15%. Manufacture in China and India where coal combustion is the main source for electricity; the emissions were significantly higher (20%). Other location dependent variables were inputted into the model in conjunction with the switching of energy mix. Depending on the location’s water scarcity, the burden of 6-APA on this parameter varies greatly. A case study of the mix switching was used when switching production from US to China. This is due to the higher use of hydroelectric power in the national energy mix and lower abundance of water in China. Production itself is water intensive due to high volume required for fermentation media and cleaning. Thus, overuse of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location of production is a critical factor in the planning of biopharmaceutical manufacturing.

438 A SUSTAINABILITY PERFORMANCE-BASED METHODOLOGY AND TOOLS FOR ECODESIGN: the case of transport infrastructures D. Le Pera, The University of Nottingham / Institute of Sustainable Transport Engineering / NTec; J. Oliveira Dos Santos, IFSTTAR; S. Bressi, University of Palermo; S. Brodie, The University of Nottingham; J. Bryce, AMEC Foster Wheeler; V. Cerezo, IFSTTAR; T. Parry, The University of Nottingham; G. Di Minio, The University of Palermo

The importance of sustainability in transportation infrastructure has raised in response to the link between anthropogenic activity and global warming, such as climate change, as well as in consequence of the ongoing development of models quantifying the social and economic impacts resulting from infrastructure development. Therefore, addressing the sustainability of transportation infrastructures requires exploring the environmental, social, and economic impacts of technological options while balancing the often-conflicting priorities of 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 tackle this challenging task, a decision support toll (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 pavement and railway transport solutions at the design stage. The DST will be freely available and can be used at professional level, by professionals interested in advancing sustainability in transportation, as well as for educational purposes, to provide knowledge and educate on the use sustainability concepts and on what are the important issues to consider during the sustainable transportation decision-making process.

439 Influence diagrams and scoping for Life Cycle and Sustainability Assessment, an example from sustainable mining A. Ciroth, GreenDelta; C. Di Noi, GreenDelta GmbH; D. Bizarro, GreenDelta; H. Wessman-Jürikelainen, VTT Technical Research Centre of Finland

Life Cycle Assessment is a technique typically intended to provide a holistic assessment of environmental and possibly also social impacts over the entire supply chain and life cycle. However, LCA has limitations, for a variety of reasons. In this situation, it is interesting to investigate, for a given issue, the ideal portfolio of tools
to be used, including LCA, but not necessarily limited to it. Moreover, in every LCA, it is in a first step important to specify goal and scope for the further analysis, and it is worthwhile to be aware of aspects which have an influence on the overall environmental impacts of an investigated product. So far, goal and scope in LCA is conducted typically without a diagram or visualization of relations between different aspects to be decided about in goal and scope. We introduce influence diagrams and advanced hot spot analysis methodology in the paper. The term “tailor” the approaches to be applied for the purpose of ecological sustainability of a given situation towards the goal and scope of an LCA, where LCA is part of said portfolio. As an application, we develop and present a causal loop diagram for sustainability assessment of mining in general, and apply this to specific mine sites in Finland, Portugal, and South Africa, where this approach is currently applied, led by GreenDelta, in the European H2020 research project ITERAMS. In the presentation, the developed causal loop diagram and the approach for obtaining the diagram for the case will be explained, with results from the ITERAMS project. Results are quite promising and we believe that using causal loop diagrams in sustainability and life cycle assessments helps to clarify selection of the (combination of) appropriate tools for the assessment, and help to structure the goal and scope setting in LCA.

440 Life Cycle Sustainability Assessment for Improved Space Mission Design
A.R. Wilson, M. Vasilie, University of Strathclyde / Department of Mechanical & Aerospace Engineering; K. Baker, Glasgow Caledonian University / School of Engineering / Built Environment

The adoption of the Paris Agreement and Sustainable Development Goals in 2015 has been the driver for a more coordinated global approach towards achieving environmental sustainability. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is now acknowledged as the worthiest methodology to outline the integration of social and economic aspects with environmental LCA 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 in the process to integrate LCA into the concept 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 third 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 current status and future work opportunities 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.

441 How can Agent-based Modeling improve decision making in Life Cycle Assessment?
A. M. Wilson University of Bordeaux / The Life Cycle Group CyVi; P. Loubet, University of Bordeaux / ISM CyVi; F. Taillandier, University of Bordeaux / I2M GCE; G. Sonnemann, Université Bordeaux / ISM CyVi

Life cycle assessment (LCA) is now acknowledged as the worthiest methodology to evaluate environmental performance of whole system in a holistic way. Thus, it has been tempting to extend LCA on simple models. 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 by forecast environmental 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 study requiring to take into account dynamic effects in the technosphere. Different types of coupling (hard-coupling, tight-coupling and soft-coupling) are defined according to: (a)data flow direction and (b)coupling dynamic. Higher the degree of coupling, 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, considering LCA 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

442 Characterization and management of excavated soil and rock
G Minini, CNR-RISA; A. Sciotto, F. Martelli, I timpa SaP

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 impact assessment, including cost-benefit analysis (CBA). In order to guarantee the construction using 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), Citivering, (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 cost-benefit analysis, 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.

443 REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICALITY AND FUTURE PERSPECTIVES
A. Selleri, Autotrustrade per Italia / direzione tecnica; S. Frisiani, Spea Engineering S.p.A.

For those who carry out public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of execution delays, in most 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), Citivering, (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 cost-benefit analysis, 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.

96 SETAC Europe 28th Annual Meeting Abstract Book
The increasing use of Earth Pressure Balanced Shields (EPB-TBMs) in the tunnelling industry has been due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of EPB-TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used by-products if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its possible ecotoxicological effects on soil and water organisms. The ecological approach here reported, consisting of site-specific studies together with ecotoxicological tests performed on the real excavated soils, aims to fill the gap between the lack of threshold limits in soil and water for these multicomponent commercial products and the environmental protection. The studies are planned following a preliminary evaluation of the foaming agent treatment ratios to be used for the specific lithological characteristics of the excavated soils. Here we report the main steps of the environmental studies useful for producing a “Protocol for the assessment of environmental compatibility of the spoil material during the tunnelling in the construction site”. The aim of the protocol is to address engineering contractors and stakeholders (e.g. Railway and Motorway operators) on how to verify the environmental compatibility of excavated soil before putting it in the destination site, in view of the product and deposit and 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 foam foams. To test the feasibility of the product in a realisation in a licenced waste facility, the ecological study here reported has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

445 Environmental effect of chemicals injected into the soil in mechanized tunnelling applications G. Vilardi, DICMA La Sapienza / Department of Chemical Engineering Materials Environment; D. Sebastiani, I. Bivasso, S. Miliziano, L. Di Palma, Università La Sapienza; F. Carriero, R. Sorge, Astaldi In recent years the management of the soils and rocks resulting from the mechanized tunnel excavation process, raised increasing concern in Europe. The need of an amount of chemicals, conditioning parameters, to the execution of 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, variable amount of foaming agents are necessary. A fundamental issue is the selection of the foams most suitable for the specific application and that provide the desired characteristics for a stable and efficient tunneling. The foam selection has taken into account the site 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, in view of the product and deposit and 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 foam foams. To test the feasibility of the product in a realisation in a licenced waste facility, the ecological study here reported has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

446 Site-specific protocol to assess the environmental compatibility of spoil materials produced by EPB-TBM A. Barra Caracciolo, National Research Council / Water Research Institute; P. Genni, National Research Council of Italy (CNR) / Water Research Institute; E. Beccaloni, National Health Research Institute / Health and Environment Department; L. Patroccoli, Water Research Institute-National Research Council / Water Research Institute
extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400, FEI) operated at an acceleration voltage of 20 kV in emission mode and using a bright field transmission electron detector. A ridge detection algorithm implemented in the image processing software Fiji was used to detect and characterize individual CNTs. The calculation was based on the total length of all CNTs (provided by the ridge detection algorithm) detected on the images in combination with their thickness (20 nm), their density (1.4 g cm⁻³) and the well-defined volume of suspension that was centrifuged on the TEM grids. CNTs were well separated on the TEM grids and an increasing number of CNTs was observed on images with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 µg L⁻¹ to 100 µL⁻¹) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of ~2. Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 mg g⁻¹), indicating that the detection of the CNTs was not compromised by the presence of soil particles. Future experiments will focus on a selective removal of the soil particles by an additional treatment with diethylene hydrofluoric acid. Initial experiments are promising and suggest that the detection limit of the methods can be lowered to 1 mg CNT/ kg (soil), which would represent huge step forward in detecting of CNTs in complex matrices.

449 Monitoring for perfluorinated compounds, insecticides, and brominated flame retardants in the water of Daechung lake and Geum river basin

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A multiphase analytical method using LC-MS/MS was developed for perfluorinated compounds (PFCs), insecticides, and brominated flame retardants (BFRs) in water samples with the simultaneous SPE method. The ranges of recoveries were 97.0 ~ 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⁻¹, 3.0 ~ 3.7 ng L⁻¹, and 5.1 ~ 11.7 ng L⁻¹, respectively while limit of quantifications (LOQs) were 0.9 ~ 21.9 ng L⁻¹, 3.0 ~ 3.7 ng L⁻¹, and 8.6 ~ 25.5 ng L⁻¹, respectively. 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, PFHxS, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

Stacia Dudley, UC Riverside / Environmental Toxicology; John Trumble, University of California, Riverside / Environmental Science; John Trumble, University of California, Riverside / Entomology; J. Gan, University of California, Riverside / Department of Environmental Sciences

Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

Stacia Dudley, Marcus Pennington, Chenliang Sun, John Trumble, Jay Gan, Environmrntal Toxicology Graduate Program, University of California, Riverside, CA
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Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water resources, it is becoming an increasingly 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 chemical nature and their tendency to accumulate in biota. To fully understand the occurrence and mass spectrometry. 14C tracing, enzyme extraction and Illumina sequencing techniques, we evaluated a wide range of biological effects in terrestrial organism c...
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 Epiauetic. 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 pea). 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 pea than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (mixture of two compound types was applied to all tested plants. The impact of application (single compound versus compounds’ mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced dissipation of other two compounds in soils, which increased relative concentrations of compounds in plants (i.e., concentrations of compound in plant divided by compound loads in soils that is a total amount of applied solute divided by a dry mass of soil).

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

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish
A. Brown, Exeter University / Biosciences; L. Gunnarson, University of Exeter / Biosciences; A. Lange; D. Rowe, The University of Exeter; M. Trznadel, University of Exeter / Biosciences; M. Linder-Nording, S. Gouveia, University of Umea; J. Wu, Umea University; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences
A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in more than half of the cases. In this context, the proposed approach to prioritisation of pharmaceuticals (EMEA/CHMP/SWP/4447/00 corr 2) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are high quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Both, data of in vivo and in vitro data sets are often 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 or 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 for priority setting leads long to a great number of different factors as applied usually for chemicals without any specific mode of action will be analyzed.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward
J. Bachmann, German Environment Agency (UBA) / Section IV 2.2 Environmental Risk Assessment of Pharmaceuticals; S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals; I. Rönnefahrt, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals
Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/4447/00 corr 2) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are high quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Both, data of in vivo and in vitro data sets are often 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 or 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 for priority setting leads long to a great number of different 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
U. Aarusieegbe, Environment Department, University of York / Environment; C. Eze, UNIVERSITY OF NIGERIA NSUKKA NIGERIA; A. Boxall, University of York / Environment Department
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, like needed for risk assessment. To overcome this, 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 official information obtained from the National Health Organisations. Daily dosage and total 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 PCPs 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 powder and dishwashing liquids. Overall, 12 PPCPs were identified as having the greatest potential to reach source water and pose adverse effects to human health. These include 8 active pharmaceutical ingredients (acetaminophen, tetracycline,
ciprofloxacin, ampicillin, cloxacillin, sulfamethoxazole, trimethoprim and pseudoephedrine) and 4 PCs ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thiglycolate and dichlorvos). This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

457 Aquatic toxicity related to pharmacological or secondary targets of human pharmaceuticals
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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 specific baseline toxicity such as narcotics would prevail. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidiocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative 1st SME-focussed Project IP4 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
C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; A. Haigis, Institute for Environmental Research, RWTH Aachen / Department for Ecosystem Analysis ESA; R. Hamann, Fraunhofer IME; S. Wuester, Institute for Environmental Research RWTH Aachen; M. Krauss, Helmholtz centre for Environmental Research - UFZ / Department of Effect-directed Analysis; M. Fenske, Fraunhofer Gesellschaft / Translational Medicine and Pharmacology; I. Werner, Ecotoc Centre Eawag-EFPL / Department of Anatomy Physiology and Cell Biology; H. Hollett, RIVM / Institute for Environment and Health; I. Werner, Microsoft Research Europe / Institute for Computer Science. Neuroactive 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 behavioral indices with rapid screening of neurotoxic endpoints in zebrafish embryos and larvae exposed to neuroactive pharmaceuticals. Danio rerio up to 5 days post fertilization (dpf) were statically exposed to venlafaxine (serotonin norepinephrine reuptake inhibitor antidepressant) or oxazepam (benzodiazepine derivative anxiolytic) at the µg/L range (1 nM to 10 or 100 µM). Solution concentrations were measured at the start and end of exposures by LC-HRMS. Assessed behavioral endpoints were embryonic spontaneous movement (1 dpf), touch-evoked escape response (3 dpf), and phototaxis and thigmotaxis reactions (5 dpf). RNA was extracted from pooled embryos or larvae (n=20-50) and submitted either to RNA sequencing with Illumina Next Generation Sequencing System (RNAseq) or Sybr Green based quantitative real-time PCR (qPCR). qPCR target genes were selected with basis on RNAseq results, but also a few targets proposed as markers of exposure or modulation by neuroactive compounds were selected from literature studies (e.g. fkhb5, cfos, per3). Reference genes were ef-1a, rpl13, rpl9. Chemical analysis indicated that solution concentrations were stable along exposure periods and in general accordance with nominal values. Oxazepam caused behavioral alterations mainly at 1 and 3 dpf stages, while venlafaxine affected prevalently larval behavioral endpoints. RNAseq of embryos exposed to 100 nM oxazepam indicated gene ontology enrichment for notochord morphogenesis. Larvae exposed to 1 nM venlafaxine presented differential modulation of response to abiotic stimulus, while 100 nM venlafaxine affected mainly muscle processes and to a minor extent circadian rhythm modulation. Confirmatory qPCR is being conducted. Zebrafish embryo-larval assays supported the elucidation of molecular mechanisms at the transcriptome level that occurred concurrently with organism-level behavioral effects. Our results are expected to contribute in the future for AOP annotation and for the setup of a regulatory assessment approach to evaluate neurotoxic environmental contaminants.

459 Virtual fish tales: Liver, Intestinal and Gill Organoids as an in vitro alternative to live fish for prioritising pharmaceuticals and other compounds of highest concern in the environment.
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Pharmaceuticals enter the aquatic environment largely through patient use, and result in a pseudo- persistent background in the aquatic environment. The risk of these compounds is assessed for new products registered since 2001. However, there is a legacy of essential medicines for which we need to understand more. Since most of the thousand or so pharmaceuticals used by patients are likely to pose little environmental risk, it is important to identify those of most concern in order to prioritise effort and resources; it is vital to be able to predict internal concentrations in aquatic organisms. One method to assess uptake potential is to expose the animals of most concern. However, there are potentially thousands of compounds to be prioritised. Factoring that we already know the uptake rate can be influenced by the concentration of the compound in the water, there are enormous ethical implications for conducting this work with live animals (fish), and significant cost of resources to practically conduct the work. Alternatives are clearly required. Significant efforts to better predict environmental exposure are underway as part of the iP4 project (IM grant no 115735). 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 microcosms (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 (BBRSC/NERC grant BB/L01016X/1). By building fish tissue cultures that better represent the complexity of the in vivo situation, we are able to offer in vitro models that can simulate live fish. Water exposure to the gill model can now be tolerated (without compromise) for several weeks, intestinal models are similarly robust. Since both methods employ a permeable barrier culture, rates of flux can be measured that provide not only simple information such as a compound may be taken up, but also rates of uptake and excretion. These data can be used to build kinetic models. The liver spheroids provide a metabolic tissue that when used in co-culture with the gut or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

460 Emergence and multidimensional interactions of engineered nanoparticiles in toxicology

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 emerging contaminants such as fullerenes (e.g. C60). A specific mechanism of action is 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 antibody as well as by chemical analysis of tissue. qPCR analysis 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 well as to the reduction of lysosomal membrane stability and the enhancement of lysosomal/cytosplasmic 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

SETAC Europe 28th Annual Meeting Abstract Book
461 Protemic 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 silver nanoparticles (AgNPs) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC20 (effective concentration) were assessed based on the variations in the overall proteome in two aquatic fungal strains of Arthtosporea tetracauldia, one isolated from a non-polluted stream (At72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. At72 was the most sensitive to AgNPs, whereas PsM1 was the most tolerant one. Characterization of AgNPs showed increased particle stability and lesser agglomeration with time in At72 while for At61 and PsM1 there was an increase in AgNPs agglomeration explaining its lower impacts on their growth. In fungi, ~40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ whereas for PsM1 this percentage was lower (~20%). At72 and At61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. At61 had ~25% more proteins induced by both Ag forms (compared to At72), suggesting higher response which is consistent with the background of this fungal strain. In PsM1, 32% of the proteins increased under exposure to AgNPs whereas the percentage for Ag+ was higher (68%) indicating different responses to Ag+ and/or AgNPs. In At72, Ag+ increased the content of proteins involved in protein homeostasis while AgNPs increased the content of proteins related to DNA repair, the transport of substances and energy production. In At61, AgNPs increased the content of proteins involved in protein synthesis and energy production while both forms of Ag increased the content of proteins related to cell-redox and protein homeostasis, biomass and spores production and also to nucleic acids metabolism. Both Ag forms induced stress-responsive proteins which was consistent with the responses of enzymes involved in oxidative stress. Overall, functional proteomics can be useful to get a mechanistic insight on the stress induced by AgNPs and/or Ag+ in microbes that play key roles in freshwater ecosystems.

462 Hazard assessment of seven different commercial silica nanoparticles on a battery of test species: bacteria, algae and fish cell lines

E. de Figueiredo, Universidade do Minho / Centre of Molecular and Environmental Sciences; J. Sturve, Goteborg University / Department of Biological and Environmental sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences. Manufactured silica nanomaterials are widely used in numerous applications in society such as paints, coatings, cosmetics, textiles and food and its release into the environment is of concern. There is a 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 results, the current study also examined the selection of an appropriate exposure metric comparing mass (mg/L), number of particles (NoL) and surface area (m^2/L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC20 value of 5.1mg/L after exposure to the smallest particle at a concentration range of 12.5-100mg/L. Toxicity to fish cells was determined to be surface dependent, except for particles coated with ethoxy silane, which did not show toxicity. For bacteria and algae, the cell wall seems to play a major role in the uptake and toxicity of silica nanoparticles. Keywords: hazard assessment, silica nanoparticles.

463 Toxicity Assessment of Engineered Titanium Dioxide Nanoparticles

S. Bitragunta, Birla Institute of Technology & Science Pilani, Hyderabad Campus / Biological Sciences; S. Palani, Birla Institute of Technology & Science, Hyderabad Campus / Biological Sciences. Titanium dioxide engineered nanoparticles (TiO2-ENP) are extensively employed in manufacturing of cosmeticceuticals, pharmaceuticals and health care products. As a result, TiO2-ENP can reach the ultimate sink such as soil in the environment during their life cycle. In this context, investigations to understand environmental implications of nanoparticulates including TiO2-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO2-ENP (r-TiO2-ENP) in soil sentences, present study is aimed at evaluating their toxicity as per OECD-207 guidelines on earthworm, Eisenia fetida. Physicochemical characterization of r-TiO2-ENP using dynamic light scattering revealed their tendency to form agglomerates (330-480 d.nm) in water. Soil exposure of earthworms to r-TiO2-ENP (0.1, 0.15, 0.2 and 0.25 mg/kg) showed no mortality after 48 h. Increased specific activities of antioxidant enzymes including catalase, superoxide dismutase and glutathione peroxidase as well as lipid peroxidation indicate the potential of r-TiO2-ENP to induce oxidative stress in the sentinel organism. Interpretations of the study can serve as cues to design a comprehensive approach for developing invertebrate based biomarkers and indicators as early warnings for assessing environment and health impacts of engineered nanoparticles.

464 Combination effects of chlorpyrifos and ZnO on oxidative stress and reproduction of the earthworm Dendrobaena veneta

D. Hackenberger, Department I Biology, University of Osijek / Department of Biology; L. Matic, University of Osijek / Department of Biology; D. Marković, University of Rijeka / Department of Biotechnology; I. Obložić Zvaz, Rudjer Boskovic Institute; B. Hackenberger, Department I 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 conditions to be exposed to a mixture of chemicals 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 chlorpyrifos (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. EC50 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 (EDXRF). 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, 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 nZnO/CHP 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 depend on the different characteristics of the soil in which the earthworms were 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. Lillicrap, NIVA Norwegian Institute for Water Research / Ecotoxicology; A.L. Macken, Norwegian Institute for Water Research, NIVA; A. Risco, IMDEA Water Institute / Aquatic Ecotoxicology; T.C. Telfer, University of Stirling Aquaculture is a major food production subsector 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. Hu, National University of Singapore; G. N., 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 pattern of multifunctional organic micropolutants were investigated in 14 different groups were investigated in offshore seawaters and fish farms of Singapore. The sampling area is affected by various anthropogenic pressures including treated effluents, fish farming, shipping and port activities. A total of 23 MPs were found in offshore seawaters, 9 of them with detection frequencies higher than 50%. The highest detected values corresponded to cyclamates, salicylic acid and sucralose, with concentration range of

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

B. B. Brooks, Baylor University / Dept of Environmental Science; J. L. Conkle, Texas A&M University Corpus Christi / Physical and Environmental Sciences. By 2050, it is estimated that global food production must increase by 50%. Aquaculture will play an important role to meet these needs. For example, in 2014 aquaculture surpassed global fisheries in providing fish for human consumption. It is important to note that global aquaculture activities can 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 nations, where many of the megacities will continue to emerge over the next few decades, agriculture is a major economic activity and public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage treatment 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 aquaculturized bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and effluents 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 domains for non-ionizing 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)

S. Brooks, NIVA / Ecotoxicology and Risk Assessment; B. Beylich, NIVA; A. Ruus, NIVA / NIVA; J. Rundberget, NIVA; A. Lilliecrap, NIVA / Ecotoxicology and Risk Assessment

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included 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 for the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation and depuration of teflubenzuron was also tested in different mussel species have raised increasing concern. For instance, we have observed 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, 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, teflubenzuron showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of teflubenzuron 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


The impact of radiation on the health and safety of the EU’s aquaculture has been stated as a priority in the Council Directive on the management and safety of aquaculture facilities. In addition, there is an increasing need to assess the risk to human health and the environment posed by the discharge of wastewater resulting from the rearing of farmed species and/or the human consumer. This has been commonly done in a single experiment. Furthermore, some radioisotopes permit the measurement 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 farmed-fish is paramount particularly as 50 % of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current aquaculture 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 radioisotopes permit 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 in different environmental conditions. It revealed, for example, the various effects that 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 have shown an increasing emergence 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 (containing a net vs. unmeshed) placed with local bottom sediment and contaminated with a mixture of antibiotics (oxitetracycline, florfenicol and flumequine). Fish feeds were applied simulating fish farm losses for a period of 3 weeks. Measured antibiotic concentrations in the sediment were 2700 – 8000 ng/g (average 1% of the applied amount) for oxitetracycline, 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 on 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 toxicity 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**

J. Asselman, J. Senoumi, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GhEnToxLab unit; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Over the last decade, molecular technologies have evolved into robust high throughput platforms available to many scientists in a wide variety of disciplines. Implementation of these technologies in ecotoxicology and risk assessments have focused on mechanisms of toxicity and stress response on the gene level to explain effects at the organism level. However, current studies remain focused at the individual level and rarely include population level molecular responses. Population level molecular responses may provide a better insight into the potential mechanisms at play at the population level while at the same time avoiding focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies selected an arbitrary timepoint and measured transcriptional responses without any prior knowledge. Here, we focus on population level responses of a *Daphnia magna* population to arsenic and copper and their binary mixture. The population was exposed to low chronic toxicity concentrations of arsenic and copper resulting primarily in effects on reproduction rather than survival. Rather than focusing on a single arbitrary timepoint, gene expression data and life history data were both recorded at multiple time points. As such, these datasets will provide a first basis on how exposure duration may affect the conclusions and decisions made about the toxicity of chemicals. In addition, by collecting both molecular data and life history data, we will be able to better understand the time response relationship in populations under stress both at the life history level and the molecular level. This will allow us to better integrate these two data types and identify potential causal relationships between the molecular level and the life history level. The identification of such causal relationships will play an integral part of incorporating omics data in environmental risk assessment.

474 **How to implement functional responses of microalgae in risk assessment processing?**

E. Cázares, Helmholtz Center for Environmental Research - UFZ, Germany; B. Billor, Université de Lorraine, CNRS UMR 7360; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Delignette-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionary Biology; M. Schmitt-Jansen, UFZ - Helmholtz Cite Environm. Research / Department of Bioanalytical Ecotoxicology

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 raise of OMICs approaches (e.g. transcriptomics and metabolomics) opens the perspective in ecotoxicology to explore pathways involved in ecological functions. The main aim of this study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICS approaches) of microalgae in ecotoxicology. The rationale to use OMICs in such context is to provide more protective and early warning thresholds. The transcriptomic and the metabolomic responses of *Scenedesmus vacuolatus* to triclosan were explored after exposure of 14 hours along an increasing gradient of 5 concentrations (from 0.69 to 6.63 μg/L), 5 replicates). Within a dedicated workflow, we selected the responsive molecular features/ pathways/ networks linked to single and mixture exposures and to use these to infer the effects of chemical mixtures. We approached this important challenge by applying a systems biology approach to integrate expression profiling, metabolomics and phenotypic data (respiration and feeding rates), representing the response of *Daphnia magna* to a panel of environmentally relevant chemicals and their mixtures. Firstly, it was exposed to a battery of single compounds with known mode of action (MoA) i.e. estrogen disruptors and acetylcholine esterase (AChE) inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within *Daphnia*. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either endocrine disruptors or AChE inhibitors. Cadmium (Cd), which clustered with endocrine disruptors or AChE inhibitors, 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 this finding we exposed *D. magna* to complex mixtures of Cd and ethynylestradiol. 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. Fokkema, 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 (stackelback liver gene expression), physiological parameters and more traditional measures of toxicity. We have 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 (alidcarb, chlorpyrifos, fluoranthene, pirimiphos methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in one of the sexes of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCBs and mineral oils) are associated with modules containing several high-risk chemicals. Functional annotation reveals further insights. For example a module of the male stickleback network correlated with liver weight and several chemicals including tricosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450“. However, a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation“, „type 1 diabetes mellitus“ and „cytokine-cytokine receptor interaction“). Conclusion. We have shown 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. Dutil, i4post, Inrae / URB RIVERLY Laboratoire Ecotoxicology; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Inrae Lyon / UR MALY Laboratoire Ecotoxicologie; J. Trapp, Inrae Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; A. chaumot, O. Geffard, Inrae / URB MALY Laboratoire Ecotoxicologie; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics

Degrading of harmful aquatic pollutants is a key concern in test species under contaminant exposure promises the possibility to gain insights into the mode of action of chemical compounds and molecular pathways involved in toxic responses. Intuitive network concepts (e.g. connectivity and modularity) have been found useful for analyzing complex interactions and successfully applied to study gene-gene and protein-protein interactions. Currently, a majority of protein networks are constructed using protein-protein interaction (PPI) databases. However, manually curated PPI databases are typically heterogeneous, documented for few model species, and often characterized by incomplete coverage, and selection or detection biases. De novo (or a priori) approaches based on observed data offer an alternative under which prior knowledge of protein interaction is not necessary but rather advantageously replaced by direct measurements and pair-wise correlation analysis of their abundance. This approach may be particularly powerful to identify signaling pathways which proteins with unknown function belong to or to identify novel, pertinent biomarkers of toxicant exposure. Here we present a network analysis method applied to shotgun high-throughput proteomic data we produced for the aquatic sentinel organism Gammarus pulex. A gene expression dataset, shotgun proteomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides potentially inducing endocrine disruption in this crusteacean. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology.

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (I)

478 How researchers can work in alliance with citizens to fight misinformation and improve public debates

S. Vanhoenacker, Sense About Science EU

Public resistance against glyphosate, GMOs, animal testing, vaccination and numerous other scientific innovations has made many scientists defensive and paranoid about the public. Recent discussion about a post-truth society and anti-intellectualism have increased this perception of a hostile and ignorant public. With concrete examples, Sofie will illustrate a different, more effective approach for both researchers and non-researchers to bring back reason into emotional debates. This approach, called public expert Fed – 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 organism 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 organism and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

482 Discussion Endocrine Disrupting Chemicals

483 A regulator’s perspective in involving stakeholders and the public in the regulation of a substance

C. Ajan, ECHA-European Chemicals Agency; W. de Wolf, ECHA / Product Safety & Regulatory Compliance

The European Chemicals Agency (ECHA) was established in June 2007 through
the REACH Regulation, and the registration of all substances already on the market above 1 ton per annum will be completed in 2018. Since its start the areas of responsibility expanded from industrial chemicals to biocides, capturing as well the communication of chemical hazards to workers and the public through the Classification, Labelling and Packaging Regulation (CLP), and the regulation of international trade of hazardous chemicals. The latter includes support for the protection of human health and the environment by providing developing countries with information on how to store, transport, use and dispose of hazardous chemicals safely through the Prior Informed Consent Regulation (PIC). With its decision making and opinion forming, ECHA uses the scientific information provided by academia and industry and applies them within the regulatory framework that it operates. Transparency is one of the values that is driving ECHA in its interactions with its different stakeholders, and the ECHA Scientific Committees invite ECHA’s accredited stakeholders as regular observers and contributors to its meetings. ‘This presentation will look at regulatory science communication by describing the different stakeholders that ECHA interacts with, the forms of communication used and their timeframes. It will also explain the regulatory boundaries ECHA has to abide to, which influence the uptake of the latest science developments, and their communication with a special focus on the decision making and opinion forming at the Member State Committee. DISCLAIMER: ‘The views expressed in this abstract are solely those of the authors and the content of the paper does not represent the views or position of the European Chemicals Agency’.

484 Questions/Discussion

485 General Discussion with panel of Sofie Vanthournout, Juliette Legler and Markus Hecker

486 Concluding remarks part I and a teaser for part II!

487 The impact of chemical pollution on the resilience of soils under multiple stress

A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and
Chemodynamics; W. Ameling, University of Bonn; H. Hollett, RWTH Aachen
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for Environmental Research UFZ / Dept Environmental Biotechnology; E.
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Biotechnology; R. Ottermanns, RWTH Aachen University / Institute for
Environmental Research; H. Piel, University of Hohenheim; S. Peth, University
of Kassel; C. Poll, University of Hohenheim; G. Rambold, University of Bayreuth;
M. Schloter, Helmholtz Zentrum Muenchen / Research Unit Environmental
Genomics; S. Schulz, Helmholtz Zentrum Muenchen; T. Streck, University of
Hohenheim; M. Rob-Nickoll, RWTH Aachen University / Institute for
Environmental Research

Soils are faced with man-made chemical stress, such as the input of organic or
metal-containing pesticides, in combination with non-chemical stressors like soil
compaction due to agricultural traffic and natural disturbance like drought.
Although multiple stress factors are typically co-occurring in the environment,
research in soil sciences on this aspect is limited and focuses mostly on single
structural or functional endpoints. A mechanistic understanding of the reaction of
soils to multiple stressors is currently lacking. Based on a review of resilience
theory, we introduce a concept for research on the ability of soil polluted by
 xenobiotics or other chemicals as one stressor to resist further natural or
anthropogenic stress and to retain its functions and structure. There is strong
indication that pollution as a primary stressor will change the system reaction of
soils, i.e., its resilience, stability and resistance. It can be expected that pollution
affects the physiological adaption of organisms and the functional redundancy
of the soil to further stress. We hypothesize that the recovery of organisms and
chemical-physical properties after impact of a follow-up stressor in polluted soil
differ from that in non-polluted soil, i.e., polluted soil has a different dynamical
stability, and resilience of the contaminated soil is lower compared to that of not
or less contaminated soil. Thus, a polluted soil might more easily change into another

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 desaturation
and elongation through thermal acclimation

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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, desg2, scd2) and elongases (elov2,
elov5, elov6). Both yellow perch and fathead minnow counteracted the effects
of changes in acclimation temperature on cell membrane properties by remoulding
their phospholipid fatty acid composition. Specifically, in the muscle of both
species, polyunsaturated fatty acids increased in cold-acclimated fish compared to
warm-acclimated fish, in agreement with the theory of homeoviscous adaptation.
However, in brain cell membrane composition was more conservative, especially in
fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than
saturated fatty acids and metal contamination leads to oxidative stress. We therefore
tested the hypothesis that temperature-induced changes in cell membrane
polyunsaturation are accompanied by variations in LPO in metal-exposed fish.
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, DMA
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 unsaturation composition of both tissues, but in a way opposite to that
for yellow perch. We observed a mismatch between desaturation and elongation
gene transcription and membrane composition. Overall, our results suggest that levels
of control of cell membrane fatty acid composition other than gene transcription may
be affected by temperature and metal exposure, such as post-transcriptional
regulation of gene transcription and de novo phospholipid biosynthesis.

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

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Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological
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Research; 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
water chemistry on cadmium induced olfactory impairment. In order to assess the
effect of Cd on the olfactory system, fish were exposed to 45-720 µg/L Cd for
24 h. Subsequently, olfactory responses to two odorants 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 150 to 40 mg/L as CaCO3 decreased the effect of
Cd on the EOG response from 55% to more than 95%, respectively.

It hence, hardness ions ameliorated Cd
 toxicity. However, metal
binding dynamics at the olfactory epithelium may be
other than gene transcription may
also affect the
membrane unsaturation composition of both tissues, but in a way opposite to that
for yellow perch. We observed a mismatch between desaturation and elongation
gene transcription and membrane composition. Overall, our results suggest that levels
of control of cell membrane fatty acid composition other than gene transcription may
be affected by temperature and metal exposure, such as post-transcriptional
regulation of gene transcription and de novo phospholipid biosynthesis.

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

105 SETAC Europe 28th Annual Meeting Abstract Book
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 activity. In 2014, we decided to confront changes in 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), behaviour (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 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. neapolitana. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently efficient to fight against the excess of ROS, leading to LPO. Furthermore, in H. diversicolor, the burrowing behaviour was impaired in polychaetes in fine sand sediments and salinity 40. For A. marina exposure to median sand sediment for all salinities and to fine sand for salinity 40 lead to a decrease of the regeneration capacity of H. 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 flossorial 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 seston 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 the ecosystem engineer species. Regarding mud shrimp, only a few factors have been studied. Among them, the role of trace metals on mud shrimp fitness and bioturbation activities has never been investigated yet. Besides, mud shrimp are frequently parasitized by bopyrid isopods, known to have a deleterious effect on their host. Indeed, they deeply impair mud shrimp physiological state and potentially alter the bioturbation intensity. The aim of this study was to examine the role of a normal 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 multiple stressors to evaluate and mitigate their management consequences. 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 applications on multiple stressor research. 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 expressed in this presentation are those of the authors and do not necessarily represent the policies or positions of the United States Food and Drug Administration, the PETA International Science Consortium Ltd., the International Council on Animal Protection in OECD programmes, the European Commission or the OECD.

494 Calibrating Non-Target Arthropod (NTA) Lower Tier Assessment Factors

F.M. Bakker, Eurofin-Mitos; S. Aldersdor, Bioresources and Evaluation; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; C. Elston, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow Agrosciences / Regulatory Sciences; G. Weymann, ADAMA; P. Neumann, Bayer Ag Assessment factors for non-target arthropod (NTA) studies were calibrated against NTA full fauna field studies for a large array of species, 20 active ingredients (23 products) and wide geographic coverage in the EU. It was investigated whether the current assessment endpoints at lower testing tiers are sufficiently protective and whether the array of test systems is sufficiently comprehensive. Lower tier studies, both Tier 1 and Tier 2, with several test species were used for calibrating low-tier 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, 2 and 250 delimit recovery ranges of 0 weeks (no effects), 1 and 2 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 2-6, 6-12 and 12-24 months were delimited by HQ of values 40, 375, 620 and 2500. Tier 2 studies could have lethal affects for 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 5, 9, 15, 60 and 560 for 1, 2, 6 and 12 months respectively.

495 The unforeseen consequences for animal welfare of the OECD TG 240 (MEGOR(T)) biological validity criteria E. Salinas, BASF SE / Eperimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology The Medaka Extended One Generation Reproduction Test (MEGOR(T)) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEGOR(T) 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 MEGOR(T) 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 is still lacking; it is currently very few laboratories can implement this highly complex TG. The MEGOR(T) 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 MEGOR(T) 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 MEGOR(T) 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 MEGOR(T). 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.

496 Variability in Non-Target Terrestrial Plant Studies Should Inform Endpoint Selection J.W. Green, Exponent; J.W. Green, DuPont / Data Science and Informatics; J. Nuz, Exponent, Inc.; D.E. Edwards, BASF Corporation / Ecotoxicology; K. Henry, NovaSource / Tressendorf Kerley, Inc. / Ecological Sciences; M.E. Kern, Waterborne Environmental, Inc. / Ecotoxicology Risk Assessment; A. Deines, Exponent; R. Brain, Syngenta Crop Protection, Inc. / Department of Environmental Risk Characterization; B. Glenn, Bayer CropScience / graduate student; N. Ehresman, Nufarm; T.S. Kung, FMC Corporation / Global Regulatory Sciences / Global Regulatory Sciences, Department of Biochemistry and Microbiology; F. Kee, FMC Corporation; K. Ralston-Hooper, Dow Agrosciences; S. McMaster, Industry Task Force II on 2,4-D Research Data

Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pesticide validity criteria is a 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 MEGOR(T). The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

497 An avian reproduction study historical control database: A tool for data interpretation J. Wheeler, Dow AgroSciences; P. Valverde-Garcia, Dow Agro Sciences LLC; T.A. Spurgin, EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Fouadlakis, Dow Agrosciences / RSR A; I. Barber, Dow Agrosciences Avian reproduction studies are a regulatory requirement for pesticides in many regions. The data often require careful interpretation due to the nature of the study design. Here we present a historical control database comprising 93 mallard duck reproduction studies performed at the Evans Analytical Group LLC avian toxicology laboratory over the period 1985 - 2016. The analysis demonstrates the stability of reproductive parameters over time and good agreement to normal control ranges as required by the regulatory test guidelines. The major source of variation is shown to be within study variation. Recommendations for the use of historical control data for the interpretation of avian reproduction studies are made. We believe the analysis and evaluation presented here can facilitate the development of practical guidance that can be implemented in regulatory programmes requiring this test.

498 Experimental Design and Model Selection for Ecotoxic Risk Assessment J.W. Green, DuPont / Data Science and Informatics Recent experience with regulatory requests for re-analysis of older studies using newer statistical methodology has resurrected an old statistical issue of designing a study to fit its objectives and the dangers of imposing a statistical structure on data not fit for purpose. There is a continual need to update statistical methodology as new ideas arise and software is developed for the OECD TGs. 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=µ+ε, where µ is the expected mean response in the ith treatment, and the ε are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another is what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means, 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 ecotoxicity 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)

499 Integration of Risk Assessment and Life Cycle Assessment in the context of recycling wood waste into particleboard S. Haywood, R.A. Alvarenga, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change.
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 Impression 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 that helps us imagine the associated advantages of using 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 challenges that need to be overcome in order to reach an overall high sustainability performance. While in some cases biochemicals have lower global warming impacts compared to fossil-based chemicals, other impacts may become higher, like eutrophication. One of the major sources of environmental impacts of biochemicals is the growing of biomass, which in most cases today is corn. This has led to investment in assessing opportunities of using side streams, like leftover algae or lignocellulose, or even algae-lignocellulose 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-based hot spots are 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 algae. This requires external application of nutrients and intensity of chemical pretreatment. Today decision making of biochemicals are further developed companies mostly rely of results from TEAs. Our results show that 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 paid when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and overall indirect productive purpose. Indirect land use change (ILUC) has been defined as an unintentional, negative, displacement effect of commodities in the primary sector such as agriculture causing additional land use changes. Provided that ILUC depends on specific legacy effects stemming from land condition prior and after land use changes, overall indirect effects are connected to the 1.1 billion tons of greenhouse gas emissions generated because of land use changes. However the application of ILUC provisions as for biofuels has been and stays controversial. The Project STAR-ProBio is a multi-actor collaborative research and innovation action and supports the European Commission in the full implementation of European policy initiatives, including the Lead Market Initiative in bio-based products, the industrial policy and the European Bio-economy Strategy. One of the specific goals calls for identifying and mitigating the risks of negative ILUC effects associated to production routes for bio-based products. In this contribution the authors present the conceptual model and the results of the identification of risk factors obtained from the analysis of economic models and a sensitivity analysis performed over one selected case study.

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 support sustainability application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended to support material development in an early 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/comparatively. Furthermore, the criteria are expanded with other criteria that go beyond only LCA relevant aspects and also include aspects like circular economy. The method is illustrated with a case study on nanoporous carbonaceous material. As a result, the most sustainable applications for this nanoporous carbonaceous material are identified and used to set parameters to be achieved for
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing of the required amount of LCA data. This makes the method universally applicable.

504 Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecoinnovations S. Sala, A. Cerutti, European Commission Joint Research Centre / Bioeconomy unit; V. Castellani, EC-JRC; M. Secchi, European Commission Joint Research Centre / Bioeconomy unit

The European Commission has been developing an assessment framework to monitor the evolution of environmental impacts associated to the EU consumption. The assessment framework aims at supporting a wide area of policies, such as those related to bioeconomy, resource efficiency, ecoinnovation and circular economy. The assessment framework is composed of two sets of consumption-based indicators: the Consumption footprint and the Consumer footprint. The Consumption footprint assesses the potential environmental impact of apparent consumption, focusing on a territorial scale and accounting for trade, assigning the impact to the country where the final consumer is located. The Consumer footprint assesses the potential environmental impact of consumption, based on the results of life cycle assessment (LCA) of representative products purchased and used in one year by an EU citizen. The Consumer footprint allow assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/recovery and disposal). For the calculation of the Consumer footprint, the consumption of European citizens is split into five key areas (food, housing, mobility, household goods and electric/electronic appliances). For each area, a respective Basket of representative Products (BoP) has been built based on statistics on consumption and stock of product.

For each of the five BoPs, a baseline scenario is defined, taking as reference the consumption of an average EU citizen in the baseline year 2010. For the future scenarios, BoP have been defined 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 reveal possible trade-offs.

Environmental Risk Assessment in Sediments

505 Assessment of risk from historic contaminants in sediments of the Elbe flood plain, using a multiple line of evidence approach S. Heise, Hamburg University of Applied Sciences / Life Sciences; U. Rieth, Institut für Hygiene und Umwelt

The Elbe river has one of the largest catchment areas in Europe (150,000 km²) of which two thirds lie in Germany. While it was once considered to be among the most polluted rivers in Europe, water quality has largely 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 may still be around, has been in the focus of several previous studies (e.g. Heise et al. 2008, Hillebrand et al. 2010). Little attention, however, had been paid to long-term storage of sediments. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffuse gradients in thin films (DGT) technique for predicting metal bioavailability in sediments. The DGT device uses an ion-exchange resin (Chelox) 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 flux measured at the SWI and the 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.


Analyses of this mine disposal uses up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposit and reference sites were sampled for studies of macrobenthic communities, 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 particles, 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 sands 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. Organic carbon (TOC) and fluxes of O2 and nutrient species were low throughout the investigated area, and the macrobenthic communities showed reduced number of species at the inner fjord site, but ecological status was classified as “good” at all sites and “very good” at the reference station. Microbial community analysis by SWI (±0.5 cm) and Cu were the only significant environmental parameters explaining the variance in the benthic community data. We conclude that both the current discharge to the water column and the leaching of Cu and Ni from the sea deposits are likely to contribute to the moderate reduction of benthic biodiversity at the old deposit sites. [1] Guideline M-608, 2016. Norwegian Environmental Agency. 24 pp.

507 In situ metal fluxes for the assessment of metal bioavailability in sediments F.D. Amato, University of Antwerp / Department of Biology; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminant Research; P.W. D. Jolley, University of Wollongong / School of Chemistry; C.P. Marasinghe Wadige, University of Canberra / Institute for Applied Ecology; W.A. Maher, University of Canberra / Institute of Applied Ecology; A. Taylor, University of Canberra / Ecochemistry Laboratory, Institute for Applied Ecology

Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS), 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 pore oxidized surface sediments can be quite poor, frequently owing to a lower bioavailability of metals from the sea deposits corresponded to 5% of the leakage from the land deposit and 8% of the current discharge to the water-column at the fjord deposit site. Organic carbon (TOC) and fluxes of O2 and nutrient species were low throughout the investigated area, and the macrobenthic communities showed reduced number of species at the inner fjord site, but ecological status was classified as “good” at all sites and “very good” at the reference station. The multivariate statistical test (DistLM marginal test) showed that in addition to depth, fine fractions (< 63 μm) and Cu were the only significant environmental parameters explaining the variance in the benthic community data. We conclude that both the current discharge to the water column and the leaching of Cu and Ni from the sea deposits are likely to contribute to the moderate reduction of benthic biodiversity at the old deposit sites. [1] Guideline M-608, 2016. Norwegian Environmental Agency. 24 pp.
Toxicity Methods for Freshwater Sediment

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Sediment toxicity tests are used for contaminated sediments, chemical registration, and water quality criteria evaluations, and can be routine elements of ecological risk assessments at contaminated sediment sites. Standard methods for conducting sediment toxicity tests have been established by USEPA, ASTM, Environment Canada and OECD. Revisions to USEPA’s Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates is planned for 2018. USEPA’s manual describes toxicity and bioaccumulation test data, laboratory techniques and guidelines, and presents results from tests of 3 freshwater species, Hyalella azteca (amphipod), Chironomus dilutus (midge) and Lumbriculus variegatus (oligochaete) and 5 sediment toxicity test methods: 10-d tests with H. azteca and C. dilutus; a 42-d life-cycle test with H. azteca; a 50-d life-cycle test with C. dilutus and a 28-d bioaccumulation test with L. variegatus. While laboratories routinely met test acceptability criteria (TAC) for short-term sediment toxicity exposures (10-d control survival and ash-free dry weight), laboratories reported variable biological performance with the longer exposures. With input from both midge and amphipod workshops, each test method has updated guidance for the starting size/age of organisms, diets and rations, reconstituted water changes, modifications to the test acceptability control survival, weight and other endpoints. Control waters needs to have a minimum level of chloride and species of a different taxonomic 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 fluoroxycon-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa represented. Overall, tests for each species and method, laboratories would report their averages for the test endpoints/weights. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

509 Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fluoroxycon

Leonard Alster, Environmental Risk Assessment; J. Romão, University of Aveiro, X.H. Yin, Zhe Jiang Agriculture and Forestry University; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team

In the EFSA scientific opinion on sediments, one of the oligochaete worms Lumbriculus spp. or Tubifex tubifex, supplemented with a second standard test species, a dipteran larva, species of a different taxonomic 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 fluoroxycon-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa represented. Overall, tests for each species and method, laboratories would report their averages for the test endpoints/weights. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

510 Spatio-temporal exposure of Plant Protection Products in OECD 219 sediment test systems - Comparison of model results with measurements

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Sediment toxicity testing among other ecotoxicologic tests is currently revised under the premise to improve quality and consistency of regulatory environmental risk assessments. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on the reevaluation 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 invertebrates 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 the simulation are compared with measured sediment concentrations in three depths (see contribution submitted by Dorn et al.). The compound properties were parameterised using values derived independently in standard tests (Koc, DT50water/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 penetration of the sediment. Presuming that chironomids live in the upper three millimeters 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 (LMICs) is of growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DWW), which creates a heavily polluted area, named the “impacted 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 “impacted zone” are typically above 0.01 µg L⁻¹, which, if predicted, would trigger the environmental fate refinement of the environmental risk assessment (ERA). In the ERA PEC calculation, a default dilution factor (DF) of 10 is used, but in at least 53 countries worldwide, the local predicted median DF is lower than 10. There is no information available in the literature about the effects of low dilutions on the natural attenuation of APIs nor impacts of DWW. Furthermore, information on the effects of low dilution on mixtures of APIs is missing, hence necessitating the requirement for evaluation of biological endpoints for the impact zone ERA. This information is pivotal for the development of an impact zone ERA approach, and we are proposing an original attempt to expand this area of 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. Acetabutol 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 that previously reported studies. As a consequence, the low concentration of 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. Acetabutol 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 that previously reported studies. As a consequence, the low concentration of
Wastewater Treatment Works: Measurement, Prediction, Risk - A Cause for Concern?

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This work reports on the ability for wastewater treatment works (WWtW) to remove active pharmaceutical ingredients (APIs), the variations within and between works, the effectiveness of trying to model removal and the risk of exceeding predicted no effect concentrations (PNEC) in the environment. The research is based on data generated from two large UK-wide WWtW monitoring programmes. Taking account of removal of parent compound from the aqueous phase during treatment in combination with estimates of dilution available it is possible to prioritise the APIs of greatest risk of exceeding estimates of their PNEC in receiving waters for all WWtW in the UK. The majority of substances studied were removed to a high degree, although with significant variation, both within and between WWtW. Poorer removal (between influent and effluent) was observed for ethinyloestradiol, diclofenac, propranolol, the macrolide antibiotics, fluoxetine, tamoxifen and carbamazepine. All except the last two of these substances were present in effluents at concentrations higher than their respective estimated PNEC (based on monitoring of effluents from 45 WWrW over 20 occasions). The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WWtW in the UK (approximately 13% of all WWtW) may cause exceedances of estimated riverine PNECs after mixing of their effluents with receiving waters. The overall degree of risk is driven by the toxicity value selected, which in itself is controlled by the availability of reliable and relevant data. Our part of the project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTP, as well as before and after the upgrading of the WWTP. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hsp70) levels and lipopolysaccharides allowed us to draw conclusions about protozoan and oxidative stress in gammarids. Macrozoobenthos community integrity was determined by means of the saprobic index as well as by the number of sensitive taxa (EPT index). Prior to the WWTP upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTP's effluent. After the upgrading of the WWTP, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTP with respect to the investigated health parameters. Furthermore, the overall number of taxa and particularly the number of EPT taxa within the macrozoobenthos community downstream of the WWTP increased distinctly after the upgrade of the WWTP with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and endocrine active chemicals from the effluent can plausibly be related to the improved integrity of macroinvertebrate health and community structure in the connected river Schussen.

114

514 Effects of full-scale ozonation of treated effluent - Environmental impact in a receiving river

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Pharmaceuticals have been found in aquatic systems globally, due to a combination of worldwide usage and low removal efficiency in wastewater treatment plants (WWTPs), or a complete lack of WWTPs (1). In surface waters, concentrations of pharmaceuticals usually range from low µg l\(^{-1}\) to close to point sources to low ng l\(^{-1}\), and are correlated to human population density in the drainage area, volume of the receiving water body and the volume of WWTPs. One technique to increase the removal of pharmaceuticals in WWTPs is to add a tertiary treatment step based on the addition of ozone. Ozonation is a cost efficient way to degrade chemicals and several studies have shown that most pharmaceuticals are readily degraded in the presence of ozone (2). However, several oxidized degradation products are formed during ozonation and the environmental impact of these are largely unknown. The aim of this study was to investigate the effect of ozonation on the removal of pharmaceuticals in a WWTP, 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 WWTP (10000 PE) were treated by an addition of 8 h\(^{-1}\) ozone during 6 months. Removal rates in the WWTP 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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Aqueous environments are subject to discharges of multiple contaminants (chemical and biological compounds). Wastewater treatment plants (WWTPs) 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 biological treatments. Therefore, they are 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 DROPE (The dreissene as purifier tool of protozoa in WWTP effluent) project aims to test the depurative capacity of the zebra mussel in terms of protozoan’s contamination in WWTP 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 WWTPs 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 WWTP’s outlet channel (Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutase, Catalase, Glutathione S-Transferase and Glutathione Peroxidase) 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 modelling organism. Considering these results, Dreissena polymorpha seems to be 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 paracetamol, 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 antibiotic resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding the 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
C. Moir, M. Cooke, Newcastle University; C. Keapp, University of Strathclyde / Civil and Environmental Engineering; J. Su, Y. Zhu, Chinese Academy of Science; D.W. Graham, Newcastle University / School of Civil Engineering and Geosciences

Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resistome, debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for 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 and multi-contaminated soils. This study identifies 24 locations across the North East of England to evaluate AMR in urban and rural soils with low and high 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), 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 treatment. Additionally, during the occurrence of the COVID-19 pandemic, the contamination 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 dissemination 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 generated 3rd, 4th, 5th and 6th selective endpoints 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, tetracyclins, quinolones and phenicol classes) and may also carry virulence genes factors. The proportion of multi-drug resistance E. coli are not ingested linked to untreated hospital wastewater discharge in urban receiving system and are widely distributed along the river, thus highlighting the risk of surface water use.

520
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 chiral culture results in antibiotics and antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can address such 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 PNEC95% (PNECs for resistance) published previously and PNEC95% 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 PNECs for environmental risk assessment of antimicrobials.

521
Determining the minimal selective concentrations of macrolides in a complex microbial community
J. Stanton, University of Exeter / Medical School; A. Murray, University of York; L. Zhang, University of Exeter; J. Snape, AstraZeneca UK Ltd, AstraZeneca Global Environment; W. Gaze, University of Exeter / Medical School

Antibiotic resistant bacteria are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antibiotic 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 address such 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 PNEC95% (PNECs for resistance) published previously and PNEC95% 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 PNECs95% for environmental risk assessment of antimicrobials.
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 (ermF, mvaA, metF, and intI1) within the community. Change in prevalence of resistance genes, when in the presence of antibiotic, was compared to change in prevalence when no antibiotic was present. Out of all of the genes tested, the ermF gene shows a selective response at the lowest concentration for all three macrolide antibiotics. No significant selection is seen for mvaA 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.

522 Impact of multi-year exposure of agricultural soils to antibiotics on the soil resistome and mobileome.

C.H. Lau, Y. Tien, Agriculture and Agri-Food Canada; E. Topp, Agriculture and Agri-Food Canada (AAFC)

Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylstosin, chlorotetracycline and sulfmethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, clarithromycin and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 µg 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 sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (e.g. intI1, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a more realistic point of view

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

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Microplastics (MPs) are fragments of plastic 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 MPs 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 (1,700–4,500 kg\(^{-1}\)) along both shores of the Firth of Forth. The number of fibres was generally higher than the particle count. There was no apparent pattern of spatial distribution. Although a spike in MP particle and fibre numbers was observed in May2015 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.

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

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Nanoparticles are constantly used at world level leading to their presence in the aquatic environment leading to possible particles interaction with living organisms. The potential impacts of such interactions on the environmental and health effects are not well understood of the induced mechanisms. Microalgae are the base of aquatic trophic chain and different possible pathways of interaction between microalgae and nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is known to monitoring material chemical composition. In this work, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalga (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polysytirne nanoparticles. After 48h or 72h of interaction, microalgae are collected for infrared analysis. In parallel, biological parameters are monitored. The multivariate analysis highlight that microalgae responses are stress dependent. Thus, infrared spectroscopy could be a new method to analyse stress effect on microalgae and particularly nanoparticles. Interaction with nanoparticles seems to induce an overexpression of the turboxanthin synthesis pathway genes. In conclusion, infrared and biological data relationships could explain interaction mechanisms between nanoparticles and microalgae. Keywords: nanoparticles, infrared microspectroscopy, effects monitoring [1] von Moos N & Slaveykova VI. 2014. Oxidative stress induced by inorganic nanoparticles in bacteria and aquatic microalgae–state of the art and knowledge gaps. Nanotoxicology. 8(6): 605-630.

525 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(amideamine) (PAMAM) dendrimers are polymeric nanoparticles which, radially symmetric, densely grafted with homogeneous, and monodisperse structures 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-NH\(_2\) and G7-NH\(_2\) PAMAM dendrimers in a prokaryotic primary producer of aquatic ecosystems, the filamentous cyanobacteria Anabaena sp. PCC7120 (Anabaenaceae). Dendrimers significantly decreased the growth of the cyanobacterium and both dendrimers induced morphological alterations of both filaments and individual cells. Furthermore, cyanobacteria exposure to dendrimers resulted in significant alteration of physiological parameters: increase in the formation of intracellular reactive oxygen species, damage in membrane integrity, membrane potential depolarization, increase in membrane fluidity, increase of intracellular pH and alteration of intracellular free Ca\(^{2+}\) homeostasis. Dendrimers also induced alterations in the photosynthetic responses of Anabaenacea. In conclusion, high-generation cationic dendrimers exhibited high toxicity towards
**526**

**Interactive effects of carbon nanoparticles and benzo(a)pyrene on marine mussels, Mytilus galloprovincialis**

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The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns over their potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels were exposed to 5 µg/L 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 characteristic by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology targeting 15 stress response pathways. Contrasting results were obtained as a function of the type of carbon nanoparticles used. Co-exposure of mussels to MWNNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestible 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 responses) and to a larger extent, the fate of CNPs, further biological analysis (e.g. DNA oxidation and proteomics) are currently in progress. This study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

**527**

**Trophic transfer of CuO NPs and Aqueous Cu: from worms to fish - a proof of concept study**

T. Lammel, University of Gothenburg / Dep of Biological and Environmental Sciences; A. Thit Jensen, Roskilde University / ENSPAC; C. Mouneyrac, Technic, University of Lorraine / LIEC, CNRS; V. M. Aflit, Kings College London; A. Khlobystov, University of Nottingham / School of Chemistry; A. Viarengo, University of Piemonte Orientale / Department of Sciences and Technological Innovation DiST; J.W. Readman, University of Plymouth / Biogeochemistry Research Centre; A. N. Jha, Plymouth University / Biological Sciences.

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**528**

**Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study**

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Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their biavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic freshwater bivalve Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 µg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP, affected C. fluminea bioeneurotoxic responses at different levels of biological organisation. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

**Luminescent biomonitoring via bioassays of different complexity - from cells through enzyme reactions to proteins**

**529**

**Applications of Luminous Bacteria Enzymes in Toxicology and Ecology**

V. Kratasyuk, Siberian Federal University / Biophysical; E. Simbeka, Siberian Federal University / Biophysics.

A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to plan, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were prepared, wherein the bacterial coupled enzyme system NAD(P)/H:FMN-oxidoreductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymoluminol was used to facilitate and accelerate the development of the bioluminescent enzymatic system. The rapid and regular pattern of bioluminescent readouts for total toxicological assays. The reagent is easy to use and convenient to be applied not only in toxicology studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

**530**

**Toxic and adaptive effects via luminescent assay systems of different**
Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in biogagnostics is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogagnostics is explained by the variety of reactions to external stimuli and their phylogenetic 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 fulamentous fungi cultivated under different concentrations of source of biodegradable and nor readily biodegradable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chlidoporus chlidosporiches, and Trichoidea harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi Physalospora sp. and agar Czapek medium contained a varying level of sucrose (0.3% and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 280, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (under conditions how the NPs’ original synthesized 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 chomophores 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 biodegradable and not readily biodegradable 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

L. Kulvabko, Moscow Aviation Institute; P. Uchanov, Institute of Ecology and Evolution RAS / Laboratory for soil ecological functions; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; K. Kryukova, Institute of Chemistry and Chemical Technology.

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534 Poster spotlight: WE209, WE210, WE211

Obesogens and lipid disruptors

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 General Physics; V. Terekhova, Lomonosov Moscow State University / Department of General Physics

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Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
C. Porre, I. Fuertes, M. Ruivo, A. Maceda-Veiga, University of Porto / Department of Animal Biology
New developments of analytical techniques have allowed the effective identification and characterization of lipids and the development of lipidomics, which has recently emerged as a key technology for human disease research and discovery of biomarkers. However, on an environmental toxicity 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 the liver tissue of two fish species (Barbus meridionalis, Squalus laetanus) 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-plasmaplamagens (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 CEs (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:5, 36:5, 38:6) was detected in the muscle of B. meridionalis sampled in polluted sites. In contrast, the lipidome of S. laetanus 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. laetanus 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.

Toward 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
C. Schwab, Adolphe Merkle Institute / Materials Science
Engineered nanomaterials are relatively new contaminants with the potential to enter the ecosystem 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: “Nanopartikel als potenzielle Umweltkiller” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that were 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. Bucheli 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.lifegem.de/news/nachrichten.php4?getnews=m2011-11-09-3109&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 conflicts of interest and is responsible for the content of the abstract and presentation.

542 Nanotechnology: Communicating scientific findings through media – what could possibly go wrong? Lessons learned from Schwab’s nanotubes

G. Oberg, UBC / 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 perceived or real?

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 on the far end of the food chain, honey to even drinkable. 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.

545 Lost in translation: Do we communicate the risks of (micro)plastics in the right way?
M. Wagner, Norwegian University of Science and Technology / Department of Biology

While research on the environmental and health risks of microplastics is still in its infancy, the public has already concluded there are unacceptable risks and, consequently, demands for action. This puts environmental toxicologists and chemists in an uncommon position, namely that public awareness of a potential environmental issue is way ahead of an evidence-based assessment of the actual risks. To further complicate the matter, researchers face a fundamental dilemma: Current narratives on the negative implications of (micro)plastic pollution create public awareness and promote change towards more sustainable economic practices, e.g., with regard to circular economy. However, these narratives are in many cases not backed by scientific evidence. The question is now: How can we promote positive societal change and at the same time stay true to the scientific principles? In my talk, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

546 Ocean Literacy – changing attitudes and behaviour of society in the face of the problems of the oceans

A. Borja, Artx-Tecnalia / Marine and Coastal Environmental Management

The H2020 project ResponSEable (www.responseseable.eu) is trying to raise awareness around six key-stories (fishing, eutrophication, renewable energies, coastal tourism, microplastics, and ballast waters), within the four European regional seas. Under the DAPSIWRM framework (Drivers, Activities, Pressures, State, Impact, Wellbeing, Responses, Measures) we are developing products to change attitudes and behaviour of different actors related to each story, but also to the society at large, from children to adults, trying to test the changes in those attitudes. The products include videos, cartoons, serious games, interactive tools, specialized courses, etc. Our aim is that if scientists and society have a shared understanding of science and risk communication regarding the problems of the oceans, these can be solved through the individual and collective changes in our attitudes towards the oceans in our daily lives.

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. Ajaoo, 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 / Applied Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
Toxic chemicals from point and diffuse sources might impact the ecological status of aquatic ecosystems. Appropriate strategies are needed to identify impacted sites, quantify impacts, or evaluate the causative involvement of chemical contaminants. Since environmental compartments usually contain mixtures of chemicals with low, possibly non-toxic concentrations of the individual compounds, any approach to assess ecological impacts and chemical contamination has to involve concepts for mixture toxicity. However, in addition to toxic chemicals, other non-chemical stressors such as habitat degradation, nutrient pollution, oxygen depletion, pH shifts, hydromorphological changes or others, may also cause a site to fail achieving good ecological status. Since the EU Water Framework Directive (WFD) aims at a good ecological status of all European water bodies through addressing water pollution, for water quality monitoring and assessment under WFD it is necessary to discriminate the impact of such non-chemical stressors from the effects of toxic chemicals. This is challenging, and no single “one size fits all” strategy exists. Therefore, multiparametric approaches, so-called “toolboxes”, are often used. This presentation will show a toolbox for the detection of the ecological impact of chemicals that was developed within the Solutions EU project. It uses a statistically informed, health-based and tiered formalized assessment of the so-called VOA approach. The developed toolbox was applied to the Danube case study, to facilitate evaluation of the very comprehensive data set from Joint Danube Survey 3. The toolbox concept proved to be practical, simple and promising for further studies, with fairly high diagnostic power.

551
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. Brick, 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 ecological impact. For instance, there is no 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 found. For instance, there is no 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 found. For instance, there is no 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.

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Wildlife is exposed to an infinite number of different combinations of chemicals. There is evidence that single substances that are present below their threshold of effect can still be of concern and contribute to combined effects. A framework for environmental mixture risk assessment (MRA) has been suggested by Backhaus and Faust (2012), however MRA is often hampered by limited data availability. An ecological Threshold for Toxicological Concern (ecoTTC) approach has been recently developed based on a database of more than 100 000 acute and chronic aquatic toxicity data. The tool allows for the calculation of predicted no effect concentrations (PNEC) derived from the underlying data to which an assessment factor (AF) is applied depending on the comprehensiveness of the data used. The data set can be used as input for the ecoTTC distribution, from which the ecoTTC value is derived by calculating the fifth percentile. Other types of chemical toxicity distributions (CTD) are also possible i.e. distribution of acute (LC50) or chronic (NOEC) ecotoxicological data without applying any AF. It is common practice to predict combined effects and risks based on information of the mixture components, most of the time based on the concept of concentration addition (CA). For this case study the sum of risk quotients has been used as a surrogate for CA based predictions. The risk quotient for the mixture (RQMmix) is based on the summation of the risk quotients of the individual substances. This approach is conceptually different from CA because the involved PNECs might be based on different groups of species and using different AF. However, it can be used as a screening level approach. If a RQMmix > 1 is identified, the MRA can be refined by using the sum of toxic units, based on LC50 data. The case study is based on chemical monitoring data in European rivers, which give realistic environmental concentrations and co-exposure scenarios to a relevant number of chemicals. Available ecotoxicological values have been gathered for the identified chemicals from regulatory sources when available, or from the literature and existing database. The possible use of the ecoTTC approach and other type of acute and chronic CTD for screening level and data gap filling is explored in this case study, within the framework for environmental MRA previously mentioned. Backhaus, T. and Faust, M., 2012. Environ ScTechol 46 (5), 2564-2573.

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Towards the development of a framework for applying non-target chemical analysis data within exposure and risk assessment T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; R. Parmar, ARN Arnot Research Consulting; J.A. Arnot, ARN Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

There is an increasing trend towards multi-targeted and non-target analysis (NTA) screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the possibilities of advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. For example, screening for new emerging contaminants or other non-conventional chemical stressors such as habitat degradation, nutrient pollution, oxygen depletion, pH shifts, hydromorphological changes or others, may also cause a site to fail achieving good ecological status. Since the EU Water Framework Directive (WFD) aims at a good ecological status of all European water bodies through addressing water pollution, for water quality monitoring and assessment under WFD it is necessary to discriminate the impact of such non-chemical stressors from the effects of toxic chemicals. This is challenging, and no single “one size fits all” strategy exists. Therefore, multiparametric approaches, so-called “toolboxes”, are often used. This presentation will show a toolbox for the detection of the ecological impact of chemicals that was developed within the Solutions EU project. It uses a statistically informed, health-based and tiered formalized assessment of the so-called VOA approach. The developed toolbox was applied to the Danube case study, to facilitate evaluation of the very comprehensive data set from Joint Danube Survey 3. The toolbox concept proved to be practical, simple and promising for further studies, with fairly high diagnostic power.

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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. Ermel, Brunel University London / Institute of Environment, Health, and Societies; D. De Zwart, DiD EcoTox / Centre for Sustainability Environment and Health; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences

Experimental mixture studies have shown that the toxicity of a mixture is usually greater than the sum of the toxicities of its components. However, empirical evidence seems to point to the fact that often natural 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 workflow scheme for performing human and ecological mixture risk assessments (MRA) in the context of the European Framework of multiple pollutants in European rivers on MRA for humans and aquatic species groups. It uses measured concentrations of chemicals co-occurring in water and builds on the principle of a tiered approach, where unnecessary expenditure of resources is avoided by discontinuing the analysis when cumulative exposures are judged to be acceptable on the basis of crude and simple worst-case assumptions. The analysis is refined when previous tiers reveal clearly unacceptable exposures, with refinements based on best-case assumptions of minimum expectable risks. The workflow is divided into three main tiers in which the distorting influence of different assessment factors present in regulatory values is successively removed, and increasingly sophisticated...
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 the 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. Scholz-Steinke, RWTH Aachen University; J. Geipel, UFZ Center for Environmental Research / Institute for Environmental Research; S. Bär, German Federal Environment Agency UBA / Section Plant Protection Products; M. Diercks, RWTH Aachen University / Institute for Environmental Research; T. Frische, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / Institute for Environmental Research; T. Schmitz, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / Institute for Environmental Research.

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 combinations. 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 partly 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, TERmultiple, TERRisk weighted). Number risk indices were calculated based on the concentration addition of single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixes 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 pesticide 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 (TERTerrestrial) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixes for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimes as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

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

556 Time-dependent effects of two fungicides and their mixture on enchytraeids and earthworm communities under field conditions
J. Amossé, S. Bart, INRAAgroParisTech; C. Pélos, INRA (Institut National de la Recherche Agronomique); M. Guénard, INRA, INRA AgroParisTech
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., Cuprafor Micro® (composed of 500 g/a of oxycarboxin and 800 g/a of oxiconazole) and Swing Gold® (composed of 50 g/a of thiacloprid and 133 g/l of dimoxydimethin), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Enchytraeidae) after 1, 6 and 12 months (i.e., t1, t6 and t12) of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait laminar method. Our result showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 ha-1 of Swing Gold® and 4.4 kg*a-1 of copper) and in the treatment with the Swing Gold® at ten times the recommended dose (i.e., 15.1 ha-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 anecics was only observed after the application of 40 kg*a-1 of copper, which was observed later at t12. We showed no overall significant difference in total feeding activity, enchytraeid diversity and between treatments with or without pesticide at different sampling periods. In the Swing Gold® treatment, earthworm community did not recover twelve months after pesticide application. We suggest thus going beyond the ISO norm 11268-3 (2014) for the study of the effects of pollutants on earthworms under field conditions.

557 Toxicity of imidacloprid and thiadiazuron 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
Fosomia candida has been used for assessing the toxicity towards non-target soil organisms using the bait lamina method. Our results emphasize the relevance of the nowadays largely non-regulated pesticide Fosomia candida as a model organism. The first species, has been transported all over the world, therefore being considered a tramp species, having a parthenogenetic mode of reproduction. F. fimetaria is present in most of natural and agricultural soils worldwide, and has a sexual mode of reproduction. Following a suggestion of the ring test to use different species or spraytails to assess the toxicity of contaminants, in this study two additional species, Heteromurus nitidus and Sinella curviseta, were used together with F. candida and F. fimetaria to determine the toxicity of imidacloprid and thiadiazuron 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, 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. Thiadiazuron 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. Thiadiazuron was more toxic than 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 species tested presented similar sensitivity to thiadiazuron and did not differ from each other. The experiments allowed us to confirm whether imidacloprid and thiadiazuron can be used together for assessing the toxicity of pesticides to earthworms – being of particular interest. More research is necessary to better understand pesticide avoidance behaviour so that population consequences of such behaviour can be estimated. We aimed to develop an efficient method to quantify changes in movement behaviour and identify avoidance behaviour in relation to pesticide exposure in the predatory mite Typhlodromus pyri, a model species and a model predator found in fruit orchards and vineyards. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mite movement behaviours when exposed to these in comparison to a control arena. We found that distances walked by mites were reduced by up to 87% compared to the control when exposed to 0.1 μg mL-1 deltamethrin, and that 54% of individuals exhibited the same reduction in movement when exposed to 0.45 μg mL-1 acetamiprid. Mites showed a similar response when exposed to the control arena.
exhibited avoidance behaviour when exposed to acetamiprid or dimethoate. We report the variable effects of 3 insecticides on a range of standard movement behaviours in T. pyri, including distance walked, time moving/not moving, velocity and meandering behaviour. We also report avoidance behaviour measured as the time taken to become trapped in the test arena glue boundary due to attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects in NEAAs by quantifying movement behaviour changes in T. pyri. We are adding to the knowledge base on 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 Hypoaspis aculeifer tests be considered in order to keep them in Tier I test battery for ecological risk assessment of PPPs?
T. Nutil-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. Amato, EFSA - European Food Safety Authority / Pesticides; J. Sousa, University of Coimbra / Department of Life Sciences

The recent scientific opinion of EFSA addressing the state of the science on risk assessment of plant protection products (PPPs) for non-target arthropods highlighted the need for the inclusion of other relevant exposure routes, besides contaminated soil, in tests from lower tiers. The reproduction test with the predatory mite Hypoaspis aculeifer (OECD 226) is currently being calculated 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 prey ingestion, directly or indirectly, via food. 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 untransformed 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 imidacloprid. The concentrations used were 1519, 5126 and 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 one of the most relevant exposure routes for making experimental reproduction tests with predatory mites for ERA of PPPs. This enhance the need for a revision of the procedures described in the standard 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. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology

The environmental risk assessment of plant protection products on soil organisms is mainly based on the outcome of laboratory and extended laboratory studies (EFSA 2017). However, the link from the laboratory to realistic field conditions over the test period but, in a real scenario, this exposure is simultaneous for H. aculeifer and their preys. Thus, throughput 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 imidacloprid. The concentrations used were 1519, 5126 and 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 one of the most relevant exposure routes for making experimental reproduction tests with predatory mites for ERA of PPPs. This enhance the need for a revision of the procedures described in the standard protocol for mite reproduction test to avoid underestimation of toxicity of contaminants.

561 PBt assessment of substrates - Proposal of a trigger value for bioaccumulation in terrestrial oligochaets
M. Simon, Fraunhofer IME / Applied Ecology; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; P. Egele, ECT Oekotoxikologie GmbH / Toxicology; W. Drost, Federal Environment Agency (UBA) / Chemicals

Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances is necessary to ensure a high level of protection of human and animal health, and of the environment. In aquatic organisms, trigger values for the identification of bioaccumulative ("B") and very bioaccumulative ("vB") substances are bioconcentration factors (BCF) of >2000 and >5000, respectively, obtained from fish flow-through studies according to OECD 305. However, Annex XIII of the REACH regulation does not define similar trigger values for bioaccumulation studies with terrestrial oligochaetae according to OECD 317 that are comparable to the B/vB criteria in the scope of the PBt guidance. For this reason, the study comprised the following soil via: 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, metoxychlor, o-tolylphenol 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. In addition, the analysis was performed using the four model substances endosulfan, metoxychlor, o-tolylphenol and PCB153. 4) 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. In addition, the analysis was performed using the four model substances endosulfan, metoxychlor, o-tolylphenol and PCB153. 5) Proposal of a trigger value for identification of bioaccumulative substances in terrestrial organisms based on the literature research and the performed experimental results. 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In addition, the analysis was performed using the four model substances endosulfan, metoxychlor, o-tolylphenol and PCB153. 10) 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. In addition, the analysis was performed using the four model substances endosulfan, metoxychlor, o-tolylphenol and PCB153.
related to: methodological framework for S-LCA, goal&scope definition (in particular regarding the system boundary definition), data access, and use of qualitative data, methodologies and selection of indicators for the impact assessment phase. The strengths of the methodology are related to its capability of making the assessment of the product more complete, adding its social aspects to the environmental and economic ones, in addition to the increased transparency and traceability along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were identified, 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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Giving that textile and especially leather industries facing constant discussions on social compliance mostly in relation to bad working environments and thus cause severe social impacts for different stakeholder groups along the supply chain due to e.g. unhealthy working conditions. In order to determine social impacts occurring during the leather production processes, social life cycle assessment’s (S-LCA) implementation is of major importance. Practical implementations have to consider indicators and impacts determining social hotspots along the supply chain and should in addition provide information on social challenges and chances by means of negative and also positive social impacts. When assessing products’ life cycles the inclusion of positive social impacts is crucial, as most of the S-LCA indicators can be both positive or negative. Thus, this study aims at providing a social significance analysis (SSA) determining social hotspots along the leather 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 primary data and processing critical topics along the supply chain, e.g. existence of labor laws. Relevant social hotspots are identified. Depending on the indicator direction, social consequences (e.g. benefits in societal health resulting from non-exhausting work hours) can be determined for the stakeholder groups. The inclusion of positive impacts may function as an incentive for improvement and guide the way towards future developments within the European leather industry. The results may also be transferred to further product groups in the global textile and leather industry.

565 Integration of sustainability in industrial research and innovation: perspectives from ArcelorMittal's experience

A. Hettlinger, M. Caraty, R. Turconi, ArcelorMittal / Sustainability RD; P. Cortijo, Utopies

The iron and steel industry is both a large contributor to greenhouse gases emissions and a provider of a key material for society's development, being used in a wide range of market sectors such as infrastructure, transport, construction and packaging. Because of its durability and capacity to support sustainable development it is essential to ensure efficient production processes, optimizing the use of resources, valorization of byproducts, but also to explore the other stages of lifecycle of products that use steel, i.e. to adopt the holistic approach of Life Cycle Assessment. Lifecycle thinking enables ArcelorMittal - the world’s largest steel producer - to promote sustainability not only in its own operations but also in the use of its products by customers. For more than a decade a research team dedicated to sustainability and lifecycle assessment has been supporting the process and product research within the group. However, with more than 1,000 researchers in 12 research centers globally and hundreds of projects carried out every year, it is impossible for a single team to cover systematically the research performed. To this goal, the “Sustainable Innovation Tool” has been developed to enable the researchers of the group to self-assess their projects sustainability. Using the tool, they evaluate environmental and social aspects of their new processes and products and engage in a learning curve for an improved sustainable performance. The presentation will describe the collaborative development of the tool, the different phases of testing and the current start of the deployment across 6 research programs. We will draw on this experience to provide elements that supported its success, pitfalls to avoid. The company is at the start of this journey and seeks a continuous progress, and possible paths for a better integration between our current assessment of industrial research and generic frameworks such as the sustainable development goals will be discussed.

566 Social footprint of a packaging waste deposit-refund system in Spain

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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 used packaging. The social footprint developed by WEIDEMA et al. (2017) is an example of how the summation of social costs during income redistribution and the sum of all productivity-reducing externalities related to an activity. It is calculated by a top-down approach using input-output data. This method can be understood as a ‘streamlined’ social LCA. We applied its two general components: the income redistribution impact (IR): the increase (or loss, if negative) in utility caused by the transfer of money from one societal group to another, and the productivity impact (loss) from missing governance (PG): the difference between the actual purchasing-power corrected value added and the potential value added when all productivity impacts are internalised. The social footprint of an activity can be defined as $SF = IR + PL$. We compared two scenarios, namely the current situation for household packaging waste in Spain in 2014 (system A), and a hypothetical scenario (system B) where a DRS is implemented. The functional unit was the total amount of packaging waste to be managed annually. Primary data for the two scenarios were obtained from the environmental and economic studies performed as part of this project. Data to quantify the social footprint were obtained from the database Exiobase v.3.3.10, which was implemented in the software SimaPro. The results show that the social footprint for both systems involves a net social benefit. However system B reduces this benefit by 50% compared to system A. Introducing this DRS system in Spain is expected to lead to a net loss in social benefit compared to the existing system. The social benefit of the increased recycling is more than outweighed by the social costs induced by the activities required to achieve these higher recycling rates (collection manually or automatically of packaging waste in shops and supermarkets and the related transport). This is an example of how the summation of 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 non-metal 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 toxokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable to describe the resulting concentration in static, semi-static and static exposure concentrations 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 L. Henneberger, Helmholtz centre for environmental research - UFZ / Cell Toxicology; M. Mühlenbrink, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; B. Fischer, Helmholtz Centre for Environmental Research GmbH - UFZ; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology

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 chemicals into mass-balance or equilibrium concentrations (Ceq), which are considered more meaningful dose metrics than nominal concentrations. In vitro exposure assessment might be challenging for pesticides and pharmaceuticals that are organic acids, due to their unusual partitioning behaviour. Hydrophobic acids are typical ligands for serum albumin and are consequently strongly bound to medium proteins in in vitro assays, while the concentrations of low molecular weight, reliable models are available to calculate the binding of neutral chemicals to lipid, protein, medium and cells, the binding of organic acids to biological matrices cannot be easily predicted. Here we applied a third 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., Ceq). Because polymers like polydimethylsiloxane that are typically used for solid phase extraction (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: dichloracene, 2,4-D, iprophen, naproxen, warfarin, trichloros, and gentisic acid. After allowing for mass balance and equilibrium, the SPME fibre and water was established within 4 h and the determined fibre-water distribution ratios were reproducible (SD ≤0.1 log units). Because the sorption of some of the chemicals to the fibres was concentration dependent, it was required to calibrate the fibres for the desired concentration range. The SPME method was applied to measure Ceq in cell culture media. At low chemical concentrations the results from the binding experiments agree with the predictions from a mass balance or modelling approach. However, saturation of the medium was observed at high chemical concentrations and further experiments will be necessary to investigate for which chemicals and at which concentration levels saturation occurs and if it is required to incorporate non-linear binding into existing exposure models for in vitro bioassays.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays L. Nuesse, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; S. Steffens, RWTH Aachen University, Institute for Environmental Research / Institute of for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis; E. Salomons, OptiWater; N. Riechter, Universität Duisburg-Essen / Aquatic Ecology; M. Schumann, University of Duisburg-Essen / Aquatic Ecology; R. Doering, RWTH Aachen University / Institute of Hydraulic Engineering and Water Resources Management; C. Bruehl, RWTH Aachen University; H. Schuettrumpf, RWTH Aachen University / Institute of Water Chemistry; P. Fischer, Helmholtz Centre for Environmental Research, Oxford; Technion Israel Institute of Technology / Civil and Environmental Engineering; H. Hollert, RWTH Aachen University / Institute for Environmental Research; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre;

The contrasting demands of performing bioassays in compliance with regulatory test guidelines at high throughput while using affordable and user-friendly components for automation technology to assist with automated handling and analysis of multwell plates. Such systems are typically highly sophisticated and thus costly. As a consequence, the availability of pipetting robots, liquid handlers, and stacking units in environmental monitoring is generally scarce. As a potential solution, we developed a simple and low-cost, versatile open-source pipetting robot that has a small footprint. The construction of the pipetting robot was realized mostly using readily available parts, and partly using open-source hardware. We tested its precision in automated 2-fold dilution series and used it for exposure of zebrafish embryos (Danio rerio) – a common model species in ecotoxicology - to cadmium (Cd) and permethrin. As expected, concentrations of permethrin rapidly decreased after initiation of static exposures and after each renewal in the semi-static exposure experiments. No such drastic differences were observed for exposures conducted using the pipetting robot. The accuracy of the pipetting steps was generally high. The apparent toxicity was not only greater in zebrafish embryos exposed to permethrin and cadmium using manual semi-static renewal (24 h interval) but also in the case of static exposure concentrations. We demonstrated the ability to automate semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the robotic system can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has makes automation technology accessible to a much higher number of laboratories around the world.

571 An intestinal fish cell barrier model to assess absorption of poorly soluble organic chemicals in vitro H. Schug, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Toxicology, F. Bungn, Firmenich / DRAP, C. Debonville, Firmenich / Research and Development; F. Berthaud, V. Laubscher, Firmenich SA / DRAS, R. Planer, Eawag / Product Safety and Regulatory Affairs; K. Schirmer, Eawag / Environmental Toxicology

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, RTgutGC, and a newly constructed chamber that enables stable chemical exposure concentrations. In this setup, we measured the permeation of 10 fragrance compounds with a range of volatility (logHLc = -5.8 to -2.2) and hydrophobicity (logKow = 3.6 to 5.7). The RTgutGC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer combined diffusion controlled permeation and intestinal biotransformation. The involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of the model, which correlated with the logKow. The chamber enabled stable exposure concentrations and close to full recovery at the end of the exposure times in the model without the presence of a chemical sink in the basolateral maintained the concentration gradient and increased the permeation by approx. 1.5 to 3 times, depending on the logKow. At present, there are no comparable intestinal permeation data for fish available, which precludes a direct comparison of the in vitro measured rates with in vivo observation. However, exactly this unavailability of data highlights the importance of the development of such a model for use with volatile at the intestinal epithelium. Data derived with this barrier model can help to 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? T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; L. Beckers, Helmholtz-Zentrum für Umweltforschung GmbH - UFZ / Environmental Toxicology; M. Koenig, B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. Krauss, Helmholtz Centre for environmental research - UFZ / Effect-Directed Analysis; m. uzf - Helmholtz Centre for Environmental Research / Cell Toxicology; P.A. Neale, Griffith University / School of Environment; J. Slobodnik, Environmental Institute; Z. Tousova, Masaryk University / RECETOX; P. Valtlado, Finnish Environment Institute / Laboratory Centre; K. Walz, MAXX Mess- und Probenannahmeknik GmbH; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

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 approach and apparatus (LVSPED) 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 onboard, allows fully automated sample processing and avoids the transport of larger water volumes to laboratory for filtration and extraction. LVSPE was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LVSPE is applicable in monitoring and survey programs, to assess surface water and wastewater with effect-based tools and to unravel one of the causes of mutagenicity in the river 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 5th 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 or even missed based on exceeding 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 #00554-214).

From detection to action: advancements in assessing and managing highly fluorinated compounds

574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils
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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 perfluoroalkyl and polyfluoroalkyl substances (PFASs). Following the improved employment of firefighting training activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFASs could surpass the concentrations of legacy PFASs by orders of magnitude, indicating the need for in-depth characterization of their transport potential and effects in ecosystems. The methods currently available for the analysis of 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 cannot be compensated through isotope dilution due to the lack of matching bioassay. Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs of the AFFF-non-target library 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 amine-based (e.g., PFHxSAs) PFASs at such sites.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination
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Perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their water, dirt and moisture 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 dealt with investigation of these materials. A total of 23 samples from products used in building industry and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C₄ to C₁₄, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C₄-C₁₄) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalky 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 perfluoroalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and thus important for mitigating future risks. Here, we report serum concentrations 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. Perfluoroarboxylic acids (PFCAs) with nine or more carbons (C₉-C₉) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, r = 0.72). Toxikokinetic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a decline in whale consumption in recent years. A previous study reports PFASs in Faroese drinking water were below detection. We thus infer that even in a major seafood consuming population, declines in SPFAS exposure after 2000 were achieved by the rapid phase out of PFOS and its precursors in consumer products.

123 SETAC Europe 28th Annual Meeting Abstract Book
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 ($K_{ow}$) can not be determined experimentally. Due to the lack of experimental data, QSARs to predict $K_{ow}$ are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant ($pK_a$) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of a $K_{ow}$ value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements 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 phospholipids: 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 rely on experimental $K_{ow}$ values, but simply takes 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning ($K_{ow}$) of the ionic perfluor species, and the predictions on $pK_a$. Whereas COSMOtherm accurately predicts $K_{ow}$ for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on $pK_a$ of alternative PFASs, e.g. Gen-X. Negative surfactants do exert a great preference on electrons of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

578 Impacts of ocean circulation on the marine PFOS burden in an era of geographically shifting emissions
C. Wagner, Harvard University / Harvard John A Paulson School of Engineering and Applied Sciences; C. Thackray, Harvard University / School of Engineering and Applied Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Laboratory of Pollution Control and Resource Reuse, School of the Environment; E.M. Gouin, Harvard University / School of Engineering and Applied Sciences
Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluoroctane sulfonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS release. In the study, a novel method was required to track and quantify 3D-molecular charge densities of PFOS samples with a high sensitivity to the concentration of PFOS. Biomonitoring studies, pose a threat to 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 our work we developed a PFOS ocean sedimentation for the North Atlantic and Greenland. Per capita PFOS emission factors were derived from waste-water treatment plant measurements. This work showed that in 2015, 60 percent of historic inputs from North America and Europe continued to be present in the North Atlantic, whereas 30 percent had been had been transported into the Arctic Ocean and 10 percent to the Tropical Atlantic. Here we extend this work to develop a global PFOS ocean sedimentation including emissions from China. The global ocean model is forced by historic PFOS releases from 1958-2015 and simulates realistic ocean physics and chemistry. Based on lateral and vertical transport processes and particle associated export we estimate PFOS residence times in the biologically relevant zone of the ocean and present the contribution of different source regions to the oceanic PFOS burden, as well as the importance of precursors. This work will provide insights into future risks associated with shifting source regions and PFOS precursor releases.

579 PFAS pollution at airport sites: point and diffuse sources, fate and transport and remediation
S. Heli, G.D. Breivel, Norwegian Geotechnical Institute
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 PFASs (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 (AFFF) containing PFASs have been used in order to practice extinguishing fires. 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 the compounds allows more informed regulatory decision making and given that the regulation of PFAS is currently under the spot light 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 sorbant amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS leaching up to 99%.

Improvements in environmental exposure assessment:
S. Pavlopoulos, C. Wagner, C. Thackray, Harvard University / School of Engineering and Applied Sciences; C. Wagner
Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; A. Di Guardo, University of Insuubria / Department of Science and High Technology; T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; M. MacLeod, Stockholm University / Department of Environmental Science and Applied Chemistry
Environmental fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and limitations of models 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 complexity of ecosystem structures and functions, and the need of tools 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.

581 Development and update of environmental exposure assessment tool EUSES for REACH and BPR Regulations
S. Fattini, ECHA-European Chemicals Agency; R. Cesa-Nairis, European Chemicals Agency; H. Schimmelflenning, European Chemicals Agency; H. Magaud, European Chemical Agency
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 2003) that harmonised 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 and distribution, chemical properties and functions in risk assessment). Fate and distribution module (including interaction with the release estimation module) as well as release estimation module are in the focus of the update process. Update needs and developments The release, fate and distribution modules should be improved based on the development having occurred over the last years, in particular: Implementation of existing and newly developed emission scenario documents (ESD) for biocides in the release module of EUSES. Complementing the release scenarios covered by EUSES, Expanding the applicability domain and exposure

580 Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; A. Di Guardo, University of Insuubria / Department of Science and High Technology; T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; M. MacLeod, Stockholm University / Department of Environmental Science and Applied Chemistry
Environmental fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and limitations of models 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 complexity of ecosystem structures and functions, and the need of tools 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 potential improvements or updates to SimpleTreat (scientifically and IT support/settling). 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 L. Della Pietra, Fertilizers Europe; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; R. Puska, Yara Suomi; M. Bjorgan, Yara International ASA; K. Oorts, ARCHE. Fertilizers are considered as formulations and therefore no registration or chemical safety assessment is required under REACH. However, use of the individual constituents needs to be covered in the chemical safety reports (CSR) of the respective substances. Currently, exposure and risk assessment of fertilizer use is mainly described in a qualitative way because of the lack of appropriate environmental release categories (ERCs) and exposure models. Under the umbrella of Fertilizers Europe and the FARM REACH consortium, the fertilizer sector has developed a fertilizer sector uses map. In addition, four sector specific ERCs (SPERCs) were developed, by grouping similar uses, mainly based upon their physical form and application mode. Next, a Fertilizers Environmental Exposure tool (FEE) tool was developed, since in the standard REACH models for environmental exposure assessment (EUSES, ECETOC TRA, CHESAR), no local sources for direct emission (i.e. hydro) was considered to test the framework proposed for exposure assessment. The scheme serves as a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. K. Oorts, M. Heijen–R WK 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 M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); E. Undeman, Stockholm University / Baltic Sea Centre; F. P. Woodhead, Stockholm University / Environmental Science and Analytical Chemistry ACES; M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry One of the grand challenges of environmental chemistry is to be able to predict human exposure to an environmental contaminant based on its emissions. In this paper we explore how, after decades of excellent research by scores of scientists, we can extend this to the global scale. Can a global scale model, persistent, hydrophobic and semi-volatile pollutant was chosen as the test chemical. We used physico-chemical properties recommended by Schenker et al. and global historical emissions estimates developed by Breivik and co-workers to drive the global multimedia fate and transport model BEITR Global. 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. The human diet in ACC-HUMAN was parameterized for each country based on the WHO Global Environment Modeling System (GEMS) vegetarian diets. The modeled concentrations of PCB 153 in human milk were compared with the concentrations measured in the WHO/UNEP global monitoring program for POPs. The predicted and observed concentrations were highly correlated, with a correlation coefficient of 0.76. For 49 out of 78 data points, the predictions and observations agreed within a factor of 4. The model over-predicted the concentrations in central Europe and under-predicted the concentrations in much of Africa, in particular West Africa. Potential weaknesses identified in the chain of models include an under-prediction of the rate of decrease in PCB concentrations in air since the 1980s and inadequate treatment of food sourcing. We conclude that we have come a long way towards meeting this grand challenge for PCB 153, but there remains room for improvement! References U. Schenker et al. Environ. Sci. Technol., 2005, 39, 8434-8441. K. Breivik et al., Environ. Sci. Technol., 2016, 50, 799-805. M. MacLeod, et al., Environ. Pollut., 2011, 159, 1442-1445. G. Czub and M. S. McLachlan, Environ. Toxicol. Chem., 2004, 23, 2356-2366. https://undatalocatalog.org/dataset/gsm-food-consumption-database M. van den
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

586 Regulatory tools and activities for environmental risk assessment of nanomaterials in ECHA

A. Kapanen, European Chemicals Agency - ECHA; L. Deydier Stephan, European Chemicals Agency / Evaluation Directorate; V. Rodriguez Unamuno, A. Karjalainen, J. Holmqvist, European Chemicals Agency ECHA European Chemicals Agency (ECHA) implements the REACH Regulation (EC) No 1907/2006 (Registration, Evaluation and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC No 1272/2008). Industry and authorities need to fulfil their obligations regarding these regulations also for nanoforms as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH will benefit from nano-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(e). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 6). ECHA currently performs three type of activities to implement REACH, CLP and BPR regulations and to support these processes aiming at ensuring safe use of nanomaterials (NM): REGULATE: formal processes under regulatory frameworks, whereby ECHA uses the legal instruments available under REACH (substance dossier evaluation, authorisation and restriction), CLP and BPR, SUPPORT: helpdesk, meetings with stakeholders and with Registries, Nanomaterials Expert Group (NMEG), COMMUNICATE: ECHA Nanomaterials web-site, conferences, workshops, communication throughout the supply chain and in a broader context e.g. EUON and press. This presentation will provide a summary of the multiple actions taken by ECHA to address NM under REACH, CLP and BPR: Dossier and substance evaluation, NMEG, EUON and ECHA’s involvement at OECD level. Communication is currently considering modifying some of the technical provisions with the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

587 Building a Risk Assessment Framework for Nanomaterials in Canada

M. Sauve, Environment Canada; A. Shahsavari, Environment and Climate Change Canada

Despite the potential benefits associated with the use of nanomaterials, concerns also exist as to potential environmental and human health risks as a result of environmental exposure to nanomaterials. Canada regulates chemical substances, including nanomaterials, under various regulatory mechanisms. The Canadian Environmental Protection Act, 1999 (CEPA) and the Chemical Management Plan (CMP) are key in safeguarding Canadians and the Canadian environment from potentially harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.

588 Inventory of available tools, methods, approaches and best practices on nanomaterials/nanotechnologies

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The EC4SafeNano initiative, founded by Horizon 2020 is an ongoing effort to build a European Centre for Risk Management and Safe Innovation in Nanomaterials and Nanotechnologies. EC4SafeNano aims to bridge the gap between scientific knowledge on hazard and risk, and ‘fit-for-purpose’ risk management tools and strategies supported by measurement and control methods. The Centre of European organisations will offer services for Risk Management and Safe Innovation for Nanomaterials & Nanotechnologies. One of the first actions of the project was developed an inventory of available resources related to nanosafety issues. Indeed, until now, many tools and studies which aim to improve human and environmental nanosafety have been developed by research organisations and EU funded projects. Therefore this inventory have the aim to give a useful overview on tools, methods, trainings, standards, standard operating procedures (SOPs), guidance documents and best practices in nanosafety, quality criteria are included to guide users the possibility to select or sort resources based on example of EC4SafeNano. This inventory will be published on the EC4SafeNano website. There is a large number of Standards (77) and SOPs (136) that can help the end user to conduct testing on toxicity and eco-toxicity, or measurements in workplaces and environment. One important issue is the scarce number of trainings available only 5. This aspect will be addressed in the EC4SafeNano project to identify the specific training needs and then be useful to promote a harmonized training on nanosafety issues and the amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated

589 The Application of Ecotoxicological Tools to Safer-by-Design Strategies for Engineered Nanomaterials

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OECD test guidelines using aquatic organisms have been identified as suitable starting points for identifying risk that engineered nanomaterials (ENMs) risk represent for the environment. However, standardized testing (mainly relevant for foodstuffs species) may not adequately capture the risk and dynamic behavior of ENMs in the environment, in particular for aquatic regions like coastal areas which are the ultimate sink for all land based contaminants. As a result, the addition of less conventional organisms to regulatory projects can promote the characterization of environmental risk nanomaterials pose. Mytilus species have a long history of being used as sentinel organisms to characterize ecosystem health and can be useful to promote a harmonized training on nanosafety issues and the amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated

590 Minimising the risk posed by TiO2 nanomaterials used in sunscreen throughout the entire product lifecycle

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The presence of TiO2 nanomaterials in sunscreen is an increasing concern due to their long history of being used as sentinel organisms to characterize ecosystem health and can be useful to promote a harmonized training on nanosafety issues and the amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated

126 SETAC Europe 28th Annual Meeting Abstract Book
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

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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

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Cyanotoxins (CTs) produced from cyanobacteria in surface water during harmful algal blooms can pose significant threat to human health and the environment. Their analytical determination in both biomass and water is a demanding task as CTs comprise a large variety of compounds with different structural and physicochemical properties, i.e. cyclic peptides (microcystins, MCs and nodularins, NODs) and alkaloids (cylindrospermopsin, CYN, anatoxin-a, ANA-a and saxitoxins, STXs). The most important issues that make the CTs’ analysis challenge is the large number of variants of various classes, the limited availability of analytical standards and insufficient validation data. Moreover, different methods of analysis are usually required for each class of CTs in order to achieve acceptable analytical performance. Based to the above there is a need to develop efficient multi-class/variant method protocols for analysis of as many as possible CTs. Our laboratory has recently developed and validated SPE-LC-MS/MS method for determination of multi-class CTs. As an example, analysis of 12 MCs ([D-Asp]MC-RR, CC-RR, CC-YR, MC-HyR, [D-Asp]MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp]MC-RR, MC-RR, MC-HyR, MC-WR, MC-LA, MC-LY, MC-LW and MC-LF), NOD, CYN and ANA-a in one run can be achieved. In addition, validated multi-variant methods for the analysis of STXs based on HILIC-MS/MS have been developed. Those methods have been combined in workflow to analyze multi-class toxins efficiently. The aim of this study was to demonstrate the applicability and efficiency of a proposed workflow for multi-class/variant determination of CTs. Furthermore, to detect and identify a wide range of CTs in Greek lakes never studied before, using this validated tool, Results of a monitoring survey in Greek lakes showed that the proposed LC/MS/MS based workflow provided unequivocal and definitive identification of multi-variant/class toxins, avoiding the drawbacks of bioassay techniques that have been used previously. Using the proposed workflow a wide range of MCs ([D-Asp]MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp]MC-RR, MC-RR, MC-HyR, MC-WR, MC-LA, MC-LY, MC-LW and MC-LF), NOD, CYN, ANA-a, STX and neoSTX were identified in Greek lakes for the first time. Acknowledgements The authors thank CYANOCOST – COST Action ES 1105 www.cyanocost.net

593 Interactions between cyanobacteria and daphnia

G. Bogajzica, UMR CNRS Ecobio; M. Boronas, UMR CNRS Ecobio / UMR Ecobic; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phycotoxines / Unité DYNECO / Dept. ODE; C. Wieczeg, Université de Rennes 1 / UMR CNRS ECOBIO

Thanks to their adaptation capability, cyanobacteria have become an important factor in the aquatic environment, particularly in areas affected by Eutrophication. The presence of cyanobacteria in waterbodies has promoted and will increase the number of cyanobacteria blooms, 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 reacted to spent medium from Microcystis aeruginosa PCC7806 cultures to alter morphology, growth rate and photosynthesis. The results of this study confirm 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 detoxification and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 reacted to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogen peroxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.

594 Teratogenic retinoid-like compounds produced by cyanobacteria into surface waters

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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 extracts 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.

Saponins in the aquatic environment: hydrolysis and toxicity
R. Xiang, University of Copenhagen; H. Hansen, University of Copenhagen / Laboratory of Plant and Environmental Sciences; B.W. Strobel, University of Copenhagen / Plant and Environmental Sciences; N. Cedergren, University of Copenhagen / Department of Plant and Environmental Sciences
Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopesticides in crop protection. They may lead into the aquatic environment due to their low octanol/water partition coefficient and poor binding to organic matter. They may therefore pose a risk to the aquatic organisms. However, their fate and toxicity in the environment are not fully understood. Hence, we aim to investigate the pH and temperature dependence of saponins 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°C, while decreased to 0.06 ±0.01 day at pH 10.0. The hydrolysis was also influenced by temperature with an activation energy of 56.9 ±14.2 kJ/mol at pH 7.2. Lake waters with pH varying between 6.4 and 8.2 showed completely different hydrolysis patterns, with a fast initial dissipation of up to 60% of the initial saponin concentration, followed by an extremely slow to nil reaction, making saponin partially persistent in lake waters. The maximal concentrations protecting 95% of the aquatic species (HC) derived from the SSD’s saponins from quillaja bark, tea seed coat, and quinoa seed coat were 2.91 ±0.01, 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
C. LaLong, U.S. EPA / Mid Continent Ecology Division; G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.R. Embry, ILISH Health and Environmental Sciences Institute (HESI); G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences; S. Munn, European Commission; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Hygiene Laboratory; D. L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; M. Whelan, University of leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues; X. Zhang, Nanjing University / Environmental Science; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre
International Horizon Scanning Approach
Setting the Stage to Advance the Adverse Outcome Pathway Framework through Horizon Scanning
Adverse outcome pathways (AOPs) are an important framework that can help support more effective use of mechanistic, pathway-based, data in risk assessment and regulatory decision-making. AOPs have rapidly evolved from a conceptual paradigm into a formalized framework for organizing biological and toxicological knowledge. Adverse outcome pathways are generally linear diagrams. In response to the recognized need to continue advancing the framework, SETAC sponsored a global horizon scanning exercise to identify major outstanding topics and challenges related to the AOP framework and its application. The development of guidance related to AOP network development and analysis was identified as a critical need. This report captures the expert findings of the exercise, and answers to FAQs, which were 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 development and assessment of individual AOPs. Next, the application of filters and layers is discussed, which can be used to refine and enrich derived AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application case studies is used to illustrate concepts under 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 necessarily reflect the policies or viewpoints of their employers or institutes.

Building and Applying Quantitative Adverse Outcome Pathway Models for Chemical Hazard and Risk Assessment

S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; R. Ashauer, University of York / Environment; R. Connolly, US EPA RTP; B. Landesmann, JRC, 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; J. E. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory Quality Assurance and Environmental Impact Assessment; N. Konijnendijk, University of Twente / Institute of Environmental Sciences. In response to the recognized need to continue advancing the framework, SETAC sponsored a global horizon scanning exercise to identify major outstanding topics and challenges related to the AOP framework and its application. The development of guidance related to AOP network development and analysis was identified as a critical need. This report captures the expert findings of the exercise, and answers to FAQs, which were 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 development and assessment of individual AOPs. Next, the application of filters and layers is discussed, which can be used to refine and enrich derived AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application case studies is used to illustrate concepts under 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 necessarily reflect the policies or viewpoints of their employers or institutes.

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

T. Hill, US EPA NHEERL Integrated System Toxicology Division; P. Browne, OECD / OSCP; K.K. Coady, The Dow Chemical Company / Toxicology Environmental Research and Consulting; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); T. Hutchinson, School of Biological Sciences, Plymouth University / School of Biological Sciences; E. Lienala, OECD; L. Maslankiewicz, National Institute for Public Health and the Environment (RIVM); T.M. Steege, U.S. EPA / Office of Chemical Safety and Pollution Prevention. An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway Concept: An International Horizon Scanning Approach,” that took place in Cornwall, Canada during April 2017. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Ensuring Long-Term Utility of the AOP Framework and Knowledge for Stakeholders

G.T. Ankle, U.S. EPA / National Health and Environmental Effects Research Laboratory; A. Carusi, University of Sheffield; H. Davies, WA State Dept of Health / Dept of Ecology; G. De Grandis, Norwegian University of Science and Technology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; G. Hodges, Unilever Research / Safety and Environmental Assurance Centre; K. Lee, The University of Hong Kong; W. Marchant, University of Cambridge / Institute of Environment, Health and Society. The adverse outcome pathway (AOP) framework serves as a knowledge and communication tool to facilitate translation of mechanistic (e.g., molecular, biochemical, histological) data into adverse apical outcomes meaningful to chemical risk assessment. Although initially designed for ecotoxicology applications, the framework has also received extensive attention relative to chemical safety assessments for human health. Moreover, as the AOP concept and associated knowledgebases have evolved, it has become recognized that the potential stakeholder community is broader than scientists and regulators directly involved in chemical safety assessment. For example, the application of AOP-based thinking for addressing biomedical challenges has become increasingly evident. This presentation will identify various stakeholders who currently, or could potentially, benefit from application of the AOP framework and knowledge to specific needs, and describes challenges and strategies to effectively engaging these stakeholders. We also present a “roadmap” on how to maintain a viable, sustainable network to support AOP stakeholders, including recommendations for governance and coordination of AOP development and knowledge dissemination in a multi-stakeholder consortium. The contents of this abstract neither constitute, nor necessarily reflect, official USEPA policy.
its introduction in 2010, it was recognized that a survey of the broader scientific community would be useful in identifying shortcomings and in guiding future initiatives. In 2016, we reached out to national and international scientific and regulatory communities to collect questions and provide an opportunity to discuss key outstanding challenges that must be addressed in order to realize the full potential of the AOP framework. Four key themes emerged from this “Horizon Scanning” exercise (see presentation “Advancing the Adverse Outcome Pathway Framework – An International Horizon Scanning Approach” in this session), which were then addressed at a Society of Environmental Toxicology & Chemistry (SETAC) Pellanom 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 Pellanom 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 present a rigid tool but rather a knowledge repository for diverse stakeholders ranging from epidemiologists to mainstream experimental toxicologists to risk assessors and managers. Furthermore, while considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Environmental specimen banks in research and regulation for a better environmental quality

604 Monitoring of POPs in the Swedish aquatic ecosystem and in human milk E. Nyberg, A. 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, herrings, cod, eelpout, blue mussel and egg from guillemot, oystercatcher and common tern are annually collected. In 1967, examination of human exposure to POPs was initiated by Karolinska Institutet in Stockholm through measurements in human milk from the area, and since 2007 milk has also been collected from Gothenburg in the southwest of Sweden. The milk samples were in 1997 transferred to the Environmental Specimen Bank at the Swedish Museum 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.


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 different ecosystems, and their accumulation behavior going back to the 1980s, e.g. from coastal herring gull 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 R. Push, C. Bryan-Salle, W. Davis, J. Lynch, B.A. Neely, J. Ness, S. Schuur, National Institute of Standards and Technology / Chemical Sciences Division 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 (M-ESB) 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 cDNA expression studies, and 2) facilitate the generation of microarrays taken in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well-ordered genome, and 2) the discovery of using total metagenomics as an alternate tool to aid in 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 Nizetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkowski, 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 continuously monitor the indoor environment and not contaminated during handling and storage. Strict quality assurance (QA) protocols are applied at the individual ESBs, including specially dedicated laboratories, no use of personal-care products, cleaning routines and more. More complicated to control is the indoor air and dust in the laboratories and storage locations. Building materials and indoor objects may contain and further enhance the release CECs to the indoor environment. To evaluate trends in concentrations of perfluorinated alkyl acids (PFAs), polybrominated diphenyl ethers (PBDEs) and polybrominated diphenyl ethers (PBDEs) are found at low levels. Weather the high levels observed in indoor air and dust affect the ESB samples or not is to be further studied but the findings highlight an important aspect to take into consideration in the QA protocols of ESB.

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
identification via DNA barcoding and high throughpout sequencing, such samples can be most helpful in documenting and interpreting environmental change. Accumulated snippets of free DNA in soil or water samples (freshly collected or from ESBs), so-called environmental or edNA, enable the comprehensive appraisal of species compositions in a multitude of environments. DNA extracted from ESB samples should be deposited in dedicated DNA banks in order to make this resource available to the scientific community and to best-evolving DNA analysis methodologies (which may prompt repeated analyses of samples over time, with ever-increasing amounts of genomic data recovered). Thus, by adding DNA banking to their service spectrum, ESBs can considerably increase their visibility and public demand. Furthermore, they can foster knowledge aggregation at the biodiversity level around their ESB samples, making these more valuable.

609 Discussion on environmental specimen banking in research and regulation

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 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-tired 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 ERICA-tool for 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 environmental risk was verified in Tier 2 where species group specific radiation as a first approach in order to combine invertebrate and aquatic ecosystems. This study highlights the potential of adding DNA banking to their service spectrum, ESBs can considerably increase their visibility and public demand. Furthermore, they can foster knowledge aggregation at the biodiversity level around their ESB samples, making these more valuable.

614 Ecotoxicity testing of environmentally realistic contaminant mixtures using passive samplers: what can we learn from repeating toxicity tests over an extended period of time?

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In current environmental risk assessment, researchers assess effects caused by single substances to single species and extrapolate for realistic conditions where organisms are usually exposed to complex contaminant mixtures. The use of passive sampling opens new possibilities to work with such mixtures and to transfer them into biotest systems by either applying passive dosing (for equilibrium based samplers) or extract spiking (for integrative samplers). Our research objective was to investigate whether or not environmentally realistic contaminant mixtures...
(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 harbor of Zeебrugge (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 analysis of the chemical composition of the chemical mixtures was undertaken. Analytical methods like GC-MS and LC-MS were used to identify those presented in Table 1. However, due to the complex chemical mixtures containing many hundreds of compounds, it was not possible to identify all chemicals and therefore they were grouped into chemical classes. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the accuracy of the lab to field extrapolation highlights the need for further understanding of the toxicity of test chemicals for soil organisms in natural soils. A screening project has been initiated in spring 2016, comprising a literature review aiming to investigate the effects of soil properties on the impact of PPP’s on soil organisms. The practical part of the project included laboratory studies on *Eisenia sp.* and *Folsomia sp.* on 4 PPP in 5 different soils. The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6.4. The highest differences were detected for *Folsomia sp.* exposed to the active substance Pendimethalin in OECD10% and Lafa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species *Eisenia sp.* as well as *Folsomia sp.* is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be set on the identification of key parameters influencing toxicity in different groups of species in order to create conceptual models allowing the extrapolation from the lab towards the field situation.

### 615 Marine Diatom Exposure to a Complex Mixtures of Fourteen Chemical Pollutants at Environmental Concentrations. What did we learn?

D. Napierska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; R. Carvalho, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; S. Chelinho, CFE Centre for Functional Ecology / Department of Life Sciences of Luz, University of Coimbra; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Costa, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; I. Sanseverino, European Commission Joint Research Centre; S. Balzano, M. Potalivo, ISPIRA Institute for Environmental Protection and Research; R. Loos, European Commission Joint Research Centre; D. Marinov, T. Lefteri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Thousands different chemicals are discharged into the environment from agriculture, industry, medical facilities, house-holds. Currently, there is an increasing concern for the environmental impact of mixture of compounds since the additive and eventhual synergistic effects are unknown and could produce serious adverse effects. To address this issue, a joint-effort of 16 European and associated research groups participated to an exercise to test a 14-substance synthetic mixture as a reference mixture at safety environmental concentration under the Water Framework Directive (Environmental Quality Standard, EQS). The mixture, was tested on the own routine bioassays to investigate the chemical mixtures effects (Carvalho et al., 2014). The bioassays covered the entire ecosystem from bacteria to fish as well in vitro assays providing an unique scenario from ecological risk assessment perspective. The results showed that effects were observed at very low concentration on algal-bacteria composition in a marine microcosm, immobilization in crustacean, fish embryo toxicity and frog embryo development. Transcriptomics analysis was performed for the marine diatom *Thalassiosira pseudonana* exposed either to single compound or the mixture to investigate whether the single exposure and multiple exposure would show different gene expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Diuron and Isoproturon. Signatures induced by the Cadmium or Nickel partially overlapped with the mixture signature. The exposure to the other compounds did in general not induce relevant signatures, although a weak overall consistent signature is present for some of them. In conclusion the effects of the mixtures could be explained mainly by the exposure to the two herbicides.

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

### 616 How protective is the current risk assessment for soil invertebrates?

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The present risk assessment evaluating effects from plant protection products (PPP) as well as other chemicals towards soil organisms encloses uncertainties. According to the European Approach on terrestrial ecotoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the accuracy of the lab to field extrapolation highlights the need for further understanding of the toxicity of test chemicals for soil organisms in natural soils. The soils used for ecotoxicity testing cover for the direct effects of the metals Cd, Co, Cu, Pb, Mo, Ni and Zn to soil organisms (plants, invertebrates and microbial processes) and calculates ecotoxicological threshold concentrations expressed as (pseudo-)total (i.e. aqua-regia extractable) metal concentrations in soil (mg/kg dry weight). All metals covered have sufficient chronic toxicity data for different species and functions allow the application of the species sensitivity distribution approach (SSD) to derive soil quality standards. This work was mainly triggered by the European legislation on chemical management (REACH) and the data were therefore primarily used to derive and used no effect concentrations (NEC) for risk assessment purposes. To facilitate a more flexible derivation of ecological quality standards for metals in soil for different protection goals (e.g. remediation thresholds), jurisdictions, regions or sites, while still making maximal use of the wealth of data and models already available, a metal soil threshold calculator tool has been developed. This freely available spreadsheet reports almost 1200 reliable toxic unit data for the direct effects of the metals Cd, Co, Cu, Pb, Mo, Ni and Zn and calcium carbonate and is not comparable to natural soils. The soils used for ecotoxicity testing cover for each metal a wide range of soil properties, making the results representative for most regions in the world. Several options are included to allow calculation of metal soil threshold concentrations for various goals (e.g. risk assessment or setting of remediation thresholds for different land uses): selection of organism groups or species to be considered, selection of...
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 ecotoxicological quality standards for metals in soil for different goals and different scenarios.

619 Assessment of pesticides on a landscape level - What is basically needed?

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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 intensive use of pesticides is considered to be a decisive factor, but the explanation 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 treatment on the contribution of the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thresholds for the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

620 Potential new soil test requirements for the risk assessment of pesticides in the European Union: do we have the right methods?

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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 contribution is to present an overview on the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thresholds for the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

621 Posterior spotlight: TH154, TH155, TH156

Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking

Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector

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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 expenditure, 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®<sup>©</sup>, 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] A. Lott, A. Curcius 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., Drzal L.T., Mohany 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. Watts, Wallington T.J. 2015. LCA of bio-composites: a case study of piano. Journal of Material Science 50: (7) 2007–2014. [4] Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture.

623 Resource depletion of a Lithium ion battery cell technology

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Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode materials, are available in the market, such as LiMn<sub>2</sub>O<sub>4</sub>, Li(Ni<sup>1/3</sup>Co<sup>1/3</sup>Mn<sup>1/3</sup>)O<sub>2</sub>. 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 the CRMs used in LIBs and in general in EVs. In this context, lithium rich layered oxides from the class xLiMn<sub>2</sub>O<sub>4</sub>–(1–x)CoO, (M=Ni, Co, Mn), known as L-NMC – NMC, have drawn attention as cathode material due to their high discharge capacity and lower cobalt content, compared with the Ni-Co-Mn cathodes (NMC). In this context, the authors carried out a Life Cycle Assessment of an 11.4 kWh LMO-NMC battery cells usually used in Plug-in EVs. We will show how the goals to assess the impact on the mineral, fossil and renewable resources depletion (MFRD); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRD; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRD and CRMs requirement. The LMO-NMC battery cell technology is modelled as 0.5LiMn<sub>2</sub>O<sub>4</sub>–(1–x)CoO, (xNi<sup>1/3</sup>Co<sup>1/3</sup>Mn<sup>1/3</sup>)O<sub>2</sub> 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 MFRD of 0.34 kg Sb<sub>eq</sub>. The relevant share of MFRD (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 MFRD 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 suitable technology to meet the demand of the EV market as it involves a lower impact on MFRD 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

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The transport sector causes environmental impacts that are mainly connected to the passenger car activities. In this context, strategies for reducing the environmental impacts related to the transport sector are required by moving from cars to alternative transport vehicles, such as electric bicycles. Although many studies have been focused on the application of the Life Cycle Assessment (LCA) method for assessing the environmental impacts of electric vehicles (EVs), there are...
few information regarding the environmental impacts connected to the life cycle of the charging infrastructures to operate the EVs, and, in particular, regarding the environmental performance of charging station for e-bicycles. This study aims to evaluate, through the application of the LCA method, the environmental burdens of a stand-alone charging station for electric bicycles manufactured in Italy, assuming its installation and 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, evaluated as 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 results demonstrate that the Climate Change impact related to the whole life cycle of the investigated charging station is 13.816.5 kg CO2 eq 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

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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 these penetration scenarios of the electric mobility adopting a Life Cycle Thinking perspective. The authors have been beyond a mere quantification of the primary materials required for the progressive electrification of the urban fleet, evaluating the raw materials availability from a market perspective and defining the limiting factor among three basic material of the current electric technologies (lithium, graphite and manganese). Therefore this work, starting from an evaluation of the material needed for different electric mobility penetration scenarios in the Italian urban fleet, wants to highlight the market dynamics especially for 3 primary materials widely required in the electric mobility focusing also on the possibility offered by a transition to a circular economy, investigating the green mining potential available for these materials both for their recovering in the same technology and in others fields.

626 Coupling dynamic carbon accounting and partial-equilibrium economic model for energy policy assessment

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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 ‘effect(s)’ 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 micropollutant concentration by passive sampling with testing of 15 biochemical endpoints. This hazard identification makes the distinction between low, acceptable and increased ecological risks. Only at sites where tier 1 indicates increased ecological risks, a customized tier 2 research is performed to identify the chemicals that cause the 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 expected that these ecological effects will be generally occurred at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wwp 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 mPASF determination (potentially affected fraction of water organisms due to multiple pollutants). At 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 mostly to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedick passive sampler extracts

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A major portion of the toxicants analysed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. Furthermore, the effects observed in surface waters cannot be limited by exposing a sorbent to the target environment, accumulating compounds from the water over time. Hence, there is an urgent need for a time-integrated effect-based monitoring strategy that employs a combination of passive sampling and bioassays, thus detecting bioanalytical responses caused by mixtures of all bioavailable compounds. Many pollutants of emerging concern are polar compounds, underlining the need to standardize the employment of polar passive samplers in such monitoring strategies. The aim of the present study was, therefore, to determine bioassay battery responses to extracts of two types of polar passive

samples, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced Speedisk, POCIS and Speedisk passive samplers were simultaneously deployed at sites likely to be contaminated with polar compounds, including agricultural greenhouse sites and wastewater treatment plant (WWTP) impacted locations. The extracts of the passive samplers were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERu, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKIT WaterSCAN for antibiotics activity. In addition, the Microtox test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger values exceedences and thereby to the detection of ecotoxicological risks. Hence, POCIS outperformed Speedisk in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzophenone, on zebrafish Q. MENG, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences

Sunscreen chemicals are used to prevent the skin and hair of human from the harm of ultraviolet light, and they are widely applied in a variety of personal care products. These materials are discharged to the environment continuously as daily care products. At present, many kinds of UV filters are found in surface water and polluted water, and their concentrations in the urine and blood of human are much higher than that in the environment, indicating that the UV filters have the possibility of bioaccumulation to cause toxic effects in the accumulated organisms. Benzophenone-3 (BP3), benzophenone-1 (BP1), benzophenone-2 (BP2), benzophenone-5 (BP5), benzophenone-8 (BP8), benzophenone-4 (BP4), benzophenone-6 (BP6), benzophenone-7 (BP7), octocrylene (OC) are four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larva and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BPs and OC and the molecular mechanism underlying the toxic effects. Docking analyses, 24 h and 96 h chemical exposures will be conducted on the ZFL cells to determine the potential binding affinities to the estrogen receptor (ER) and the half-lethal concentration (LC50) for the UV filter chemicals. The gene expression profiles on the ER pathway and the aryl-hydrocarbon receptor (AhR) pathway will also be measured by quantitative real-time PCR in ZFL and larvae exposed to the sunscreen chemicals. A dual-luciferase reporter gene system with AhR and ER clones transfected in ZFL cells will be used to confirm the biological activities of these sunscreen chemicals in ZFL cells.

631 Current status of in vitro bioassay approach in environmental risk assessment of androgenic environmental mixtures and individual organic contaminants M. Machala, Veterinary Research Institute / Chemistry and Toxicology; K. Penčíková, S. Strapáčová, Veterinary Research Institute, Brno / Chemistry and Toxicology; L. Svrčková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Neca, M. Ciganek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Bartonková, Z. Dvorák, Faculty of Science, Palacky University, Olomouc; J. Mařík, Institute of Experimental Medicine, CAS, Prague; J. Vondrácek, Institute of Biophysics, CAS, Brno

Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays combined with a detailed chromatographic analysis, and in some cases the effect-directed analysis, in order to identify principle modes of action of contaminants bound to river sediment, airborne or diesel exhaust particles. Toxicity profiling of selected individual contaminants was used as a complementary approach, which aimed to identify major toxic modes of action and principle contributors to specific toxicity effects. The AhR-mediated activity has been recognized to play a key role in toxicity of organic extracts of abiotic environmental mixtures. Using the DR-CALUX assay, we established relative effective potencies (REPs) for a large panel of polycyclic aromatic compounds, including PAHs, methyl-, nitro- and oxy-PAHs, thiophenes, dinitrophenolures, benzoazines and carbazoles, which complemented the available data on polychlorinated biphenyls, dibenzo-p-dioxins and dibenzofurans. Recently, we also developed REP values in human AhR-dependent reporter gene assay, in order to compare the potencies in rodent and human models. Using a set of various CALUX assays, receptors and selected individual classes of organic contaminants. The general outline of those studies will be illustrated using an example of a detailed in vitro toxicological evaluation of standard reference material of diesel exhaust particles (SRM 2975), with an aim to document both the complexity of the observed effects and the difficulties faced when applying these data in risk assessment of complex mixture. [The study was supported by the Czech Science Foundation, grant no. P503-12-G147.]

632 Hormone-like activities in waste water characterized by CALUX bioassays, target screening and identification of transformation products in wastewaters G. Papoutsis, only found in the Bay, VU University / DRC / LPTC / UMR 5805 CNRS; M. Dèvignier, University of Bordeaux / EPOC / LPTC / UMR 5805 CNRS; E. Maillot-Maréchal, INERIS / UMR SEBIO ECOT; E. Geneste, University of Bordeaux / EPOC / LPTC / UMR 5805 CNRS; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; H. Budzinski, University of Bordeaux

Wastewaters represent a major pathway of introduction of EDCs into the aquatic environment. Considering the uncertainty of the chemical identity of their possible transformation products, many EDCs are currently unknown. Therefore, characterization of the presence and identification of EDCs in wastewater 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 microplutants 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 reintroduced by the 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. Lakew, University of Saskatchewan; D. Shamblin, Saskatchewan; Toxicology Centre; M. Hecker, University of Saskatchewan; School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (Acipenser transmontanus) are a genetically unique population of fish which have inhabited the Nechako watershed for roughly 10,000 years. Within the last 50 years this population has suffered significantly because of anthropogenic activities. In the 1980s the Committee for Conservation of Fish and Wildlife in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations, in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional governments, industry, and public volunteers. The CWG plays a crucial role in communication, public outreach, and promoting community involvement. Activities of TWG and CWG support the mandate of the NWSRI through direct involvement of First 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; S. R. Patidar, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amarawansha, University of Saskatchewan / School of the Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; E. Hébert-Houle, Université du Québec à Trois-Rivières / 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 Elder Society; H. Snowball, The Northern Village of Kangirsualuajujuaq; R. Mickpegak, Sakkuq Landholding Corporation Kuujjuaarapik; 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 ineligies important on both biotic of life. One concern 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 Kuujjuaarapik-Whapmagoostui (K-W) and Kangirsualuajujuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. Work done during this project has gathered information on the fate, behaviour and toxicology of REEs in the Inuit communities. Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and biomagnify in northern food webs? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key species important for both biomonitoring and country food. Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

637 Te Ohu Mō Papatūānuku: A Collaborative Response to Healing T. Godfrey, H. Hirere, Te Whare Wanga 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 Ngāi Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formation of multiple collaborative groups, including a youth-based group and a group composed by indigenous members of Ngāi 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 community. 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 research however, is the role of indigenous knowledge—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 Papatūānuku research collaboration – using a synchronistic approach –
Drinking water advisory levels have been adopted by many regulatory agencies to
reduce chronic exposure to persistent fluorocarbons. However, most U.S.
advocacy 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 = 1,096)
of archived drinking water samples and serum samples. We evaluated the
relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that
home tap water is a significant exposure source for general American women.
In 1989–1990, the median contribution of drinking water to serum PFASs in women
in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies
across individuals and is predicted to be up to a factor of 2–3. We will investigate
how this ratio varies geospatially and whether it is associated with distance to
well-known point sources. The spatial analysis results will also be discussed in the
presentation. By comparing PFAS concentrations in archived tap water sample with
recent tap water samples matched on the township, we found the fraction of
quantifiable PFASs (i.e. known PFASs) has decreased in most towns and unknown
extractable organic fluorine (EOF) has increased. Our analysis suggests tap water
may be a significant exposure source for five PFASs 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 suggested to dominant overall exposure of
individuals in the NHS cohort prior to the restrictions and regulations of legacy
PFASs in the U.S.

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

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 Oeobre / 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 fluorocarbons. However, most U.S.
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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 suggested to dominant overall exposure of
individuals in the NHS cohort prior to the restrictions and regulations of legacy
PFASs in the U.S.
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 Chemistry, University of Michigan / Department of Environmental Health Sciences; O. Jolliet, University of Michigan

When interpreting biomonitoring data, we are limited by the cross-sectional nature of biomonitoring data and incomplete longitudinal data. It is important to differentiate between the potential influential of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product use. In addition, an overarching systematic approach to study measuring 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 persistency of chemical biomarkers from 16 different classes of chemicals from databases, literature, and extensive search of 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 aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Microgopions furinieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as biomarkers to evaluate the environmental quality assessment in tropical estuaries of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposition as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups 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 legacies of exposure trends for 229 chemicals in the US population. Integrating generically developed 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 greater deal of interest. The principle of the biomarker approach is to analyze the organism's responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Microgopions furinieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as biomarkers to evaluate the environmental quality assessment in tropical estuaries of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposition as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups 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 legacies of exposure trends for 229 chemicals in the US population. Integrating generically developed linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

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

C. Cheney, University of Ottawa / Biology; M.P. Potthier, J.R. Thienpond, University of Ottawa / Department of Biology; J.B. Korosi, York University / Department of Geography; L.E. Kimpe, University of Ottawa / Department of Biology; J.M. Blais, University of Ottawa / Biology

Natural resource extraction has supported the development of Canada’s 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 nanoplastics: Mechanistic

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


Using the monitoring of chemicals in the context 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 provide new tools to estimate the exposure. Using the monitoring of chemicals in the context 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 provide new tools to estimate the exposure. Using the monitoring of chemicals in the context 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 provide new tools to estimate the exposure.

Ecotoxicology of micro and nanoplastics: Mechanistic

138 SETAC Europe 28th Annual Meeting Abstract Book
approaches to understand their risk for the environment and human health

646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms

S. Ziajahromi, Griffith University - Smart Water Research Centre / Griffith School of Environment; P.A. Neale, Griffith University / School of Environment; A. Kumar, CSIRO / Center for Environmental Contaminants Research; L. Rintoul, Queensland University of Technology; F.D. Leusch, Griffith University / Australian Rivers Institute

Microplastic pollution has become a serious environmental concern. Microplastics associated with wastewater treatment plant (WWTP) effluent have been found globally in marine and freshwater environments. Nevertheless, the concentration of microplastics discharged via wastewater after different treatment processes remains less understood. In this study, we identified microplastics in the wastewater effluent from three major WWTPs utilizing primary, secondary and tertiary treatment processes in Sydney, Australia. A novel validated sampler was designed for in situ collection of microplastics from wastewater effluent. The sampling method was combined with an efficient sample processing procedure to enhance the accurate detection of microplastics. The results indicated that primary effluent contained an average 1.5 microplastics/L. The amount of microplastics reduced to 0.6 microplastics/L after secondary treatment and 0.2 microplastics/L after tertiary treatment. Polyester fibres and polyethylene beads were predominantly detected in wastewater effluent, which possibly originate from synthetic clothing and cosmetic products, respectively. This suggests that WWTPs can act as a significant pathway to release microplastics to the aquatic environment, given the large volume of treated wastewater being discharged on daily basis. The effects associated with wastewater-based microplastics (e.g. fibres and beads) were thus investigated by exposing two freshwater organisms, a water fleas (Ceriodaphnia dubia) and a sediment-dwelling midge larva (Chironomus tepperi), to microplastics in water and sediment, respectively, at concentrations within the range of environmentally realistic concentrations. A dose-dependent effect was observed after acute and chronic exposure of C. dubia to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than those deemed environmentally relevant. Furthermore, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tepperi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 μm showing more pronounced effects. Our study demonstrates that microplastics are released into the environment by WWTPs and can have effects on freshwater organisms at concentrations within an order of magnitude of environmentally relevant levels.

647 What is in our plastic? In vitro toxicity of extracts from plastic products

L. Zimmermann, Goethe University Frankfurt am Main; C. Völker, Institute for Social-Ecological Research; M. Wagner, Norwegian University of Science and Technology / Department of Biology

The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e. plastic additives and side products, attract less attention in this context.

We focused on the acute effects of extracts from plastic consumer goods made of high-density polyethylene (HD/LDPE), polyurethane (PS), polylactic acid (PLA), and polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyolefin (POF) on the invertebrate zebrafish (Danio rerio). Different plastic types were ranked according to the toxicity of their leachates. Thirty-four plastic consumer products made of high-density polyethylene (HD/LDPE), polystyrene (PS), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyacrylic 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 leaked chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and four slightly estrogenic. Overall, PVC and PUR extracts induced the highest toxicity in terms of potency and number of affected endpoints as almost all extracts triggered a high toxicity, oxidative stress and anti-androgenic activity. In contrast, PET extracts were less toxic with only one sample inducing oxidative stress. Interestingly, all PLA extracts produced a very high unspecific toxicity. Effects of HDPE, LDPE, PP and PS extracts strongly depended on the product. Our findings indicate that extracts of plastic products induce a range of toxicological endpoints, including unspecific toxicity, oxidative stress and endocrine activity. Sorbed compounds are more persistent than leached ones and therefore contribute to a toxicological response. This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.

648 Microplastic size-dependent toxicity, oxidative stress induction, and multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanaus)

C. Jeong, J. Lee, Sangkyunkwan University

Plastic pollution in marine ecosystems is a great concern in these days due to their world-wide distribution, persistence, and increasing amount of small-sized plastic particles due to degradation of larger plastic debris. However, little is known about their impacts on marine organisms, particularly at the molecular level. Here the dependence of microplastic toxicity to the monogonont rotifer (Brachionus koreanaus) on particle size was investigated by studying the ingestion and egestion of plastic microbeads recently labeled 0.05, 0.5, and 6 μm polystyrene microbeads. Exposure to polystyrene microbeads led to significant size-dependent negative effects on growth rate, reproduction, and lifespan. In consistent, transmission electron microscope (TEM) analysis have revealed cellular damages in the rotifer B. koreanaus exposed to 0.05 μm microbeads, indicating nano-sized microbeads would cause more serious impacts on aquatic organisms. To further explore the defense mechanisms in response to different sizes of microbeads, the activities of several antioxidant-related enzymes and phosphorylation statuses of mitogen-activated protein kinases (MAPKs) were determined. Particularly, 0.05 μm microbeads have inhibited multixenobiotic resistance (MXR), resulting increase of sensitivity of rotifers to environmental pollutants. Our study provides a better understanding of molecular responses in the rotifer B. koreanaus in response to microplastics and their potential impacts on the aquatic ecosystem.

649 Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio)

B. Cormier, EPOC University of Bordeaux; M. Larsson, Orebro University / Marine Pollution-Environment research centre (MTM); L.W. Yeung, University of Oporto / Department of Chemistry; C. Clérendeau, EPOC University of Bordeaux; A. Karman, Orebro University / MTM Research centre; B. Morin, University of Bordeaux / EPOC; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Bégout, X. Cousin, IFREMER / Laboratoire de Recherches Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; S. Keiter, Orebro University / MTM Research centre

The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 μm. MPs can result from runoff and degradation (in water bodies) or weathering (in the environment) of macroplastics. Microplastics are found 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 model pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of POPs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity aspect, 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 aroclor activity) between the control group and fish exposed to virgin MPs, spiked MPs or contaminated water. 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 microparticles. Experiments are currently being done to test the toxicity of MPs.

650 Comparative role of microalgae and microplastics in the effects of chlorpyrifos on molecular biomarkers in marine mussels

L. vidal-linan, Universidad de Vigo; B. Fernández, IEO; M. Albentosa, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area. Fisiología y Ecotoxicologia of Bivalve Molluscs Department; J.A. Campillo, Instituto Español de Oceanografía / Centro Oceanográfico de Murcia; J. Bellas, IEO

Plastic particles within the microns range (microplastics, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine ecosystems is their role as vectors of pollutants which sorbed at the surface over time. The toxicity of MPs can be vectors of pollutants which sorbed at the surface over time. The toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of POPs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity aspect, 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 aroclor activity) between the control group and fish exposed to virgin MPs, spiked MPs or contaminated water. 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 microparticles. Experiments are currently being done to test the toxicity of MPs.
habitats is that they might act as vectors of pollutants to marine organisms, since hydrophobic organic contaminants with low water solubility tend to concentrate on the surface of these particles. In this study we have compared the role of polyethylene MPs and microalgae (MA) of similar size, as vectors of the organophosphorus insecticide chlorpyrifos (CPF) to *Mytilus galloprovincialis* marine mussels. With that aim, CPF pre-exposed MP and MA were offered to the mussels as a benthic feeding stimulus and bioconcentration and bioaccumulation were measured. AChE activity in digestive gland and gills was significantly inhibited at all CPF treatments, disregarding exposure time. Levels of GST activity in the digestive gland in the three CPF treatments (CPF, MA+CPF and MP+CPF) after 7 days exposure were significantly higher than levels in treatments without CPF. However, after 21 days exposure, GST activity in the controls significantly increased, and differences with controls disappeared. For GST in gills, a significant increase in activity was observed in the MP, CPF and MA-CPF treatments after 7 days, compared to the MA control. When the nine biomarkers recorded are combined using the Integrated Biomarker Response (IBR) index a similar response in the three CPF treatments is initially observed (7 d), but after 21 d an enhanced response in observed in the MA+CPF and MP+CPF treatments only. In conclusion, AChE inhibition was similar in all CPF treatments disregarding the presence of particles. However, both MP and MA particles in CPF-exposed mussels produced in the long term an increase in biomarker response compared to waterborne exposure. Therefore MP seem to play a similar role than natural organic particles as vectors of organics to marine organisms.

651 Poster spotlight: TH001, TH002, TH003

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

652 Dissipation of the carcinogenic ptauisolide in water resources

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Ptauisolide (PTA) is a natural carcinogen in a number of ferns Worldwide. The distribution and occurrence of PTA is best known from the Bracken ferns (*Pteridium aquilinum*) which are classified in Group 2B Possibly carcinogenic to humans by WHO/IARC. The content of PTA in Bracken is highly variable (up to 5-10%). PTA readily leached from Bracken stands from where it can enter the soil, waterways or potentially contaminate groundwater. Several records of PTA contamination of surface and upper groundwater exist from Denmark and Great Britain. The fate of PTA in surface and groundwater has not been studied. Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: $k_{ obs} = k_{acid}[H^+] + k_{ alkaline}[OH^-]$. The rate constants are: $k_{ acid} = 25.7±1.0 \times 10^{-6} \text{ mol} \cdot \text{L}^{-1} \cdot \text{h}^{-1}$ and $k_{ alkaline} = 9.5±0.6 \times 10^{-8} \text{ mol} \cdot \text{L}^{-1} \cdot \text{h}^{-1}$ and $k_{algin}=4.8±0.5 \times 10^{-8} \text{ mol} \cdot \text{L}^{-1} \cdot \text{h}^{-1}$. The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol$^{-1}$. Hence, hydrolysis is a function of both pH and temperature. The purpose of this investigation was to study the degradation of PTA under natural environmental conditions, including different surface and groundwater conditions from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives of 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 groundwater at a molar ratio of approx. 1:1 for PTA:Pterosin B. However, under conditions of neutral pH. PTA persist considerably longer in groundwater. Half-life of PTA was approx. 75 kJ mol$^{-1}$. Hence, hydrolysis is a function of both pH and temperature.

653 On-line detection of algal toxins in sea water

S.F. Bodini, SYSTEA; F. Pasquazzi, Systea SpA; A. Porchetta, L. Micheli, G. Volpe, L. Fabiani, University of Tor Vergata; L. Sanfilippo, P. Moscetta, Systea SpA; G. Pallecchi, University of Tor Vergata.

Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and complex 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 microplate 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 beads and simplicity of colorimetric detection. Next, the manual assay was integrated within a fully automated PC-controlled on-line analyzer 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 of the reagents needed to be kept at 4°C, a Pelhier 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 raw marine water samples, in which the instrument was integrated together with a data logger for real-time data recording. 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 marine toxins known, its metabolic profile had never been fully clarified. In fact, PLTX is considered as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity through 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-related and intra-specific variability, structure variations in PLTX congeners 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 proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing all these aspects, was integrated within a fully automated, continuously operating, field test, able to perform on-line detection of marine biotoxins. The present work is a step forward towards the development of an effective on-line monitoring system for aquatic ecosystems.

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 irritations were observed together with death of marine invertebrates. 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 marine toxins known, its metabolic profile had never been fully clarified. In fact, PLTX is considered as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity through 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-related and intra-specific variability, structure variations in PLTX congeners 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 proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing all these aspects, was integrated within a fully automated, continuously operating, field test, able to perform on-line detection of marine biotoxins. The present work is a step forward towards the development of an effective on-line monitoring system for aquatic ecosystems.
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

According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phytoplankton, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant subdrivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.

659 Contaminants of emerging concern in the North American Great Lakes: Evidence of reproductive disruption from field and laboratory studies

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 environment. In addition, fluctuations in water discharge due to the Mediterranean climate create high variability of conditions along the Ter River. One of the major problems detected in Ter River in the recent years is the appearance of geosmin. This is a metabolite generated mainly by cyanobacteria and actinomycetes that, when die, is released into the water, giving it a bad smell and taste. Although some studies have described that the production of this metabolite depends on environmental conditions, the factors associated with its production are still not clear. This supports the need of an improved approach in sound supply companies, since they cannot predict its appearance and have to act when customers complaints arrive. The aim of this study is to evaluate the co-relation between physicochemical parameters and geosmin appearance along the Ter River during one year, and to study seasonal variability of geosmin concentration. The study has been performed in four sampling sites across the upper-middle part of the Ter basin. The sampling frequency varied through the years due to the potential health risk in a selected period (February to June), sampling was performed weekly from June to December, sampling was performed monthly. The parameters analysed have been nutrient concentration, suspended solids, organic material, turbidity and geosmin concentration in water. Biofilm samples were taken in order to analyse the chlorophyll a content. The results obtained clearly reflected the seasonal variation in the occurrence of geosmin, being its concentration higher in winter (32 ng/L). They also evidenced the N/P ratio as one of the key factors involved in the geosmin formation. However, a more in-depth analysis of the N/P ratio in water is still necessary in order to explain the mechanisms that generate the geosmin formation within the organism. For this reason, a mesocosms experiment that tests the influence of the N/P ratio on the geosmin formation within the biofilm could be the next step to follow.

Italian guidelines to assess and manage the risk associated to cyanobacteria blooms in water during bathing and recreational activities

The Mediterranean region is one of the most densely populated and industrially developed areas in Europe. The still growing number of recreational activities makes necessary to assess and manage the risk associated to cyanobacteria blooms in water during bathing and recreational activities. Several guidelines have been developed in Italy to assess and manage the risk associated to cyanobacteria blooms, but they mostly lacked pharmaceuticals and personal care products. Almost 3,000 resident pharmaceuticals and personal care products being tested in supply companies, since they cannot predict its appearance and have to act when customers complaints arrive. According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phytoplankton, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant subdrivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.

657 Identification and prioritization of emerging risks for food safety: climate change as a driver

According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phytoplankton, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant subdrivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.
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 managed concentrations enhanced fecundity in the F2 and 3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicates that EC2s in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment; M. Cronin, Liverpool John Moores University.; E. Evensted, Norwegian School of Veterinary Science.; L. Evensted, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iguchi, YOKohama City University / Molecular Environmental Endocrinology; C. LaLone, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Norwegian Institute for Water Research; C. Mellor, Liverpool John Moores University / School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers ERDC; T. Rundberget, Norwegian Institute for Water Research; B. Saltu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Engineering and Environmental Systems Research Center; S. Kroesen, International Ecological Institute for Water Research / Ecotoxicology and Risk Management

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 and used as a 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 EDs 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 of specific concern. The present paper focuses 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 ecotoxicological testing scenarios. The current project will address parts of these questions, a static life-cycle test with zebrafish (Danio rerio) has been performed to examine if a pulse exposure to an ED mixture of pollutants at environmentally relevant exposure scenarios. Acknowledgement - Funding from RCN-221455 A_Adverse Outcome Pathways for Endocrine Disruption in Daphnia magna, a conceptual approach for mechanistically-based Risk assessment (www.niva.no/edrisk); RCN-268294 "Cumulative hazard and risk assessment of complex mixtures and multiple stressors (www.niva.no/mixrisk)" and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).

661 Assessing impacts of place-based mixtures of emerging contaminants on endocrine activity and adverse outcome pathways: comparisons of different life stages. R. Klunge, University of Wisconsin-Milwaukee / School of Freshwater Sciences; J. Crago, Texas Tech University/TIEHH / Environmental Toxicology The Institute of Environmental and Human Health TIEHH

Emerging contaminants often appear as mixtures of differing concentrations across a landscape. Traditional toxicological assays as well as receptor binding assays that examine the implication of the mixture on chemical activity usually do not adequately detect all EDC compounds and do not describe the collective impact of mixtures as there can be cross-talk among molecular pathways. Using place-based mixture concentrations of emerging contaminants in combination with multiple molecular initiating events from adverse outcome pathways can help to identify potential hotspots of potential environmental impact that cross multiple mechanisms of action. This talk will discuss the use of transcriptomics to modify the OECD fish embryo acute test (FET) and chronic exposure to juvenile and adults fish are being used to examine EDC pathway related disruption. Examples discussed will include several experiments using exposure mixtures representing those measured in several locations in Lake Michigan.

662 Interference of hepatotoxicity with endocrine activity in zebrafish (Danio rerio) L.A. Baumann, University of Heidelberg / Aquatic Ecology and Toxicology; H. Holbeck, University of Southern Denmark / Biology; L. Westj. BASF SE / Crop Protection Ecotoxicology; H. Schmidt-Posthaus, University of Bern / Institute of Animal Pathology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; T. Braunbeck, University of Heidelberg / Centre for Organismal Studies Vitellogenin (VTG), a well-established biomarker for the diagnosis of endocrine activity in fish, is used in the OECD test guidelines 229, 230 and 234. A reduction of VTG production (maximally in males) by androgenic or anti-estrogenic activity, whereas an increase of VTG (mainly in males) is associated with estrogenic activity. However, the synthesis of VTG may not only be modified by typical endocrine-related pathways, but also through non-endocrine-mediated processes. In particular, hepatotoxicity, i.e. toxicant-induced impairment of liver function and structure, can influence VTG as a biomarker, since it is synthesized in the liver. Changes in VTG caused by non-endocrine hepatotoxicity in a screening assay would unnecessarily trigger very labor-, animal- and cost-intensive higher-tier testing (e.g. a fish life cycle test). Therefore, an intimate understanding of the interplay between primary endocrine-related and non-endocrine-related pathways influencing VTG production is crucial for the avoidance of false diagnoses. The present study is driven by the hypothesis that hepatotoxicity may interfere with VTG synthesis in liver tissue of zebrafish. Thus, we investigated the effects of two well-known hepatotoxicants, acetaminophen (APAP) and isoniazid (INZ), on zebrafish (Danio rerio) in a 21-day flow-through exposure test according to OECD guideline 230. Various hepatotoxicity- and endocrine system-related endpoints were recorded: - mRNA expression of different endocrine-related (vtg1, vtg3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoal, cyp2k19 and cytP450 1a) in the liver; - hyaluronic acid (a biomarker for liver toxicity) levels in head/tail homogenates; - liver histology and ultrastructure; Both APAP and INZ had different effects on exposed fish. While APAP did cause any histopathological alterations in the liver, INZ significantly induced hepatocyte degeneration. VTG levels in APAP-exposed females were elevated, while no effect was observed in INZ-exposed fish. Likewise, differences in VTG suppression between both compounds and indicate that both did interact with different endocrine- and hepatotoxicity-related pathways. The results from both studies will further be evaluated with respect to their potential for the development of an adverse outcome pathway (AOP) for interference of hepatotoxicity with the VTG response in fish.


The discussion about the regulation of endocrine disruptors (ED) is on-going between groups of scientists, authorities and stakeholders. Especially dose-dependency, low dose effects and effect thresholds are still under debate. To address parts of these questions, a static life-cycle test with zebrafish (Danio rerio) has been performed to examine if a pulse exposure to an ED mixture of pollutants - distinguishable effects and the establishment of a dose-response relationship is possible. The results will be used for a comparison with available data originating from a flow-through study with TC in zebrafish. A water-sediment system has been set up to expose different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints include early-life stage (EEL) endpoints, growth, reproduction, as well as adult growth, sex ratio, vitellogenin levels and F2-generation early-life stage. Four concentrations of TC were applied as a pulse in three replicates each, ranging from 125 µg/L to 1000 µg/L (spacing factor 2). Four controls replicates were included. Mortalities occurred in all developmental stages (groups A to C), especially in high concentrations (500 µg/L, 1000 µg/L). In sexually mature fish (group C) mortality was higher in males. A decline in fertility could be observed for group C, possibly related to the higher male mortality. Total egg numbers appeared unaffected. The results were mirrored for fish introduced as juveniles (group B): While fertility rates and sex ratio were not influenced negatively, fecundity was lower in remaining concentrations (125 µg/L, 250 µg/L). Changes in egg morphology were noticed shortly after exposure. Changes in growth, reproduction (group C), corresponding to F2-egg numbers and F2-generation mortality were dose-dependent with decreasing survival rates and growth. Although reproduction data are difficult to be attributed to endocrine activity, an influence on the endocrine system of the test animals seems apparent. Particularly sex specific effects in F0-fish as well as an impaired early life-stage in F1-fish are of highest interest. Further data on vitellogenin and reproduction will help clarifying pending questions. Additionally, several other accessible datasets from zebrafish studies featuring paired pulse and flow-through exposures of EDs with diverse dissipation times will be integrated in the concluding assessment. The final objective is to deduce possible effect thresholds based on internal concentrations.

BIER is good for you: How biotransformation and elimination rate information can improve chemical assessments

SETAC Europe 28th Annual Meeting Abstract Book
664 A Tiered Approach for Screening Chemicals for Biomagnification Potential in Humans

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Bioaccumulation is a process in which the chemical concentration in an organism exceeds the concentration in the respiratory medium, the diet or both and is an integral aspect of hazard and risk assessment. Strong correlations between partitioning properties such as the octanol-water partition coefficient (Kow) and the octanol-air partition coefficient (Koa) and the water-respiring and air-breathing organisms have led to Kow and Koa being the primary screening criteria for bioaccumulation assessment. However, primary biomagnification 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 biomagnification (Tiers from 1 to 4 respectively). Biomagnification Factor (BMF) derived from a typical human diet as calculated by the Risk Assessment Identification And Ranking (RAIDAR) model is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13,000 chemicals including industrial chemicals, pharmaceuticals, personal care products and chemicals used in consumer goods. Tiers that do not consider biomagnification (1, 2 and 3) estimate a high percentage of chemicals with BMF greater than 1 (i.e. about 95%, 95% and 93%). In particular, in Tier 2 and in Tier 3, the introduction of the biotic partition coefficient kStorLPw, kMemLPw and kProtW and after the tonic state at pH 7.4 reduces BMF estimate for some chemicals, but in Tier 4, BMF estimates are limited. In Tier 4, the introduction of the HLH has a high impact on the screening results, strongly reducing the BMF estimate to < 1 for most of the compounds (i.e. about 90%). This shows how models based only on partition coefficients are not sufficient to describe and address the bioaccumulation and biomagnification processes, and can lead to overly conservative estimates (“false positives”). Moreover the study highlights the key role of biomagnification in bioaccumulation assessment for air-breathing organisms and highlights the need for reliable data on biomagnification to effectively categorize chemicals for hazard.

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

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Despite the fundamental value of database of biotransformation rate information, relatively few measured in vivo data are available for humans compared to the thousands of chemicals requiring evaluation. Reliable models, laboratory measured in vitro biotransformation rate data, and in vitro-in vivo extrapolation (IVIVE) methods can be applied to address in vitro biotransformation rate data gaps and, coupled with data confidence assessment methods, uncertainty and data utility. We have developed a new database of >11,000 human in vitro biotransformation rate estimates (half-lives, clearance rates and rate constants) derived from liver microsomal, S9 homogenate, and hepatocyte-based assays for >8,500 organic chemicals from the literature and publicly available databases (i.e., ChemBL). The database is comprised primarily of pharmaceuticals and pharmaceutical candidates from various experimental sources. The organic chemicals in the database represent a broad range of physical-chemical properties (Log Kow=-4 to 13, Log Koc=0.01 to 47), water solubility (Kow=10^{-11} to 10^{-1} mL/L kg^{-1}) span about 8 orders of magnitude. We developed and applied novel data quality assessment methods based on proposed standardized testing guidance to address variability and uncertainty in the database. The data quality assessment methods included compiling physical-chemical property data (e.g., Kow, pKa, water solubility) for all of the chemicals and applying a mass balance in vitro model. The measured data quality scores (e.g., high or low confidence) may help identify datasets that are most appropriate for QSAR development and for other potential applications (e.g., bioaccumulation screening, prioritization). The score results are further examined in a case study of seven chemicals and the utility of high and low confidence biotransformation rate data, its merits and limitations for various use contexts, are discussed and overall key findings of the critical review of existing human in vitro biotransformation rate data are summarized.

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, bioaccumulate (B) in biota, and possess potential toxicity. Applying standardized exposure setups (i.e., water-only exposure) as historically has been employed in environmental risk assessment may 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 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 compound 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)

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Diuron is a commonly used phenylamide herbicide which acts by interrupting the photosynthetic electron transport chain. Like other phenylamide herbicides diuron is bio-transformed to 3,4-dichloroaniline (3,4-DCA) which occurs in plants, the liver of vertebrates and in soil. Fish embryos do not possess the same metabolic potential as adult fish. It was not determined so far if different embryo stages differ regarding toxicokinetics and 3,4-DCA and whether toxicities come from parent compounds or metabolites. We addressed the following questions: What are rates of uptake and elimination of diuron and 3,4-DCA in different zebrafish embryo stages? Is diuron biotransformed by the embryo via which metabolic pathway? Does the embryo’s chorion form a barrier for diuron 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\textsubscript{inh}, 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/H\textsubscript{2}O and quantified using liquid chromatography tandem 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 hrs. The tissue concentrations for diuron reached T\textsubscript{max} around 48 hpf, T\textsubscript{max} 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\textsubscript{u}, k\textsubscript{s}) were determined. Both elimination rates and residue 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-dichloroacetanilide in the embryo and two products of N-demethylation of diuron were found. This confirms that both phase I and phase II metabolic reactions are active in the first hours of embryo development and pinpoints to the biotransformation capability of the zebrafish embryo at this early stage.

668 Application of a generic fish PBTK model for binary mixtures of chemicals

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The integration of mechanistic approaches in Environmental risk assessment requires the integration of processes to move towards estimating internal dose from exposure or environmental concentrations (external dose) to predict toxicity in each taxa or the whole ecosystem. In this context, the overall objective of this work is to develop models to integrate TK data for environmental risk assessment of single and multiple chemicals. Three steps were defined to fulfill this objective: (i) Data collection of biological, physiological, and toxicological variables to calibrate and develop PBTK models, (ii) Development of PBTK models for environmental risk
assessments 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 hydrobicity [2, 3]. An optional interaction term was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

669 Application of Aqueous and Dietary In-Vivo Bioaccumulation Tests to Determine Biotransformation Rates, Elimination Rates and other Bioaccumulation Metrics

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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)

MO004

Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea.

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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 heavily intensifying marine traffic in the area increases the occurrence 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 the water, accumulated on the PAHs and a battery of biomarkers in Baltic Sea mussels (Mytilus spp.) exposed to a common type of low-sulfur marine diesel oil produced by Neste Oil’s Pervo refinery in Finland. The diesel oil was applied to mussel aquaria as a water accommodated fraction (WAF). The exposure set-up consisted two replicate aquaria in each treatment; control, WAF-high and WAF-low, each with 200 mussels in 20 liters of artificial seawater (10°C). Water and WAF treatments were renewed every two days. Changes in PAH concentrations in water were constantly quantified using a TriOS Envirotu HC-500 fluorometer sensor. Another sensor was used to collect auxiliary data on temperature, turbidity and chl a concentration (mussels fed with algae). Biomarkers of oxidative stress, biotransformation, neurotoxicity and bioenergetics were measured from mussels of exposed and control groups 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. 30ng/L in WAF-high and 15ng/L in WAF-low treatments. In a semi-static system with mussels the concentrations decreased during 24h 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 Eucrouter brasiliensis along four tropical estuaries in the Brazilian Northeast.

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Univ. Federal de Pernambuco / Zoology;
MO006
Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances
T. Parkerton, ExxonMobil Biomedical Sciences Inc / Toxicology & Environmental Science; A. Bleich, ExxonMobil Biomedical Sciences Inc; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; C. C. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; A. D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; M. Lampi, ExxonMobil Biomedical Sciences

A recent study aimed to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heteroaromatic compounds were detected in the range 0.01% to 0.1% of the analysed samples. The compounds were detected in the range of 1 to 1000 ppm. They were used in bioaccumulation studies in rainbow trout to evaluate the toxicity potential of these compounds. The results indicate that these compounds can be bioaccumulated by rainbow trout and they can cause toxicity in this species. The compounds were detected in the range of 1 to 1000 ppm. They were used in bioaccumulation studies in rainbow trout to evaluate the toxicity potential of these compounds. The results indicate that these compounds can be bioaccumulated by rainbow trout and they can cause toxicity in this species. The compounds were detected in the range of 1 to 1000 ppm. 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Marine Biology and Biotechnology PIEUVEHU
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-level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm; large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromsø (69º 40’N) and Trondheim (63º 26’N) were sampled in early autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvVAS) 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 order to establish structural changes and oxidative changes in the endo-lysosomal system (LSC) of digestive cells were also determined. Higher VvVAS 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) indicating general physiological changes, multilayered parietal barriers and atresia, higher aged 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 parasite burden, large mussels exhibiting a higher level of parasitization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lysosomal biomarkers of digestive cells were also determined. The selected biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679269), Basque Government (IT810-13) and UPV/EHU (UFI11/37).

M0010

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 and oil transport pose a risk to marine ecosystems. Hemocytes respond to toxicants present in oil spills. Biomarkers of hemocytes like lipofuscin accumulation, neutral lipid accumulation, and lysosomal changes (e.g. increase in lysosomal membrane and thickening of lysosomal layers) have been identified as potential molecular biomarkers of oil stress. However, the short-term cytotoxic effects of oil spills are not well characterized. As a first step, we studied the cytotoxic effects of the WAF of naphthenic North Sea crude oil produced with dispersant at the three different temperatures was measured. The cytotoxicity of the WAF of naphthenic North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mytilus galloprovincialis (L.) was evaluated using a rapid screening tool for environmental risk assessment of oil spills and oil products. Hemocytes were isolated from mussel tissues and were incubated in vitro with different concentrations (up to 20% WAF) of oil plus dispersant (1.25, 12.5, 50 and 20°C). These results suggest that the next refining steps needed for oil and gas products received from various oil and gas fields to be tested in order to determine its management. We also found that although the palm stearin had little effects to marine organisms, it was toxic to microalgae species as reflected by growth inhibition. Its toxic mechanisms on the microalgae may be associated with its adsorption onto microalgal cells, and reduction of light penetration to the cells due to obstruction from the stearin and palm oil. At present, we are generating additional toxicity data on other microbial species (Thalassiosira weissflogii and Tetraselmis suecica). Using all toxicity data generated from this study, we will ultimately determine an interim WQG for the palm stearin, and use this WQG to assess its ecological risks to local marine ecosystems. This study represents the first comprehensive investigation on the ecological risk of the palm stearin in the world, and the results will facilitate informed decision-making by the environmental authority.

M0013

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

neutralizing amine solutions by IC coupled with a single quadrupole MS. This study, therefore, aimed to examine its contamination levels in seawater, sediment and animal samples collected from seven locations along the south coasts of Hong Kong; determine its toxicities to selected marine organisms including microalgae (Isochrysis galbana and Chaetoceros gracilis), the copepod (Tigriopus japonicus), the mussel Mytilus galloprovincialis (L.) and the mitten crab (Erimacrus isenbeckii), and derive interim 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-mass spectrometry. PAL-STEARIN had a significant impact on all the selected species. The results showed that all seawater samples collected from the six sites were heavily contaminated by the palm stearin after one week of the accidental pollution. We also found that although the palm stearin had little effects on marine animals, it was toxic to microalgae species as reflected by growth inhibition. Its toxic mechanisms on the microalgae may be associated with its adsorption onto microalgal cells, and reduction of light penetration to the cells due to obstruction from the stearin and palm oil. At present, we are generating additional toxicity data on other microbial species (Thalassiosira weissflogii and Tetraselmis suecica). Using all toxicity data generated from this study, we will ultimately determine an interim WQG for the palm stearin, and use this WQG to assess its ecological risks to local marine ecosystems. This study represents the first comprehensive investigation on the ecological risk of the palm stearin in the world, and the results will facilitate informed decision-making by the environmental authority.
Effects of oil spill on coastal seaweed in the Arctic
S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment
In case of an acute oil spill response operation, decision making regarding the operational response strategy and prioritizing biology at risk must be resolute. For that a Net Environmental Benefit Analysis, NEBA, is often performed to achieve the optimal environmental benefit with respect to choice of oil spill combat methodology and biology at risk. To provide data for assessing the ecological impacts of the Arctic areas, the effects of oil smothering of the macroalga 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 dispersible oil types. The effects were observed on the origin of crude oil and refinery process, and hence may have different effects due to their physical and chemical characterizations. Photosynthetic activity was measured as proxy for effect on growth and the self-cleaning potential was tested by wash in sea for oil smothered tips of F. distichus over a period of 2 weeks. The removal of the oils from the seaweed surface was considered as relatively fast (T½ = 3–4 days).
Depending of oil type, the oil inhibited or stimulated photosynthetic activity. Marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated 1) that oil smothering was relatively fast washed off in the sea water; 2) that, depending on the oil type, photosynthetic activity were stimulated or inhibited; and 3) that the photosynthetic activity was still affected (stimulated or inhibited) even after 14 days, although oil on the oil surface was washed off. Thus, this study shows the importance of investigating the effects of subacute oil spills for decision making regarding the operational response strategy and prioritizing biology at risk in the Arctic environment.

MO014
Effects of a coastal oil spill on marine invertebrates and their potential to recover
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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 environmental health. Still, the contamination by polycyclic aromatic hydrocarbons (PAHs) remains one of the most ubiquitous sources of pollution in the marine environment, being reported to elicit toxic, carcinogenic and mutagenic effects on marine biota. Moreover, the assessment of these impacts in costal invertebrates after a spill, the extent of these effects and energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. After an accidental industrial oil spill at the rocky shore of Peniche, Portugal in the summer of 2018, the water was analyzed during the low-tide for PAHs one week later and regularly throughout six months in the spilled beach and in 7 other rocky beaches in the vicinity. Also, at all locations, Patella depressa and Gibbula umbilicalis organisms were collected, and several biomarkers were analyzed from both species, the newt (newt) before 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.

MO015
Effects of water accommodated fractions of crude oil on the Baltic Sea blue mussel Mytilus trossulus at different salinities
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 biota. In addition, the effect of dispersants on the Baltic Sea biota is difficult to predict since the dispersants and the weather conditions is not well studied. In the present study, impacts of a crude oil and the dispersant Finsal 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-acute aquarium experiment. Concentration of WAF or WAF-D in the aquaria was 5%. The mussels were sampled after 0, 1, 7 and 21 days of exposure, and analyzed for accumulation of polycyclic aromatic hydrocarbons (PAHs), and biological effects including acetylcholinesterase, glutathione-S-transferase, catalese and glutathion reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial communities extracted from the gills and the digestive gland 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 C20-C44). A significantly higher oil concentration was observed at the lower salinity WAF-D water with 44 mg/l oil at 5.6 and 1.82 mg/l oil at 15. The higher salinity and WAF-D elicited more oxidative stress and neurotoxic effects already after one day of exposure. Mytilus-associated bacterial communities also varied depending on salinity and the use of dispersant. The results indicate that during the application of dispersants salinity plays a key role for biodegradation of oil concentration 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.

MO016
Multiple biomarkers on the estuarine guppy Poecilia vivipara to monitor two Integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuaries with ecologically relevant tools. The guppy Poecilia vivipara, native species with a broad tropical distribution, was utilized in such an approach, using in situ field exposures in cages

MO007
soil characteristics, the group composition was determined for each borehole of all migration of petroleum pollutants, and the relationship of this migration with the vertical migration in the alluvial area of Sava river. The investigation was started in 1km from its estuary in the Danube, and represents a potential source of petroleum

...Metallurgy, University of Belgrade / Department of Chemistry; G. Devic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; S. Miletic, J. Avdalov

...Petroleum pollution of alluvial sediments near Sava river, Serbia

A new methodology was developed using as mobile phase methanol and H$_3$O$_2$ as acidifying agent with 250μL of HNO$_3$ (70:30, v/v), Ettre XDB C18 column (5μm 4.6 x 250nm), flow of 1.5 μL min$^{-1}$, λ = 205nm and T = 50 ° C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector. Data were acquired using the OpenLAB 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 ppm for ethylbenzene and 1 to 85 ppm for xylene. The curves were submitted to inter- 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 solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for the analysis of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in the next step.

MO020 Petroleum pollution of alluvial sediments near Sava river, Serbia

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...The sample was sizes in three different microlocations (Z1, Z2 and Z3) up to depth of 15m. The sampled material was organized in the layers, and for all microlocations was made a lithological profile. Most of the samples have had a clayey-sand structure with low content of organic matter. Extraction of petroleum pollutants from soil samples were done using the Soxhlet apparatus with dichloromethane. After extraction, the dichloromethane extracts were then fractioned by column chromatography into fractions of: saturated hydrocarbons (Fraction I), aromatic hydrocarbons (Fraction II), and polycyclic aromatic hydrocarbons (Fraction III) [1]. For monitoring changes in the vertical migration of petroleum pollutants, and the relationship of this migration with the soil characteristics, the group composition was determined for each borehole of all microlocations, taking into account their lithological profiles. Results of our research showed that in all samples the most represented were polars (Fraction III), while the saturated hydrocarbons were least represented (Fraction I). This trend is almost unchanged in samples from different microlocation at different depths. It can be concluded that composition of petroleum pollutants can be unchanged through the alluvial sediments up to 15m depth and they can reach the underground waters consequently, affecting the quality of the underground and surface waters. Further investigation of petroleum pollutants migration in the alluvial area of Sava river was intensified by the Ecological Impact Assessment (EIA) and to non-existence of acetylcholinesterase (ACHE). Behavioral activities related to swimming speed and resistance were also evaluated. Individuals grown in the laboratory were used for in situ exposure and also as controls (CON) for IS and RES. Significant contamination by PAHs was evidenced from both estuarine systems, with higher phenanthrene and chrysene concentrations in the bile of resident fish at BPS, which in turn partially justified the significant induction of EROD and GST in these individuals. Resident fish at BJS 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 BPS inner region. This study shows the potential and feasibility of using the guppy, P. vivipara on the evaluation and monitoring of pollution in estuaries along the Brazilian coast.
Risk-based assessment of produced water discharges - need for alignment

M.G. Snit, 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 assessment and modelling, dilution screening and 3D dispersion modelling, etc. Within those practices a wide range of risk endpoints are being applied, each with their own level of conservatism. Without harmonization of endpoints it is difficult to interpret when risks can considered to be adequately controlled. For example, different approaches base the assessment on either chronic or acute toxicity data. And where one method considers an acceptable mixing zone of 500m, 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 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. Nicolas, Cefas Lowestoft Laboratory / Environment and Ecosystems
Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb and Zn, and total petroleum hydrocarbon (TPH) concentration were analysed at 43 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 trends were expected to be dependent on oil pollution, as the oil price was increased significantly since Cr and Cd. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

Temperature-dependant toxicity of Naphthenic 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 last years, posing a risk of spill oil. The risk of spill oil is connected to daily driven 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 Glibear the aim of the present work was to assess the potential toxicity of WAF produced from: Naphthenic 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 larvae 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 the studied, 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 FPUP/05/0517 grant) and the Basque Government (Consolidated Research Group GIC IT910-13).

Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentrarchus labrax L., 1758) larvae

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 assessment and modelling, dilution screening and 3D dispersion modelling, etc. Within those practices a wide range of risk endpoints are being applied, each with their own level of conservatism. Without harmonization of endpoints it is difficult to interpret when risks can considered to be adequately controlled. For example, different approaches base the assessment on either chronic or acute toxicity data. And where one method considers an acceptable mixing zone of 500m, 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 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.

Tentative identification of halogenated polycyclic aromatic hydrocarbons in biota

Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francioso, I. Idouw, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry Polyaromatic compounds (PACs) are a complex class of compounds that are present in fossil material such as petroleum oils. The most common PACs are the polycyclic aromatic hydrocarbons (PAHs) of which 16 have been identified as priority compounds by the United States Environmental Protection Agency. However, there are other important PACs that to date have received less attention. These include halogenated PACs, non-halogenated alkylated PACs and heterocyclic aromatic compounds that contain S-, O- and N-atoms. Halogenated PACs especially those containing chlorine atoms are likely to be more environmentally persistent than their non-halogenated analogues because of the presence of the halogen atoms. In addition, the toxicity of some halogenated PACs have been found to be similar to dibeno-p-dioxins and dibenzofurans. Because Cl and Br ions are present in the marine environment, we hypothesize that halogenated PACs can be formed and will be bioaccumulated in biota samples. Here we present a method based on high resolution mass spectrometry coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ions transitions in the electron ionisation mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chloro-pyrene is present in this sample. In addition, work is ongoing to identify other halogenated PACs that present in biological samples from Canada.

The experience with the use of biomarkers as Risk Indicators in Environmental Risk Assessment of oil based discharges offshore

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An approach to integrate biomarkers into probabilistic risk assessment has recently been developed and published regarding oil based discharges offshore. The main purpose has been to enable the use of measured biomarker responses offshore as Risk Indicators in the procedures for Environmental Risk Assessment of produced water (PW) discharges. The principles of the approach and experiences obtained in applying it to existing oil field monitoring data will be presented. The approach was tested using data from a recently completed dataset on the different components of the total PW series (including oil, produced water, and gas) from the latest surveys in the biomarker based Water Quality Monitoring (WQM) 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 study, the biomarker data from the latest surveys in the biomarker based Water Quality Monitoring (WQM) program on the Norwegian Continental Shelf were used to assess the potential for future biomonitoring programmes in the area. 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 benthic organisms. The Baltic Sea blue mussel (Mytilus trossulus) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and 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 Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersed Finasol ORS 51) mixtures (WAF-D) and sampled at 0, 1, 7 and 21 d. Tissue level biomarkers were investigated to determine the following biological responses: cell type composition (volume density of basophilic cells, Vbas/H of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/ diverticular ratio (CTD), gonadal development and other histopathological alterations in digestive gland, gonad and gills. Vbas/H increased significantly after 1 d in mussel exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MET/MET changed markedly with exposure time at 15.0 whereas MET/MDR showed no response. High CTD values in mussels observed at the salinity of 5.6 indicate a poorer condition of the digestive gland at low salinities than in mussels acclimated at 15 psu. Pathological responses (atrophy, necrosis, vacuolization, haemocytic infiltration, granulocytes) were assessed, being more evident in mussels exposed to WAF and WAF-D (21d). Salinity is a major factor controlling the biology of mussels in the Baltic Sea. The results obtained here indicate that during the early winter the health of native mussels in the very low salinity central-northern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first ones applying tissue level biomarkers in Mytilus trossulus in the Baltic Sea and provides preliminary reference values for future biomonitoring programmes in the area. Acknowledgements: Funded GRACE project (EU H2020 grant N°679266) and a Basque Gov. fellowship to EGU

MO030

Toxicity of diluted bitumen to freshwater fish and invertebrates

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The toxicity of diluted bitumen to freshwater fish and invertebrates after exposure to vidifferent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically-dispersed (chemically-enhanced WAF; CEWAf). Toxicity of weathered and unweathered Cold Lake Blend (CLB) dilbit was assessed on Rainbow trout (Oncorhynhus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceridaphnia (Ceriodaphnia dubia). For weathered mnnnow, unweathered AWB demonstrated a significantly higher toxicity (LC50-96 h = 0.628 g/L) compared to the weathered AWB (LC50-96h = 2.06 g/L). Chronic toxicity tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7 d = 1.31 g/L) whereas larval growth toxicity was lower for AWB (IC50-7 d = 0.312 g/L) compared to the weathered dilbit (IC50-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96h = 5.66 g/L) compared to the weathered CLB (LC50-96h = 1.6 g/L). LC50-96h was also observed to be lower than the weathered CLB WAF where no mortality was observed with the weathered CLB. The reproductive effects on ceridaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC50 = 1.99 g/L). Volatile organic compounds (VOC), polyaromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

MO031

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

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Regulation of produced water (PW) discharges on the Norwegian continental shelf is based on a maximum 0.05% toxicity may be acceptable, with cover; results 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 components that contribute to toxicity. This is currently the current PW "collection and analysis" of four oil platforms on the Norwegian continental shelf. PWs were selected from oil fields of different operational ages, which produce oils exhibiting different physical and chemical properties. Samples were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions using solid phase extraction, recovering 80% of the total PW amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC–MS, GC/MS–GC, MS–Orbitrap-MS, and by direct infusion FT–ICR-MS. The total PW extract, as well as the apolar and polar fractions were subject to acute toxicity tests using nauplii of the marine copepod Acartia tonsa. LC50 values for the total PW extracts ranged between 0.05–0.98 mg L–1 (based on total GC amenable fraction analysis). For the polar fractions, the toxicity was mainly related to the apolar fraction, with LC50 values ranging between 0.17–0.57 mg L–1. Interestingly, toxicity was mainly attributed to the apolar fraction of the fourth PW, with an LC50 of 0.05 mg L–1. For the PWs where toxicity mostly related to the polar fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). For the PW where toxicity mostly related to the apolar fraction this was 35%. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

MO032

Toxicokinetics of oil components in Arctic copepods

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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 contexts. The central idea is that firm stage of developmental stage copepodite three (CIII) and five (CV) were tested on biomarker data from the latest surveys in the biomarker based Water Quality Monitoring (WQM) 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 study, the biomarker data from the latest surveys in the biomarker based Water Quality Monitoring (WQM) program on the Norwegian Continental Shelf were used to assess the potential for future biomonitoring programmes in the area. 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.
CIIs, the slope was close to unity, indicating a similarity between structural lipids and octanol. The lower slope for CV signifies that storage lipids are less well represented by octanol. Elimination rates were consistently higher in the CIIs than the CVs, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors may contribute to this difference.

MO035
Seabird-derived contaminants and genotoxicity in Collembola from the Arctic S. Kristiansen, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; H. Leinaas, University of Oslo / Department of Biosciences; G.W. Gabrielsen, Norwegian Polar Institute; D. Herze, NILU Norwegian Institute for Air Research; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

Seabirds occupy high trophic positions and due to biomagnification their bodies contain high concentrations of many anthropogenic contaminants. In the Arctic they have been shown to function as important biovectors of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritious and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collembola) contribute to a high proportion of the biomass. Marine birds play a vital role in assembling contaminants such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collembola. Two Collembola 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, Collembola were analysed for genotoxic responses, i.e. the amount of DNA strand breaks and micronucleus frequency. Seabird influence (indicated by δ15N) and contaminant concentrations were indicated to be higher in soil/moss sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites, however, no association between δ15N and contaminant load was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collembola were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polychlorinated diphenyl ethers (PBDEs), and chlorodane (CHLs). No association was observed between contaminant concentrations in Collembola and habitat. DNA fragmentation was higher in Collembola 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 Collembola and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronuclear frequency were associated with both Hg and contaminant load. Species diversity decreased with increasing concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

MO036
Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013 H.K. Midthaug, Department of Biosciences, University of Oslo / Department of Biosciences; J.O. Busnæs, Norwegian Institute for Nature Research / Fram Centre; A. Polder, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

The Antarctic ecosystem is associated with chemical exposure to the Antarctic ecosystem has been considered low. However, recent investigations have shown that south polar skua (Catharacta maccormicki) has the highest levels of biomagnifying contaminants among Antarctic seabirds. The present study quantifies OHC levels in south polar skua (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, the study investigates temporal change of organochlorine contaminant (OCs) in South Pole skua blood, and evaluate associations between contaminant occurrence, diet, trophic position, biological variables and day of sampling. Furthermore, the 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 pole skuas were sampled during the breeding season of 2013/2014 in Sverthamaren, Dronning Maud Land, Antarctica. Whole blood was analysed for 87 OHCs of which 36 were detected. Stable isotope ratio of carbon (δ13C) and nitrogen (δ15N) in blood, were used to determine carbon 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 white polar colonies and Antarctic seabirds at similar ecological niches. Multivariate analysis indicated that skuas sampled late in the breeding season had higher concentration of perfluoralkyl substances (PFASs) and low relative contribution of OHCs, levels, increasing with concentrations of lower polybrominated diphenyl ethers (PBDEs). Due to low intraspecific variance in δ13C and δ15N, no significant associations were found between OHCs and isotopes. However, lack of associations could also be due to influence of migration, wintering habitat and different turnover rates in OHCs and isotopes. Skuas from 2013/2014 had significantly higher contaminant levels of most OHCs and a lower body condition than skuas from 2001/2002. Skuas from 2013/2014, however, were comparable to those of the previous year. Mirex (%PCB 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 warming grounds and diet, as well as the level and contaminant occurrence in Antarctic Petrel (Thalassoica antarctica), the main prey

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

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. Niemikoski, Finnish Institute for Verification of the Chemical Weapons Convention / Department of Chemistry, University of Helsinki; K. Straumer, Thünen Institute of Fisheries Ecology; J.A. Tornes, Norwegian Defense Research Establishment; P. Vila, 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

Chemical warfare agents (CWA) dumped after the Second World War. Entire ships filled with chemical munitions were sunk, the so-called ‘wrecks’. The fate of CWAs in wrecks is unknown; if released into the environment they pose a threat to the marine ecosystem. The aim of this study was to examine the fate of CWAs in a wreck located in the Skagerrak Strait (North Sea) using the hagfish (Myxine glutinosa) as a test species. Hagfishes are highly sensitive to chemicals and were shown to be useful in source apportionment. Toxic alkyl homologues in environmental samples as well as proper identification of CWA markers can be achieved with high resolution time-of-flight mass spectrometry (HRTOF/MS). This was achieved by varying the primary oven column length (30m to 60m) using the same column stationary phase (55m MS (low polarity)) and a 2m 175m MS (mid-polarity). To address a wider scope of CWA markers, the analysis included extracts of biota, used lubricating oil and coal samples. Resolution of individual isomers of interest was observed on the 30m primary column and much more evident on the 60m column. The peak capacity and vast database of information provided by 2DGC-HRTOF/MS for different sample matrices is an asset for the study of the fate of CWAs in wrecks. Hagfishes seem to have no effect on the partitioning of CWAs between the biota and the environment.

MO003
Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples I. Idouw, University of Manitoba; W. Johnson, University of Manitoba / Chemistry; O. Wasowicz, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; J. Stetefeld, University of Manitoba / Chemistry; C. Sandau, Chemistry Matters; T. Obal, Maxam Analytical International Corporation / Scientific Services; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry.

Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two-dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and detection of PACs and their alkylated homologues was performed from muscle samples and separate whole fish samples, and the results indicated that PACs and their alkylated homologues are ubiquitous in the environment. PACs and their alkylated homologues are ubiquitous in the environment.
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
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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 face fish in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment 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 focussing on the metabolically most important organ, the liver. (III) Additional inclusion of biomarker data like EROD activity (CYP1A1, indicating pollution with dioxin-like compounds) or cholinesterase, 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 inhibitor 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 (UED, Durango, Mexico), we collected 10 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

MO039 Multigenerational toxicity of Fipronil to Folsomia candida
D.d. Oliveira, C.M. Reganhan Congelian, 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 for non-target terrestrial organisms (i.e. the collembolan Folsomia candida), which plays important roles in the maintenance of soil quality. The main objective of this study was to evaluate the ecotoxicological effects on the reproduction of three generations of the Folsomia candida species when exposed to fipronil over time, under a natural tropical soil. Test procedures were adapted from the ISO 11267 guideline. The chosen concentrations of fipronil were based on the recommended doses (RD) for the control of the pest Migodls yruamys in sugarcane crops (RD = 1.3 mg of the commercial product / kg of dw soil), which means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (±) kg / soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities
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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 organophosphorus insecticides in agriculture lands, in a simple test birds says please no
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Due to the human population increase and the consequent high demand for food, each day a larger area of the planet is dedicated to the practice of agriculture. Crops favor the reproduction of various organisms (invertebrates and vertebrates) that are combated with large amounts of pesticides, it is chemical compounds used extensively, and so all organisms are exposed from different sources such as food, water and soil, therefore the toxicity of agrochemicals, as well as the patterns of use and disposal that is made are very critical for the general balance of the biodiversity of agroecosystems. The main pesticides used in agriculture are organophosphates (OP), they are highly toxic. In birds, the main route of intoxication to OP is through the consumption of contaminated food, although it can also occur by inhalation when flying over or inhabiting the crop fields and its surroundings. The OP affects the nervous system by inhibiting the function of cholinesterase, 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 (UED, Durango, Mexico), we collected 10 house sparrows and serum ChE activity was determined by spectrophotometry before and after the consumption of food treated with malathion. The results show a ChE inhibition (11.58 %) after treatment (p = 0.03), also we observed nonsignificant
relationships (Pearson, R²=0.11) between the ChE and the weight or sex of the birds. The weight of the birds increased 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
L. García Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Santalesta, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM

The mobilization of metals from mining areas (i.e. Valde Alcudia-Sierra Madrona, district for Pb, Almadén district for Hg) input 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/dl 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 these biomarkers and blood Pb levels. Similarly, the highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.8±3.84 μg/dl 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 preventing from oxidative damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sub-lethal effects in reptiles for the vast majority of territories from the most contaminated sites (100% of territories from Solana del Pino with blood Pb levels > 15 μg/dl; 70.3% from Almadenejos with blood Hg levels ≥ 2.76 μg/dl dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R ≥ 0.765, P < 0.001), but not for Hg (R ≤ 0.362, P ≥ 0.127). Thus, these 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.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals from mining areas
L. García Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Santalesta, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM

The mobilization of metals from mining areas (i.e. Valde Alcudia-Sierra Madrona, district for Pb, Almadén district for Hg) into 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/dl 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 these biomarkers and blood Pb levels. Similarly, the highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.8±3.84 μg/dl 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 preventing from oxidative damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sub-lethal effects in reptiles for the vast majority of territories from the most contaminated sites (100% of territories from Solana del Pino with blood Pb levels > 15 μg/dl; 70.3% from Almadenejos with blood Hg levels ≥ 2.76 μg/dl dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R ≥ 0.765, P < 0.001), but not for Hg (R ≤ 0.362, P ≥ 0.127). Thus, these 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
A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santalesta, 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 / Department of Biology

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/effects; 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 persistent 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 IPP authorization.

MO045 European common frog (Rana temporaria) larvae show subcellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bt) 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 (Bt) is presumed to be an environmental friendly alternative 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 Bt 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 Bt 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 Bt exposures, while body condition was similar throughout the treatments. Furthermore, Bt induced significant increases of all enzymatic activities irrespective of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bt 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 Bt for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

MO046 Influence of salinity and temperature on tadpoles of Xenopus laevis C. Monteiro, R. Alves, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to the seawater intrusion. Carbon dioxide emissions are projected to lead to an increase in the global mean surface temperature for the year 2100. Therefore, this increase in temperature is expected to have great impact on the coastal ecosystems, which are already considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the influence of temperature on the adverse effects that increase of salinity may cause to tadpoles of the amphibian species Xenopus laevis. To address this objective, X. laevis tadpoles (Gosner 25) were exposed to a range of 5 NaCl concentrations under three temperatures: 20, 23 and 26°C. The following parameters were used at the end of the test: feeding rate, body weight and growth rates. The differences reported for size between control and NaCl concentrations were mainly due to the tail length. For all concentrations, the feeding rate decreased with increasing NaCl concentration. As well, body weight decreased significantly with increasing NaCl concentrations. The results indicate that increased temperature and salinity have additive effects on the growth and development of Xenopus laevis tadpoles.
with increasing salinity. Although significant interactions between temperature and salt concentration were registered, a pattern of influence in the temperature was not observed. Adverse effects were observed at the lowest tested salinity levels, which suggest that these species are highly vulnerable to small salinity increases and would be at high risk under seawater intrusion scenarios. Keywords: Salinity; toxicity; amphibia

MO047
EFFECTS OF THE EXPOSURE OF LARVAS OF Dendropsophus columbiaus (ANURA: HYLIIDAE) TO WATER CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES
V. R. Zambrano Cañizales, 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. columbiaus exposed to contaminants of agricultural, livestock and mining (with mercury: Hg, and with mercury and cyanide: Hg/CN) varied in the snout-vent length (SVL), tail length (TL), head width (HW), and body weight, and 2) to evaluate the effect of exposure on metamorphosis and behavior of the larvae. The AMPHITOX protocol was followed using ten larvae in each of the treatments and in the control, which were exposed from the moment of hatching to complete metamorphosis. Significant differences were found in the LRC between the larvae of the control and the Hg/CN mining treatment (Z= -28.92, p= 0.000) and between Hg/CN mining and agriculture treatments (Z= 25.325, p= 0.001) after 50 days of exposure. Differences in LC were found between the larvae of the control and the Hg/CN mining treatment (Z= -25.57, p= 0.001), and between Hg/CN mining and Hg mining treatments (Z= 21.525, p= 0.009) in the same time. The weight did not show differences. The majority of larvae of the control and the agriculture treatment showed similar development rates, reaching stage 46 between days 60 and 75 of exposure. While tadpoles exposed to Hg/CN mining did not complete the metamorphosis and reached stage 42 between days 50 and 55. Surface flotation was the activity that was most stable at the time of exposure, presenting percentages of individuals greater than 60% in the control (81%), and in the agriculture (70%) and Hg mining treatments (65%), between the last days of exposure evaluated: 22 to 28. It is shown that 1) the effects on growth of anuran larvae due to agricultural, livestock and mining contamination are similar. However, samples contaminated by mining produce smaller tadpoles than agriculture and livestock, and 2) tadpoles exposed to agricultural and livestock contamination, unlike other studies which reported no effects on metamorphosis, showed a time of this process that approximately 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. Strinissel, EFSA / Pesticides Unit; P. Adrianiou, Alterra Wageningen University and Research Centre; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; K. Machera, Benaki Physiopathological 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 bodies temporarily. Some species 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 increasing concern on potential long-term effects from exposure occurring during one reproductive season 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 applications, whereas 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.

MO050
Long-term survival of mancozeb exposed common vole populations from one to the following reproductive season
F. Von Blankenhagen, J. Ludwigs, 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 increasing concern on potential long-term effects from exposure occurring during one reproductive season 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 applications, whereas 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, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santalices, Instituto for Game and Wildlife Research (IGME), UCLM-CSIC-JCCM; S. Peiper, 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 on amphibian and reptilian risk assessment, focusing on the role of fish as surrogates for amphibians. This presentation do not necessarily represent the views of the U.S. EPA or the United States.

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 aquatic-phase amphibians is historically evaluated using surrogate toxicity data from standard fish species. Recently published test analyses on amphibian and fish ecotoxicology have shown that 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 studies are primarily designed to inform 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: Declarations: The views expressed in the presentation do not necessarily represent the views of the U.S. EPA or the United States.
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 reptiles 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 basis for further research necessary to advance the ecotoxicological risk assessment of reptiles within the remit of the pesticide authorization.

MO052 Amphimove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes


The current decline of amphibian populations on global and local scales is discussed by scientists around the world. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFEA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecology (e.g., aquatic and terrestrial life-stages in the wild) (e.g., species’ 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 focus of this project is to fill the data gap on terrestrial life-stage exposure of 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 and around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.

MO053 A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles

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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 a useful tool to determine the relationship between the sensitivity of chemicals with a molecular initiating event and an adverse outcome among species. Previously, a qAOP has 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 using embryo extracts from 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 (PCDF). Embryo-mortality was assessed in common snapping turtle embryos exposed to serial concentrations of one of four DLCs: TCDF, PcCDF, 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
MO056
Ecotoxicology of Africa’s three largest reptiles: POPs, metals, eggs, and eggshells.
H. Bouman, North-West University / Unit for Environmental Science and Management; R. Nel, Nelson Mandela Metropolitan University / Department of Zoology; H. Kylin, Linköping University / Department of Thematic Studies Environmental Change; D. Govender, SANParks; M. Du Preez, North West University / Zoology
The Nile Crocodile (Crocodylus niloticus), Loggerhead Turtle (Caretta caretta) and Leatherbacked Turtle (Dermochelys coriacea) are the largest reptiles in Africa. The bioaccumulation and effects of metals and metalloids on large-bodied reptiles are less well known compared with birds and mammals, especially those from Sub-Saharan Africa. Globally, reptiles are experiencing declines, and pollution is one of the hypothesized reasons for the decline. The Nile Crocodile and Loggerhead Turtle are at relatively high trophic levels, with the Nile Crocodile also being the largest predator in Africa. We sampled eggs from these three species (27 crocodile, and 10 each from the two turtle species) and analysed the shells and contents separately for metallic elements using ICP-MS. Trophic level, body size, and migratory patterns influenced the concentrations in shells and egg contents, but crocodiles generally seem to have lower concentrations than the sea turtles. Compared with data from elsewhere, sea turtle eggs had lower concentrations, but crocodile eggs had higher copper and mercury concentrations.
Comparisons between eggshells and egg content elemental compositions for each species clearly showed that eggshells 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, strontium and cadmium were monitored in the different samples. In Tables 1 and 2 the concentrations are presented for POPs and other contaminants in eggs, eggshells and blood plasma, also for POPs and other contaminants in eggs, eggshells and blood plasma. Emission of some POPs is a matter of societal and environmental concern (IPCC). The main scope of this study is to further analyse the standard dataset available and the specific guidance in use for the consumer risk assessment in order to better define how the data and knowledge developed in the context of the consumer risk assessments (internationally agreed methodologies, existing guidance documents) could be integrated in the environmental risk assessment. Particular consideration is given to the possibility of extrapolation between crops, use patterns (e.g. growth stages, application number) and European zones.

MO057
Increasing salinisation effects on Pelophylax perezi populations - Could historical exposure levels be responsible for the evolution of salinity tolerant populations?
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 in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. Pelophylax perezi is distributed along all coastal territory in Portugal, where there are some populations historically exposed to salinity 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 8-10) were exposed for 96h, and tadpoles for 72h to 168h (test dependent) 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 (EC$_{50}$ of 14.04 and EC$_{50}$=11.89 mScm$^{-1}$ for seawater and NaCl, respectively). As well, for the sub-lethally monitored endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles salinization-impacted population, but for non-impacted populations, tadpoles growth decrease with the decrease of seawater dilution.

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 Environmental and Forest Sciences; J. Pereira, University of Aveiro / Department of Environmental and Forest Sciences; J.J. Keizer, University of Aveiro / Department of Environmental Planning and 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 the input of pollutants to different aquatic compartments. This study aimed to evaluate the effects of wildfires on the aquatic environment, diagnosing the potential occurrence of effects on hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goals of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a currently burned eucalyptus area located in Préstimo (Águeda, central Portugal) and occurred after the first fire rainfall events at four sites (RDS and SDS), sampled in the month of September 2017. The following endpoints were monitored: mortality, mortality and post-exposure feeding inhibition, reduced growth, and sub-lethal pollution feeding inhibition, revealed a decrease in the feeding rate of organisms from the sites impacted by wildfire (RDS and SDS). Unlike, the sites outside the burnt area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that in situ bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.

MO060
Estrogenic effects of an Organophosphorous Flame Retardant (TCP) on Edible Sea Urchin "Paracentrotus lividus"
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Environmental risk assessment. Often the residues studies submitted in the regulatory exposure driven scenarios. The refinement of the RUD values is done only in rare cases since the 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 the input of pollutants to different aquatic compartments. This study aimed to evaluate the effects of wildfires on the aquatic environment, diagnosing the potential occurrence of effects on hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goals of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a currently burned eucalyptus area located in Préstimo (Águeda, central Portugal) and occurred after the first fire rainfall events at four sites (RDS and SDS), sampled in the month of September 2017. The following endpoints were monitored: mortality, mortality and post-exposure feeding inhibition, reduced growth, and sub-lethal pollution feeding inhibition, revealed a decrease in the feeding rate of organisms from the sites impacted by wildfire (RDS and SDS). Unlike, the sites outside the burnt area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that in situ bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.
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-Methylvinyl) 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 gill and liver total DNA damage. Behavioral responses were also examined for over 93.3% of total TEQs. Mono-ortho-DL PCBs accounted statistically higher levels than females (ANOVA, p< 0.0357). DL PCBs accounted from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs. 13C-labeled 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-HRMS on a Trace GC Ultra 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⁻² (2100-20800 ng g⁻²) for DL-PCBs, 612 ng g⁻² (312-1390 ng g⁻²) for PBDEs and 57.8 pg g⁻¹ (45.4-83.5 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 save for PCDD/Fs which were found in an order of magnitude lower. Yet, they were generally much higher that those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower that those reported for sperm whales from North-Atlantic. The PCDF congener profile (hexa > penta > tetra > octa) was relatively similar to those reported for sperm whales from Australia and to those reported in blubber of striped dolphin (Stenella coeruleoalba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa > penta > tetra > 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 2100 ng g⁻¹ lw. in biologically relevant areas as starting point of immunosuppression in harbour seals. This high level of contamination is not considered to be the cause of death of these animals, but may have contributed to lowering the defense of their immune system.

MO064

Biochemical and molecular responses to organic contaminants in bottlenose dolphins (Tursiops truncatus grypus) from southern Brazil. B. Righetti, Universidade Federal de Santa Catarina / NEPAQ-CCA; J.J. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Aquicultura; M.N. Siebert, Universidade Federal de Santa Catarina / LABCAI Biocinética; D.D. Lima, Universidade Federal de Santa Catarina / Bioquimica; F.L. Zacchi, Universidade Federal de Santa Catarina / Departamento de Bioquimica; P. Fruet, FURG Universidade Federal do Rio Grande / Museu Oceanográfico; F. Daura-Jorge, P.C. Simões-Lopes, Universidade Federal de Santa Catarina / ECZ; A. Bainy, Universidade Federal de Santa Catarina / Bioquimica; K. Luchmann, Santa Catarina State University / Ingenhensia de Pesca; C. Avila. Organic pollutants associated with the exposure to persistent organic pollutants (POPs) in cetaceans. Such effects threaten the maintenance of endangered populations, emphasizing the need for biomarkers that indicate early-on biological responses to POPs. The present work evaluated biomarker response to organic contaminants in bottlenose dolphins subspecies grypus from two estuarine systems of southern Brazil impacted by agricultural and industrial runoff: Lagoa dos Patos (a river estuary system) (n=7) and Patos Lagoon Eutrophication (n=10). Antioxidant enzymes and mRNA transcript levels of genes related to xenobiotic detoxification (AhR, ARNT, CYP1A1, GST, MT2), antioxidant defense (GST-γ, GPX 4, GR) and immune response (IL-1, MHC-II) were analyzed in integument samples obtained through remote biopsy. POPs were measured in the blubber of the same animals. Generalized linear models (GLMs) were used to analyze the response of each biomarker to PCBs, ZDDTs, Mirex, Chlordane (CHL), Hexachlorobenzene (HCB), sampling season (winter or summer) and location (LES and PLE). The best model to describe each biomarker response, with the lowest Akaike Information Criterion (AIC), was chosen using backward selection. GLMs results indicate that
the transcript levels of all studied genes were higher in winter when compared to summer, potentially due to enhanced metabolism over colder months. mRNA transcript levels of AHR, GR, IL1 and MT2 genes correlated positively with increasing levels of blubber 2PCBs, 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 levels of metals. Organochlorines reduced the skin of bottlenose dolphins is altered due to exposure to 2PCBs and PBDEs, which co-varied with 2PCBs, 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 significantly high exposure to PCBs 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 Gené, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, as well as cellular abnormalities (MN assay) were measured in blood samples collected from wild individuals, captured on the island of Antikythera (Greece), in May (N=13) and September 2017 (N=19). The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of F. eleonorae, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.370±0.433 - 11.34±0.829 nmol mkg⁻¹ min⁻¹ in May and 4.44±0.079 - 9.31±1.618 nmol mkg⁻¹ min⁻¹ in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cytoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals were below the naturally relevant levels, including those above the regulatory limit. 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
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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 equation for the risk evaluation, due to the lack of better data. It is therefore worthy to study deeply the presence of effects in the field in order to obtain a proper risk assessment. We highlight three complementary ways to improve the quality of such field studies. An analysis design considering the ‘extensive’ approach, by using a great area or number of agricultural fields in different study sites, with the ‘intensive’ approach, by using radio-tracking techniques in a control/treatment design. This double approach covers the natural variation in parameter estimates and enables the identification of possible treatment effects. The radio-tracking technique is sensible enough to monitor the fate of individuals in a treated area over a long period of time, and to find out the time of mortality. However, in most cases the critical point is the disappearance of individuals; an increase in their number can indicate a greater vulnerability to other stressors. In the context of a good study design, we also propose an improved statistical evaluation to increase the detectability of effects in comparison to earlier studies. The Kaplan-Meier survival curve and the Cox proportional hazards model are recommended as methods for the analysis of survival information. The Cox model is a well-known statistical technique used in medical tests. It provides an estimate of the treatment effect on survival adjusted for other explanatory variables. Moreover, as it isolates the effects of treatment from the effects of other covariates, the assessment of results of such field studies is facilitated. Additionally, an essential part of every statistical evaluation is to know the minimum number of individuals needed in order to perceive actual treatment effects in the statistical output. Using data from genetic radio telemetry studies on real untreated populations of wood mouse and several bird species, we run simulations of acute effects for different scenarios. The results show that minimum sample size is highly dependent on, first, the species, and second, the action mode and persistence of residues of each specific PPP.

MO067 Assessing impacts of legacy pollutants on wildlife of the Trinity River (Texas, USA) using Neotropical Cormorants as indicator species
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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 analyzed for OC pesticides, PCBS, and PBDEs. Levels of tri- and tetrabrominated diphenylethers varied with the species, number of agricultural fields in different study sites, with the results show that the minimum sample size is highly dependent on, first, the species, and second, the action mode and persistence of residues of each specific PPP. 

MO068 Testing the effects of a neonicotinoid insecticide on songbird migration
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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 refuge may be particularly vulnerable to the acute toxic effects of neonicotinoids. Effects of 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 OC pesticides, PCBs, and PBDEs of its biodigha were experiencing significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northerly orientation. To corroborate results from captive trials on free living birds, we conducted a study on radiotagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed to via gavage to a single 1.2 mg/kg bw dose of imidacloprid. These results should be useful to wildlife managers regarding concerns over contaminant impacts of the Trinity River on wildlife.

MO069 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, regulation, exposure pathways, toxicity, mechanism of action, pathology, pharmacokinetec, genetic resistance, non-target risk and its mitigation, alternatives
to ARs and integrated pest management (IPM). Broad concepts that emerged were: there is high conservation of the blood clotting process and so ARs can affect a wide range of non-target species; development of genetic resistance in target species led to global use of the more acutely toxic and persistent second-generation ARs (SGARs); vitamin K1 can be an effective antidote (unlike for many rodenticides); variation in non-target sensitivity may be due to pharmacokinetic, ecological and behavioural processes; >50% of predatory species contain AR residues; AR residues are an exposure of 10 ng/g liver and of 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 suited to assess risk; and primary AR exposure associated with ARs in general, although corresponding to 25 (51%) species. Knowledge of exposure and effects in invertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO070
Anticoagulant rodenticides in red kites (Milvus milvus) in Britain

Second generation anticoagulant rodenticides (SGARs) can be toxic to all mammals and birds. Studies have shown that, in Britain, there is widespread exposure to SGARs in a diverse range of predatory mammals and birds, including red kites (Milvus milvus). This species may be particularly at risk as it scavenges dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites is difficult due to an independent case may cause localized areas of exposure and effects in invertebrates and lower vertebrates; high incidence of SGAR exposure in red kites. We report the findings of the first such national-scale exposure study which was conducted for red kites found dead in 2015. Carcasses were typically found by members of the public, sent to an investigating laboratory, necropsied and analysed for liver SGARs by Liquid Chromatography Mass Spectrometry. Of 26 red kites from England & Wales that were analysed, all had detectable residues of difenacoum and brodifacoum; most also contained bromadiolone. Difenacoum was less frequently detected and flocoumafen was not detected in any birds. Sum liver SGAR concentrations ranged from 50 to 1266 ng/g wet wt. (arithmetic mean: 372 ng/g). Post-mortems indicated that 9 (35%) of the kites had internal hemorrhaging that was associated with detectable trauma; most had elevated serum liver SGAR concentrations. On the basis of these two factors, it is considered probable that SGARs were a contributory cause of death in these birds. Residue data were also available for 6 red kites from Scotland. Three (50%) had liver residues of at least two SGARs (bromadiolone and difenacoum); brodifacoum was also detected in one of these kites. SGARs were assessed to be a contributory cause of death in the bird that had residues of three SGARs. The data for Scotland, although limited, suggest that exposure of red kites in 2015 may have been less marked than in England & Wales, as has been found for other species collected in other years. Overall, these results suggest all red kites in England & Wales at least, are exposed to SGARs and that poisonings are not uncommon. Despite this, the red kite population has greatly expanded in England & Wales as birds recolonize former haunts. The entice to which exposure to SGARs may affect future population growth merits further investigation.

MO071
Environmental determinants of the exposure to anticoagulant rodenticides in non-target species
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Anticoagulant rodenticides have some similarities with other bioaccumulative persistent organic compounds, because of their frequent presence in many predatory species. In addition, the fact of being highly toxic substances makes this biaccumulation particularly harmful for these predators. Considering that the use of rodenticides occurs mainly in areas with high density of rodents that are in turn prey to multiple predators, we can also expect an ecological trap scenario. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. The analysis included liver samples of wild animals (n=244) found dead between 2007 and 2011 (34% in the region of Valencia, 44% in the region of Murcia, 11% in the region of Andalusia). The sampling included 30 different species (17 reptiles, 16 mammals and 32 birds). Liver samples were analysed by LC-MS and the presence of SGARs was statistically analysed with generalized linear models with a binary logistic response to study the effect of environmental or habitat characteristics including human population and livestock density and types and surface of crops. SGARs residues were detected in 83 (34%) of the analysed animals and 22 (67%) of the species collected. Ten species (53 individuals) corresponded to four mammals and six birds, had residues >200 ng/g, which is the threshold associated with adverse effects: these included common raven (67%), red fox (50%), red kite (38%), eagle owl (25%), common buzzard (17%), Western marsh-harrier (17%) and Eurasian badger (14%). The spatial analysis at the municipality level has allowed to identify the percentage of future urban land according to the geographic presence of SGARs. SGAR exposure in red kites as well as in other non-target species is related to multiple predators, we can also expect an ecological scenario. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species.
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds

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The antidepressant fluoxetine has been identified as a contaminant which may pose a risk to wild birds. However there is little empirical evidence regarding which bird species are most at risk of exposure to fluoxetine, in terms of concentration levels in wild bird samples. A significant barrier to sampling wild birds is that fluoxetine is cleared very quickly from systemic circulation and plasma concentrations might be expected to fall to levels below the limit of detection in less than one hour post-exposure. Facial sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an avian study with wild caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 µg d\(^{-1}\)) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC-MS/MS for fluoxetine and its major active metabolite norfluoxetine. 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.

MO074

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-history 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 habitat types. Parameters measured were body weight, daily reproduction performance, and survival rates and 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.

MO075

Monitoring NSAIDs in carrion and avian scavengers from Spain: preliminary results after diclofenac registration for veterinary use

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The serious impact of diclofenac on Asian vultures raised the alarm of the deficient environmental risk assessment of some veterinary drugs. In the case of diclofenac, there was an evident gap in the knowledge of the high toxicity that this non-steroidal anti-inflammatory drug (NSAID) has in Old-World vultures that can feed on treated livestock (LD\(_50\) in Gyps bengalensis of 98-225 µg/kg body mass). Avian scavengers (carrion and vultures) are the collapse of the vulture populations in Asia, in 2013 this drug was authorized for use in veterinary medicine in Spain and other countries in the European Union with the consequent risk of repeating the situation generated in Asia. In this work, we have studied the presence of NSAIDs in carrion animals (kidney, liver and musculature of pig, n=125) supplied in “muladares” to feed vultures. We have also studied the presence of NSAIDs residues in tissues of avian scavengers, n=27 found dead with suspicion of being intoxicated. NSAIDs were detected in tissues of four pigs (3.2%). Low levels of flunixin were detected in liver (4.1 ng/g) and kidney (7.9 ng/g) of two pigs; meloxicam was detected in the liver of one pig (23.8 ng/g), and diclofenac was 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. Flunixin was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffons (Gyps fulvus) analysed had 330 and 23 µg/g of flunixin in liver, another cinereous vulture (Aegypius monachus) had 2.83 µg/g of flunixin 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 griffons 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.

MO076

Different approaches comparison for evaluation of hypopharyngeal glands (HPG) activity in honeybees (Apis mellifera L.)


Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in natural pollination and in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypopharyngeal glands (HPG) which produce proteinaceous substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypopharyngeal glands development evaluation, in order to select the method that combines the highest reliability (the smallest technical error), the optimal cost, the least effort and time-consumption. The study was conducted on Honeybees subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSJ Journal 2013;117:3:2925). 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 (histochemical test); – scanning electron microscopy (SEM) (linear and quantitative measurements, imaging). The linear measurements 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 mm\(^2\)) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from WM 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 hypopharyngeal glands development the linear measurement combined with imaging should be used.

MO077

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 contaminant 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 candidates for risk assessment 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 pesticide exposure. Data on each species regarding their distribution, feeding habits, trophic level and life cycle were compiled. Further, a number 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 risk-specific risk assessments for birds and mammals.
Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

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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 such reintroduction projects, and one of the greatest challenges is to lead from the first generation of lammergeiers to the third generation. However, getting biological samples suitable for biomarker analysis may be a challenging task, especially when it comes to collecting post mortem liver samples from the Alps by analysing moulted feathers found in the field, relating them to the concentration of lead in the segments of rachis feathers. The objectives of this study were to assess the exposure to lead that the bearded vultures have in the Alps and to determine 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 the concentration of lead in the segments of rachis feathers. The results show higher OHC concentrations in Steigen [median and range; \( \Sigma_{PCBs}: 5.1 \text{ ng/ml (1.5 – 59.1 ng/ml)} \), \( \Sigma_{OCPs}: 4.2 \text{ ng/ml (1.3 – 52.2 ng/ml)} \), \( \Sigma_{PBDEs}: 0.3 \text{ (0.1 – 2.6 ng/ml) and } \Sigma_{PFASs}: 20.8 \text{ ng (7.2 – 52.9 ng/ml)}, \) than Smøla [median and range; \( \Sigma_{PCBs}: 3.9 \text{ ng/ml (0.8-3.47 ng/ml)} \), \( \Sigma_{OCPs}: 2.4 \text{ ng/ml (0.9 – 15.3 ng/ml)} \), \( \Sigma_{PBDEs}: 0.2 \text{ (1 – 1.5 ng/ml) and } \Sigma_{PFASs}: 4.6 \text{ (4.6 – 46.7 ng/ml)}, \)]

The analyses of thyroid hormones have been carried out and the results will be presented at the conference, along with biological parameters and OHCs.

MO081
Assignment 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 long-range transport, exposure measures have been taken to reduce the levels. To assess the effectiveness of such restrictions and the current levels of these chemicals in the environment, biomonitoring using birds is very useful. Hg has caused detrimental effects in birds such as haematotoxicity, immunotoxicity and endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the exposure to Hg and its effects at the biochemical level in white-tailed eagles (WTE) and Northern goshawks (NG) from Norway. Samples were obtained in 2014 from nestling WTE (n=14) and NG (n=11) in northern Norway (Nordland-N 68.30 – 68.47; E 24.54 – 25.27-° and Troms– N 68.77 – 67.39; E 20.39 – 23.47-°, respectively). Total Hg in feathers, total and free plasma corticosterone levels were analysed, along with following blood chemical parameters (BCCPs): albumin, creatinine, bilirubin, potassium and uric acid. Total protein, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, cholesterol, triglycerides, creatinine, amylase, glucose, creatinine, bilirubin, potassium and uric acid. Stable carbon (\(^{13}C\)) and nitrogen isotopes (\(^{15}N\)) were analysed in feathers to evaluate inter- and intra-specific contaminant exposure. 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 NG and 3.01 ± 1.34 mg/kg in WTE. The significantly higher levels in WTE than in NG (\( T (\text{MW} < 0.01) \) may be related to different dietary input, as confirmed by stable carbon and nitrogen isotope analysis of body feathers. The marine prey of WTE seem to determine the Hg loads, as Hg is known to be abundant in the marine environment. Due to the relations between Hg and biochemical parameters (corticosterone, BCCPs) showed relations between Hg and aspartate aminotransferase (an enzyme that may increase after liver damage). The effect of mercury on this enzyme seems controversial, as some experimental studies on nestlings of different species have found both positive and negative relations. Moreover, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NILS Science and Sustainability.

MO082
Thyroid-related gene expression, hormones, and thyroid gland histology in American kestrels exposed in ovo to two persistent organic pollutants, SCCPs and TBBPA-BDBPE

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Highly brominated flame retardants are being replaced by alternative flame retardants such as Tetrabromomobisphenol A bis[2,3-dibromopropyl ether] (TBBPA-BDBPE). TBBPA-BDBPE was introduced as a possible substitute for decabromodiphenyl ether (decaBDE), but has shown similar persistence and environmental transport mechanisms. This additive flame retardant is used in plastic products, textiles, paints, and household electronics. Although it is produced only in the US, Israel, and China, TBBPA-BDBPE is detected in environmental samples and wildlife tissues from across the globe. Short-Chain Chlorinated Paraffins (SCCPs) are priority emerging persistent organic pollutants (POPs) identified as chemicals of concern by the Stockholm Convention, Environment and Climate Change Canada, and the US. Environmental Protection Agency. SCCPs are used in metal lubricants and coolants in metal cutting, and as plasticizers and flame retardants in plastics and paints. SCCPs are of concern because they bioaccumulate in wildlife and humans, are environmentally persistent, transported globally, and are toxic to aquatic organisms at low concentrations. However, few data are available on the potential adverse effects of TBBPA-BDBPE and SCCPs in birds. A comparative exposure assessment of these two classes of flame retardants was 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 hatchlings 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.

MO083 Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk
J. Alves, R. Minu, A. Alves da Silva, C.FE - Centre for Functional Ecology, / Department of Life Sciences, University of Coimbra; T. Natal da Luta, University of Coimbra / Laboratory of Applied Ecology, Coimbra / Department of Life Sciences, University of Coimbra; P. Barros, CITAB - Centre for Research and Technology of Agro-Environment and Biological Sciences / Laboratory of Applied Ecology, University of Trás-os-Montes e Alto Douro; C.J. Topping, Aarhus University / Department of Bioscience; J. Sousa, University of Coimbra / Department of Life Sciences

More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on the effects of metal pollution on bats are focused on organic contaminants, and the consequences of exposure to other substances (particularly metals), remaining largely unknown. The aim of this study was to evaluate the potential risk of metal contamination in bat species occurring in Portugal, and to evaluate the suitability of non-lethal sampling methods. The concentration of As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se and Zn was measured in two categories of biological samples (lethal-samples: liver, heart, bone and brain; and non-lethal samples: wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savii, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmeus).

Concerning the metal concentration obtained in each sampling tissue, significant differences were found between the concentrations obtained in each species for all the metals (P<0.05), except for Zn (P=0.223). Significant differences were also found between the concentrations of metals in organs and organs and metals (P<0.001). Depending on the metal, the organ/tissue that showed the highest concentrations varied, but even so far and wing presented the highest concentrations of most of the metals. These results support the hypothesis that non-lethal samples may be useful for studies on wildlife ecotoxicology, and may help to define a protocol capable of being applied at large-scale, to investigate the risk of metal accumulation for bats. For this purpose, non-lethal samples are the best option, and as demonstrated by this study can yield reliable results. Our results therefore provide valuable insights for development of further studies, aiming to understand the importance of metals as a cause for some of the observed declines in bat populations worldwide.

MO084 Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus
J.D. van Aswegen, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University; H. Brown, North-West University / Unit for Environmental Science and Management

The Strydom 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 tends 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 0.00057 and 0.000084 mg/kg dm, and for Zn it was 2.1 and 62 mg/kg dm, respectively. Of the five elements, only Sr (p = 0.0141) and Ti (p = 0.0013) concentrations showed significant positive regressions between egg contents and eggshells. Chromium and Zn showed a positive regression, but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Strydom River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.

MO085 Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part
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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. Measurements included (Hg, Cd, Pb, Cr) in these eggs were analysed with the aim to: (1) evaluate geographical patterns of possible for 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 Baleares) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher Hg concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first assay 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 'n

MO086 Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos
M. Parolini, University of Milan / Department of Environmental Supplementation and Policy; C.D. Possenti, B. De Felice, Università degli Studi di Milano; N. Saino, University of Milano

Oviparous mothers transfer to the eggs components that have both independent and combined effects on offspring phenotype. Functional interactions between egg components, such as antioxidants and contaminants, have not been well investigated. The aim of this study was to evaluate the potential of vitamin components in egg content to improve embryos’ health and to prevent potential effects of contaminants on egg membranes. Eggs were manipulated the concentration of vitamin E and BDE-47 (PBDE) by administering a physiological, large (2 standard deviations) dose of vitamin E and BDE-47 to eggs. To assess the effects of these treatments, we studied the oxidative stress-related activity, in the eggs of wild yellow-legged gull embryos. 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 exposure to these chemicals is largely unknown. To better understand the role of vitamin E and BDE-47 in the development of embryos, we manipulated the concentration of vitamin E 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/g 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.
MO087 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, freshwater pearl mussels are 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 ecotoxicological studies. The aim of this work was to determine the sensitivity of 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. These 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.

MO088 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.

MO089 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

O. Jollet, University of Michigan; L. Huang, University of Michigan / Dept of Environmental Health Sciences; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division

Direct exposure of consumers to chemical ingredients within our daily products is an important pathway that often dominates environmental performance profiles of these consumer products, but has been currently left aside in LCIA toxicity characterization. One 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 estimation tools. The tool allows to identify how freshwater resources can be described as an entity to protect within the Area of Protection (AoP) natural resources, (2) describe 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.

MO093 Adding the resource dimension to the WULCA framework on assessing freshwater use in LCA

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Effective management of freshwater resources is recognized as being vital at present, existing LCIA methods for water use do not entirely reflect the state of such a vital resource remaining for future generations. Thus, the objectives of this work are (1) identify how freshwater resources can be described as an entity to protect within the Area of Protection (AoP) natural resources, (2) describe the impact pathways affecting this resource, and (3) propose a characterization framework to assess the impacts from the identified impact pathways. Freshwater resource has a particular status in LCA resource modeling. First, it exists in the form of three types of resources: flow, fund, or stock. Then, in addition to being a resource for human economic activities (e.g. hydropower), it is above all a non-substitutable support for life that can be affected by both consumption (source function) and pollution (sink function). Therefore, both types of elementary flows (emissions and water consumption) should be linked to a damage indicator for...
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 different anthropogenic factors 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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Soil is a rare natural resource and it is at the center of the main issues in agronomy, environment and land use planning. At global level, erosion is one of the major soil degradation processes and it is responsible for the decrease in agronomic potential of soils and in agricultural land surfaces. Water and soil conservation works (WSCW) are generally built in upland areas to reduce runoff and erosion, to increase on-site deposition of eroded particles and to increase local water infiltration. Contour ridges modify water and soil flows at catchment scale, so it is necessary to use a model able to calculate the inventory flow at the catchment and not only at the plot level. In this study we present a methodology to integrate the impact of contour ridges on topsoil erosion at the catchment level and to compute characterization factors in presence of such WSCW. The proposed method was applied in a case study in semi-arid context in central Tunisia (Merguellil watershed) which presents the issues of over-exploitation of water resources, accelerated land degradation and a high expansion of conservation works. In order to highlight the impact of WSCW on topsoil erosion, a model was developed. This model was compared to the results of a study carried out by the Walloon Agricultural Research Centre, S. Belboom, ULiege; E. Pezennec, Knauf Laboratory; J.C. Bare, U.S. Environmental Protection Agency / National Risk Management Research Laboratory; D.E. Meyer, United States Environmental Protection Agency. The study shows that the contributions of different WSCW types in pollutants loads into stream are not negligible. However, the results obtained with those models indicate that the contribution of contour ridges is limited compared to the contribution of other WSCW types. It is necessary to improve the models in order to better represent the role of these works in reducing erosion and improving water infiltration.

MO095
Impact of heavy metals on human toxicity using LCA: a case study for Wallonia

S. Gerbinet, Université de Liège / Chemical Engineering; F. Van Stappen, CRAW Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Insulation sprl.; S. Grosland, University of Liège - Chemical Engineering / Dpt of Chemical Engineering - PEPs; A. Leonard, University of Liège

This study aims to focus on the following research questions: how does the human toxicity of corn farming in Wallonia, Belgium contribute to the health of the Wallonia population? How does the Metal Species-Factor (MSF) method used in the USEtox model contribute to this field of study? The study shows that agricultural practices can have a significant impact on human health. For example, the consumption of pork from pigs reared on land treated with manure from animals fed on a diet rich in heavy metals can lead to an increase in the concentration of heavy metals in the pork. This increase can have negative effects on human health, such as increased risk of cancer or reproductive problems. The study also shows that the use of organic fertilizers can help to reduce the concentration of heavy metals in the soil, which in turn can reduce the risk of negative health effects in the population. The study concludes that a holistic approach to the management of agricultural practices is necessary to protect human health and the environment.

MO097
Comparing ProScale Hazard Factors with USEtox Effect Factors for human toxicity

T. Rydelberg, IVL Swedish Environmental Research Institute; H. Holmqist, Chalmers University of Technology

The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScale™, and the Effect Factors (EF) for human toxicity of USEtox™, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting health effect severity basis. Hazard factors in USEtox are based on criteria in ProScale hazard classes, and an OEL based correction factor has been introduced to account for potency within each class. The effect factor (EF) is a metric of the change in life time disease probability due to change in life time intake of a pollutant (cases/kg). USEtox™ determines effect factors for carcinogenic and non-carcinogenic chemicals separately. Both methods have separate factors for inhalative and oral exposures. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposures have been poorly characterized. This poster will describe the research project, including the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project.
Impacts of Chemicals
R. Calvo-Serrano, G. Guillén Gosalbez, Imperial College London / Chemical Engineering

Process sustainability has become one of the fundamental criteria for decision making in chemical industry, being Life Cycle Assessment (LCA) the most popular method in recent years, currently being one of the most extended sustainability assessment methods. Since LCA is based on the analysis of all interactions for all the stages of the life cycle, it ends requiring large amounts of information. This information, however, can be difficult or impossible to gather, being one of the main obstacles when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for small and relatively simple processes and only information of a few hundreds. In these cases, when a full assessment cannot be applied, a simplified 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 effects of chemicals as attributes, for a better characterisation of the chemicals and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP,33.55%) or Eco-Indicator 99 (EF99) (18.34%).

MO101 Development of USEtox characterisation factors for micropollutants in effluents
E. Maillard, ELSA-PACT Industrial Chair

Many substances are increasingly detected in surface waters, after their use by the human population. In most cases, these substances will exert the same effects as desired when they are originally applied, only now affecting different organisms. These effects can occur at concentrations of µg/l, which is why these substances are called micropollutants. In the context of Life Cycle Assessment, there is a need of characterising the toxicity potential of these micropollutants affecting ecosystems and/or the human population. A substance which is not characterised will not be considered in a LCA study, which may result in misguided decisions and the omission of essential environmental issues related to biodiversity and human health. The aim of this project is to develop a database of characterisation factors for the most chemicals as attributes, in the effluent of wastewater treatment plants with the USEtox model. In order to develop this database, the following tasks are needed: identification of a priority list of substances currently missing in USEtox, while being highly relevant in the context of treated and untreated effluents; Literature review and database searches on existing data (required to calculate fate, exposure and effects) for the priority substances identified; Establishment of a database of USEtox characterisation factors for human toxicity and ecotoxicity impact potentials. All these newly developed characterisation factors will be submitted for inclusion to the official USEtox database center.

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

Anthropogenic contributions of the nutrients nitrogen (N) and phosphorus (P) threaten the health of freshwater and marine ecosystems around the world [1]. The increase in environmental nutrient availability, known as eutrophication, can lead to harmful algal blooms (HABs) and decreased levels of oxygen (hypoxia) needed to sustain aquatic life [2]. This presentation evaluates the current state of life cycle impact assessment (LCA) methods for eutrophication in freshwater and marine ecosystems using a criteria-matrix reviewed of the underlying fate and transport (F&T) models. Results of the review point to several key recommendations for further scientific development of midpoint eutrophication methods in life cycle assessment (LCA). Current eutrophication methods in LCA are limited. Most LCA studies use simplified F&T models with continental or global geospatial resolution, characteristics of which tend to be inadequate for regional analyses and complex community-based decisions. Therefore, this critical review examines a set of surface water quality models, watershed models, marine models, and air quality models that each have potential for integration into LCIA. Factors examined included sources of nutrient loading to each environmental compartment (e.g., water bodies, soils, and air), the forms of each nutrient modeled, and the representation of each F&T mechanism. Review results suggest several possible recommendations, including the continuation of the recent trend toward separation of freshwater and marine eutrophication methods, expanded characterization of the freshwater cause-effect chain, and the development of new soil and freshwater fate models. By incorporating findings of the F&T models into current eutrophication methods, LCA can better inform scientific decisions that affect water quality, nutrient management, and environmental policies across watersheds and global ecosystems. [1] Rockström J, Steffen W, Noone K, Peterson Å, Chapin FS, Lambin EF, Lenton TM, Scheffer M, et al. 2009. A safe operating space for humanity. Nature 461: 472-475. [2] Diaz RJ, Rosenberg R. 2008. Spreading dead zones and hypoxic waters in the global ocean. Science 321: 929-931. Disclaimer - The views or policies of the U.S. Environmental Protection Agency, or representing the views or policies of the U.S. Environmental Protection Agency, or representing the views or policies of the U.S. Environmental Protection Agency, or representing the views or policies of the U.S. Environmental Protection Agency, or representing the views or policies of the U.S. Environmental Protection Agency, or representing the views or policies of the U.S. Environmental Protection Agency.
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 tools, 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 established within the natural environment such as fresh water ponds or offshore cultivation systems, either in brownfield lands in an optics of redevloement 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
I. Sánchez-De Castro, D. Gurrain, Y. Léchon, CIEMAT / Energy Dept

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 context of application. After having summarised the main state-of-the-art of the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: i) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wula-waterlca.org), a midpoint water use indicator representing the relative Available Water Remaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint
P. Ingrassia, University of Aveiro / Department of Environment and Planning; b. nidout, CSIRO; L. Arrojo, A. Dias, University of Aveiro / Department of Environment and Planning

Freshwater stress and its implications for present and human welfare and the natural environment awakened 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 contribute to the recharge groundwater). After having summarised the main state-of-the-art of the methodologies to consider this impact category, this work presents the state-of-the-art of methodological challenges remaining in the assessment of a water scarcity footprint.
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 nitrogen that has not occurred naturally due to species (PNOF) due to a change in the river basin-specific emission of P or N to fresh water (via WWTPs) or agricultural soil and consist of a fate and an effect factor. To determine the fate factors, the changes in N and P concentrations resulting from agricultural as well as from WWTPs 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 and comprehensive impacts due to nitrogen as well as phosphorus from soil as well as from freshwater emissions, in a coherent way. The factors can be applied to determine eutrophication impacts of products in LCIA, as well as to determine country-specific eutrophication footprints using multi-regional input-output (MROI) analysis.

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

MO109 Carbon and material footprint of consumption in Flanders - an input-output based assessment

A. Vercalsteren, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten, VMM-MIRA

Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks, based on the Flemish environmentally extended input-output model. The Flemish EE-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 Flemish consumption amounted to about 20 tonnes per inhabitant. Nearly three quarters of the carbon footprint are linked to household consumption, mainly caused by the production and transport of the goods and services consumed. Three quarters of the carbon footprint of goods and services purchased by households are linked to housing, food and personal transport. Whilst the majority of the greenhouse gas emissions, primary materials and employment is outsourced, the added value linked to Flemish consumption is mainly created in Flanders. The presentation will introduce the overall results of the carbon and material footprint assessment of Flemish consumption in 2010 and go more in detail into the value chain impact of some household consumption activities e.g. food consumption. The relation between carbon and material footprints, 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. Shiromi, Kyushu University / Economics; S. Kagawa, Kyushu University; Y. Kondo, Waseda University

In this study, we focus on the effects of changes in material and energy input structure on the life-cycle CO2 emissions (i.e., consumption-based emissions). Previous studies and discussions about consumption-based emissions have introduced deep structural changes including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether for some development levels of countries can explain these environmental effects. Specifically, we employed the mutual multi-regional structural decomposition analysis based on the World Input-Output Database (WIOD) during 1995 to 2008 (Dietzenbacher et al., 2013) and decomposed life-cycle CO2 emissions of 40 nations into the following four inducement sources: (i) inputs from material goods (including energy) to material goods, (ii) inputs from material goods to services, (iii) inputs from services to material goods, and (iv) inputs from 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 shift to the industrial structure with less emission-intensive material goods.

MO111 Influence of substance coverage on impacts from the electricity sector

A.S. Leclerc, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering; Y. Kanae, Kyushu University / Economics; S. Kagawa, Kyushu University; Y. Kondo, Waseda University

The electricity sector is a major source of emissions of greenhouse gases, 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 (Exiobase) includes emissions related to electricity production 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 cover of toxicity impacts in large-scale life cycle assessments (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (ENEEL) by upsampling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEEL covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using ENEEL 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. Kamemoto, 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 national consumption are occurring. It offers the potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to the production system, enabling the identification of the actual hotspots where impacts occur. We present a novel mapping framework for locating the actual hotspots where impacts occur. This framework maps national footprints to areas where the impacts are occurring and can be used to identify the hotspots at a national and international level. By combining global biodiversity datasets with remote sensing or earth observatory GIS data, we can identify the actual hotspots where impacts are occurring and provide a more accurate picture of the environmental impacts of national consumption.

MO114 LCA data machine applied to GHG emissions, air pollution, and biodiversity footprints

A. Ciroth, GreenDelta; M. Srocka, GreenDelta GmbH

In any LCA study, finding data sets that are “fit for purpose” is probably one of the most challenging aspects. As the consumption footprint of a country can be very large and remote, it is often difficult to connect consumers and other downstream users to the origins of their GHG emissions and other impacts. Given the importance of the 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 footprint methodology.
created so that they meet requirement sets, such as, for example, related to PEF. Meanwhile, the “DAMA” has been applied to various sectors, products, and data sources. The presentation will summarise key steps of the development and will demonstrate the DAMA, for specific data sets and also for specific use cases. The LCA data machine will be demonstrated in three different application cases: 1) finding and if necessary creating data sets in situations where no data set is directly available, i.e. for data gaps; Paper machine example 2) creating a data set as copy of an existing data set; Creating soy bean production US 3) Product comparison, identification of differences between compared products The approach with DAMA will also be compared to approaches currently used in LCA, with examples from the PEF remodelling project and others. The LCA data machine has the potential to truly change the current approach for data set creation, exchange, and also use, in LCA and related areas and can be especially useful for creating inventories in a larger scale.

MO115 Static and dynamic modeling of high performance buildings: Comparison of average and marginal electricity mixes, a consequential effect on LCA results
M. Bilec, W. Collinge, University of Pittsburgh / Civil and Environmental Engineering; H. Rickenbacker, University of Pittsburgh / Civil & Environmental Engineering; A. Landsis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Population and Public Health

Trident ont (life cycle assessment (LCA) involves explicit assumptions and major uncertainties associated with the source of electricity across two main dimensions: spatial and temporal. There is a need within the LCA community for an approach that addresses this ambiguity and allocates environmental impacts as a function of marginal and time-specific variations. In our study, particular attention is paid to the dynamic characteristics of two buildings’ electrical energy consumption in relation to their energy source. The results show that in the studied cases marginal impacts. The marginal consequential model improved the payback period by an order of magnitude (12.5 years to 3.0 years). Additionally, the dynamic scenarios explored in this study were able to effectively account for the growth in natural gas generation, assigning or ignoring emissions based on a marginal increase or decrease load during the building’s use. The LEED Gold building is solely reliant on the regional electric grid, making our findings indicative of a market-as-usual scenario and therefore comparable and/or scalable to other building studies. No studies combining time-resolved building electrical usage with time-resolved grid electricity production have been found in a U.S. context. There are notable differences between the European and North American power grids, on that account this approach aids to the advancement of DLCA research domestically.

MO116 Life cycle framework for environmental assessment of public transport systems
A. Shinde, Indian Institute of Technology Bombay, Mumbai, India; A. Dikshit, Indian Institute of Technology Bombay, Mumbai, India / Centre for Environmental Science and Engineering (CESE); R. Singh, Thinkstep Sustainability Solutions Pvt. Ltd., Mumbai, India

Several studies have assessed life cycle environmental impact of public transport systems. However, there is no single platform, software or tool for comparing the environmental performance of commuting processes. The objective of this study was the development of an LCA based framework to evaluate, analyze and compare the life cycle environmental impact of public transport systems. The modular and parameterized system of GaBi 6.5 platform has been used for exploring the life cycle environmental performance of commuting trains, public bus transport and intermediate public transport (IPT) modes viz. taxi, auto-rickshaw. The system boundary comprises the limited construction phase and maintenance of transport infrastructure, manufacturing and maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PKT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PKT environmental impact of public transport systems are highly sensitive to ridership levels, the environmental impact of public transport systems and IPT modes has been compared for off-peak, average and peak hour levels of ridership. This framework has been developed on the basis of extensive data collected for the material and energy required for the construction and maintenance of infrastructure, manufacturing and maintenance of rolling stock, use phase impacts of fuel/energy production and tail-pipe emissions, in addition to the transport of raw materials. Therefore, this framework is highly comprehensive but it is also amenable to future additions and expansions. The regional transport authorities can proactively address the target areas for improving the environmental performance of their transportation system, and ultimately the competitiveness of their network. The regulatory authorities will have the information to improve on their policies to reduce environmental impacts associated with each mode at each stage.

MO117 Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment methodology
A. L. MERCCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslantrab, University of Liege / Chemical Engineering; A. Léonard, Liège Université / 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 rail 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 rail-road 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, we have created four different scenarios with a time frame set in the year 2030 have been used 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 show that the initial plan to build plants for the production of lithium 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; J.A. Hingston, Chemicals AG, Crop Science Division / Environmental Safety; J.A. Hingston, Chemicals AG, Crop Science Division / Environmental Safety; J.A. Hingston, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi-phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err measure misleading as it does not account for systematic deviations or 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, depending on the subjective 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 temporal data). The area under the curve is then weighted, depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data.
point. Thus, the criterion mimicks the visual assessment process, taking into account the presence and size of systematic deviations, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFO should also be assessed. Testing of the criterion for metabolite fits should be done in such cases. In its current form, it was constructed to be also useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MOI120 "Southside"- Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

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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 (ENASGISPs) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. It is not to be accepted. 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, reasons and consequences

J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX, P. Kosubova, Central Institute for Supervising and Testing in Agriculture; S. Polakova, Central Institute for Supervising and Testing in Agriculture / Official control section; M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Brodky, Charles University in Prague / Bielecki, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Brandstaetter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinisová, AQUATEST Inc.; Z. Simek, L. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Sudoma, Masaryk University / Central Institute for Supervising and Testing in Agriculture; M. Svobodova, L. Krkolová, J. Vasickova, 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 and simazine in soil contamination, 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 15-20065S).

MOI122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?

P.I. Adriaanse, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

DegT50 was determined in 110/2009 exposure concentrations are calculated in ponds, ditches and streams in ten FOCUS surface water scenarios distributed across the EU (https://esdac.jrc.ec.europa.eu/projects/surface-water). Currently, these scenarios are based on simulation periods of 12-16 months, so only one application year. However, for more realistic probabilistic assessments a simulation period of about 20 years seems more appropriate. This will result in significantly increased simulation times. For the TOXSWA model simulation times may raise up to approximately 5 minutes for ponds, 15 minutes for ditches and one hour for streams. We investigated whether it would be possible to reduce the simulation time without compromising the accuracy of the predicted concentrations. In the current FOCUS scenarios TOXSWA uses segments of 30 m (ponds, 1 segment), 10 m (ditches, 10 segments) and 5 m (streams, 20 segments) in the numerical solution of the pesticide mass balance describing the concentration in the water layer. This allows to e.g. create concentration profiles as a function of distance in the ditches and streams. To reduce the simulation time rigorously, we cut down the number of segments in the water layer of ditches and streams to one segment. Next, concentrations calculated with a single segment for the water layer were compared to the maximum concentrations in the most downstream segment of the ditch or stream as used in the FOCUS scenarios. We considered maximum and 7 d time-weighted average concentrations both in water and sediment for a range of fictitious compounds. Initial simulations for the 12 and 16 months demonstrated that simulation times greatly reduced by replacing the standard FOCUS scenario with a single segment (still coupled to the standard 14 sediment segments). For the water layer we found that instantaneous peaks lowered up to 11% for ditches, but less than 2% for streams. For the sediment peak concentrations changed up to 20 or 30%, indiscriminately for ditches and streams. Consequently, time-weighted average concentrations also changed, up to 7% both in water and in sediment. Based upon these initial calculations replacing the standard 20 segments in FOCUS streams by one segment could be applied to obtain accurate concentrations in water, while significantly reducing simulation times.

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

W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and for general water quality research by industry, governments, and academic organizations. However, use of the monitoring measured data has been limited in the regulatory assessment process to refine/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timings 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
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing

D. Weber, M. Brauer, Eurofins Regulatory AG / Environmental and Ecological Modelling; A. Boelehan, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The calculations of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goerlitz, 2015; Bach et al., 2016, Poulsen, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e. any comments from official side (EFSAs 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. Pwel. Nature Sustain 2015: 127–129; M. Logsdon and T. Galle (2015): Multiyear FOCUS surface water modelling: Options and Proposals for Realisation. XV: Symposium in Pesticide Chemistry. Piacenza, Italy. September 2015 Klein M (2015): Long term surface water simulations using the FOCUS scenarios. Pesticide Behaviour in soils, Water and Air, York, UK. September 2013 Poulsen V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Luxembourg. September 2016 Weber et al. 2017: Multi-Year evaluations in the FOCUS Surface Water assessment. Conference Pesticide Behaviour in Soils, Water and Air, York 2017.

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

S. Multsch, F. Krebs, S. Reichenberger, DR. KNOELL CONSULT GmbH; S. Heine, Bayer AG / Effect modelling; P. Kraft, L. Breuer, Justus Liebig University Giessen / Chair of Landscape, Water and Biogeochemical Cycles; T. Schad, Bayer AG / Environmental Modelling


MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models

B. Kind, A. Guckland, J. Kleinmann, WS HU Scientific GmbH

For the zonal registration in the EU predicted environmental concentrations in surface water need to be simulated based on the FOCUS models. Three different entry paths are considered: runoff (simulated in PRZM), drainage (MACRO) and spray drift (SWASH drift calculator). While the latter only depends on the amount sprayed, the distance to the water body and the spray equipment used, runoff and drainage amounts are also triggered by substance properties, e.g. degradation in soil and 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 amounts 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 as different application times within the same field to proof a drift 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 reduced to certain worst-case scenarios depending on the DT50 and KOC properties of the substance.

MO127 Quantitative exploitation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation

P. Sieler, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittius, 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 sampling techniques provide a cost-efficient solution that is not only attractive but also allows 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 use specific loads in catchments and exceedance 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

M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; J. Farlin, Luxembourg Institute of Science and Technology LIST

The impact of agricultural practices on water pollution can be addressed. Based on monitoring in different hydrogeological contexts the approach is used to derive land and crop use specific loads in catchments and exceedance probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

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MO129
Recallibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data

S. Schenkelberg, D.R. KNÖEHL CONSULT GmbH / Environmental Fate / Modelling / GIS; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; C. Kley, Bayer AG Crop Science Division; S. Sittig, D.R. KNÖEHL CONSULT GmbH / E-Fate Modelling; S. Multsch, D.R. KNÖEHL CONSULT GmbH

Vegetative filter strips (VFS) are widely used for mitigating pesticide inputs into surface waters via surface runoff and erosion. To simulate and assess the VFS condition of the field soil (as a proxy for the clay content of the eroded sediment). The Sabbagh et al. (2009) equation, the coefficients of which were obtained by calibration against 47 data points, has not been widely accepted by regulatory authorities. The open source approach presented here, its reliability, has not been sufficiently established yet. Hence, evaluation against additional experimental data is necessary. Chen et al. (2016) proposed an alternative regression equation with a different structure based on 181 experimental data points. This equation uses fewer independent variables, but has more parameters than the Sabbagh equation. The objective of the present study was to improve the predictive capability of the Sabbagh et al. equation by broadening the available experimental data. For this, additional experimental VFS datasets were compiled from the available literature and thoroughly checked for their suitability. Moreover, existing errors in the calibration and validation data points of Sabbagh et al. (2009) were corrected. The consolidated experimental dataset (n = 244) was used to recalibrate the Sabbagh and Chen equations. Moreover, a 5-fold cross-validation analysis was performed to assess the predictive capability of both models. The Sabbagh equation fitted the whole dataset slightly better than the Chen equation (r² = 0.82 vs. r² = 0.79) and performed consistently better in the cross-validation exercise (with respect to the prediction performance indicators Q², predictive r², and RMSEP). Finally, a maximum-likelihood-based calibration and uncertainty analysis were performed for the Sabbagh equation using the DREAM algorithm.

MO130
Vanda - Visualize and Assess: a tool for the pesticide risk mitigation in surface water

F. Galimberti, G. Azimonti, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health: A. Moreno, Università degli Studi di Milano

The Directive 2009/128/EC of European Parliament and Council on Sustainable Use of Pesticides introduced a community action framework to protect the Environment of the EU and requested Member States to implement policies and actions in order to reduce the risk of pesticide use. In the Region of Lombardy, in Italy, this Directive was adopted with DGR n. X/3233. The aim of the present work is to develop an interactive, easy-to-use tool to evaluate the potential risk of surface water contamination, assess the potential pesticide risk and identify areas where to introduce mitigation measures to reduce the contamination, and consequently to reduce the risk in the surface water compartment. The datasets to start with are the monitored concentrations of pesticides in surface water, produced by the Regional EPA. These values are used in this context as Measured Environmental Concentration - MEC. The ratio MEC/PNEC is proposed in this work as a sort of risk assessment, even though the limitation and the complexity of usage of monitored data is well known. In addition, the ratio MEC/ECQS - Environmental Qualitative Standard (annual average concentration), is considered, to address the water quality with respect to the regulatory limit for pesticides in surface water (Environmental Quality Standards). A MS Excel tool has been developed to map the monitored residues of pesticides, assess the potential pesticide risk (MEC/PNEC) and identify “hot spots”, that is areas where mitigation measures should be included. The tool is thought to be an anyone-can-use one, even with no particular knowledge of GIS or database management. Its peculiarity to be built inside MS Excel gives itself the possibility to share and to ease the dissemination of results. For more advanced mapping, the tool can interact with ESRI ArcGIS. The openness of Vanda makes it a tool suitable to work with other environmental compartments or other environmental theamtics.

MO131
Selecting application dates for UK higher tier drainflow modelling: comparing the FOCUS PAT and CRD PAT rules, and assessing the role of soil trafficability

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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 Timing (FOCUS PAT), which selects an application date for a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8): 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil. Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g. in dry springs applications might take place in March while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuance 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 predict drainflow was shown to improve the uncertainty of the tropical weather in the French Caribbean makes spot on 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 on of passive samplers for the monitoring of chlordecone obsolete and new approaches should be explored to monitor the fate of this molecule in the aquatic system. Here, three types of integrative samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordecone: the classical POCIS (Poly Organic Chemical Integrative Sampler) (with Polysuflhione membranes), the POCISny 30µm (with nylon membranes), and the POCISny 0.1µm. Calculated sampling rates (Rs) were corrected by a PCR (Performance Reference Curve) approach. This enabled the POCISny 30µm and the POCISny 0.1µm to be used for long-term monitoring. Moreover, a ratio was defined to compare factors under a continuous flow system, and the field calibration was done in triplicates in river Capisterre (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.90±0.1 L.day⁻¹ for the POCISny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCISny 30µm. Two distinct Rs have been calculated for the POCIS and the POCISny 0.1µm: one for the first five days of the experiment (R=0.19±0.01 L.day⁻¹ for NOCIS 0.1µm) and one for the overall experiment (R=0.19±0.02 L.day⁻¹ for POCIS; R=0.43±0.01 L.day⁻¹). POCISny 30µm followed the same pattern than the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than...
in the laboratory calibration (R²=0.82 ±1.93 L⁻¹). POCIS and POCISny samples can accumulate chloride efficiently despite its hydrophobic properties. POCIS 30μm seem to be a useful tool to monitor short flash floods, which happen regularly in this area.

MO134 Temporal patterns of pesticide residues in four major river basins in Korea C. Kim, K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples were collected at these sites from March to July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongjin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, iprobenfos and thiadiazanine as fungicides were mainly detected in rice season. While other fungicides including dimethconazole, procymidone, fenarimol, nuarimol and boscalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphoruses, cadusafos, diazinon, fenitrothion, fenothion, phenthoate and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Since surfactant monitored, nine pesticides which include alachlor, butachlor, dimethametryn, dithiophos, methalactoh, oxadiazon, 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 samples collected from April 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, chlorazone, diuron, hexazinone and tebuthiuron.), 3 fungicides (oxazosiforin, carbademzin and tebuconazole), 3 insecticides (carbofuran, imidaclopid 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 and from 2.8 to 74 µg/L, 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%), carbademzin (93%), telon (99%), tebuconazole (91%), imidaclopid (96%) and ametryn (81%). The pesticide that presented the highest concentration for this matrix was imidaclopid, reaching 2579 ng L⁻¹. The risk to aquatic life was 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 imidaclopid, carbademzin, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidaclopid (14%), carbademzin (10%), tebuthiuron (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuthiuron, reaching 107 ng L⁻¹.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil B. Jene, BASF SE / Environmental Fate; R.P. SCORZA JUNIOR, Embrapa / EMBRAPA AGROPECUARIA OESTE; D. Máximo, R. Rebelo, IBAMA / DIQUA / CQGASQ; A.V. Waichman, Universidade Federal do Amazonas; N. Peranginangin, Syngenta Crop Protection, LLC / Product Safety; A. Tomiseli, Bayer CropScience / GENCS - E-Fate; L. Murakami, Bayer AG Crop Science Division; O. Perez-Ovilia, Bayer CropScience / Environmental Safety; E. Henry, Bayer / Environmental Safety; T. Haering, BASF SE A tri-partite technical working group consisting of regulators, academia and industry was formed to develop a framework for aquatic risk assessment of pesticides in Brazil. The framework should include a sophisticated science based approach resulting in a comprehensive guidance. The basis of the exposure assessment is the selection of the 90th percentile vulnerability which is seen to represent a reasonable worst case and is used as basis of the exposure assessment in other parts of the world. Surface water scenarios should be identified in six pre-defined climatic zones for the seven most important crops soybean, maize, sugar cane, wheat, cotton, citrus and coffee. Runoff and spray drift were found to be the main entrance pathways of pesticides into surface water bodies. Whereas spray drift mainly depends on technology and local climatic conditions during application, surface runoff is influenced by pedoclimatic conditions that could be assessed in a spatial vulnerability analysis. For this the USDA Runoff Curve Number approach (RCN) which is implemented in PRZM was used. A simple model based on the equations of the RCN approach was developed to calculate daily surface water runoff volumes for the agricultural area of Brazil for 34 climatic years. Calculations were carried out on highest available resolution of soil data resulting in more than 63,000 raster cells. Hydrological soil groups were determined by using a Brazilian specific classification scheme applied to the national soil map. Relative runoff vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.

MO137 Identification of Herbicide Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment H. Rathgens, M.F. Winchell, Stone Environmental, Inc. / Environmental Systems Management, Inc. / Sur, Bayer CropScience Division / Environmental Sciences Division, C. Baets, Bayer AG Crop Science Division / Sustainable Operations; F. Krebs, DR. KNOELL CONSULT GmbH; D. Lembrich, Bayer AG Crop Science Division The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and erosion during storm events, subsurface transport through lateral flow and through subsurface tile drainages, and from spray drift during applications. The Soil and Water Assessment Tool (SWAT) is widely used in the United States and the EU for catchment scale hydrologic and water quality modeling of non-point source chemicals in the environment. The SWAT model was applied to a 992 ha agricultural catchment in the Flanders region of Belgium to help in better understanding the development of herbicide residues observed in daily sampling over 3.5 years at two locations along the catchment’s primary stream. The SWAT model was calibrated to observed flow and chemical monitoring data, then used to characterize the relative contributions of herbicides via surface processes, subsurface processes, and spray drift. In addition, very vulnerable fields with significant contributions to surface water exposure were identified. A quantitative comparison between monitoring data and simulated exposure profiles was made to single out those high residue concentrations that could not be attributed to any of these traditionally considered exposure pathways, and could ultimately be explained by point source contributions. The model results demonstrate that SWAT is capable of simulating streamflow in a small agricultural catchment, and is capable of simulating diffuse source pesticide concentrations. This allowed applying SWAT as an approach to model treated moslin fields. The model was used for distinguishing between diffuse source dominated high concentrations from those most likely affected by point sources. The SWAT model also proved useful in identifying the spatial variability in the dominant transport processes contributing pesticide residues to the stream. While surface runoff of soluble pesticide was the major non-point source contributor on most fields, lateral subsurface flow was found to be important as well, especially in the western portion of the catchment. While surface runoff is dominated by pedoclimatic conditions, spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmyards as well as diffuse sources.

MO138 Pesticides in water and surface sediments from Douro River estuary (Portugal) - assessment of environmentally relevant mixtures using acute toxicity bioassays P. Moreira Rocha, ICBAS / U.Porto, CIMAR / CIMAR LA; C. Cruzeiro, CIMAR / CIMAR LA, Porto, CF; FCTUC / U.Coimbra; S. Amaral, ICBAS / U.Porto, E. Rocha, ICBAS / U.Porto, CIMAR / CIMAR LA 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

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Myclobutanil is a fungicide used mainly in pome and stone fruit areas, and in vineyards. For national registration in Italy, FOCUS groundwater modelling showed that the PECgw for its soil metabolite (X1129885; up to 6% of applied) reached up to 2 µg/L. This was accepted at EU level since the metabolite is not toxicologically relevant. However, according to national rules, this triggers a groundwater monitoring study for a metabolite when the PECgw is >0.75 µg/L. For completeness, myclobutanil was also monitored. To allow for a robust monitoring study, it was necessary to identify monitoring areas with the following characteristics: (i) be representative of an intensive use of myclobutanil, and (ii) reflect reasonable worst case scenarios for Italy. To facilitate this, a GIS-based indicator (PLI: Potential Leaching Indicator) was developed to integrate information about sales data, the spatial distribution of the target crops and the distribution of the FOCUS groundwater model scenarios throughout Italy. Use of the PLI allowed five suitable areas to be identified (Bolzano and Trento for apple trees, Verona for stone fruit and grapes, Forlì-Cesena for pear trees and stone fruit, and Matera for stone fruit). These areas are also representative of the FOCUS groundwater scenarios relevant in Italy (Châteaudun, Hamburg, Piacenza and Thiva). In each area, five monitoring wells were identified to cover a range of parameters (depth to groundwater, hydrology, pedology, and presence of the target crops). Subsequently, a three year monitoring campaign was conducted (autumn 2014-spring 2017). From a total of 150 samples analyzed, the concentrations of myclobutanil and its soil metabolite (X1129885) were below the LOD (0.001-0.002 µg/L) 94% of the time and in all instances, the number of positive detections was 23 and of these, 20 samples showed concentrations well below 0.01 µg/L. Only in one sample did the measured concentration exceed the trigger value of 0.1 µg/L. However, a number of factors indicate that this is due to point source origin. Even better results were obtained for X1129885 where the number of positive detections was only 13, with concentrations less or very close to 0.01 µg/L. Based on these results it can be concluded that given the actual use conditions, the probability of myclobutanil and its soil metabolite exceeding the threshold value of 0.1 µg/L in groundwater in Italy is very low.

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

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1,3-Dichloropropene (1,3-D), also known as Telone™, is an active substance used worldwide in soil fumigant products for the control of cyst and free-living nematodes. It is used in a variety of crops including fruiting and vegetable crops. Soil sorption studies have shown that 1,3-D and its metabolites present characteristics of highly mobile molecules with a potential to leach into groundwater when applied in vulnerable areas such as sandy soil and in areas characterized by shallow groundwater. European member states have a wide range of groundwater monitoring activities for plant protection products and their metabolites, but analysis of 1,3-D and its metabolites is not currently part of the routine programme. In this study we illustrate a methodology allowing to identify areas most at risk where monitoring should be focused in priority, taking the example of Italy. The methodology considers three parameters: i) crops distribution, ii) soil properties and iii) 1,3-D use. The data, structured as layers of information are managed within a GIS, and are intersected to get the so called Uniform Geographic Units (UGU) which are areas of uniform in their characteristics and are representative of a specific set of values parameters. The data about the spatial distribution in Italy of crops where the 1,3-D is applied were first gathered from the last agricultural census, which provide information at a provincial scale. Successively, these data were refined at municipality scale. The identification of sandy soil areas in Italy was performed using pedological information extracted from different official sources. Subsequently, the information was interpolated in order to identify the areas where the percentage of sandy soils falls among three different categories (< 60%, 60-80%, >80%). Also these data were structured as GIS layers, which were processed and represented using the same GIS of the crop distribution. Overlapping the crop distribution and sandy soil areas and by merging the two databases, it was possible to identify sub-communal areas where crops and sandy soils coexist, characterizing the extension in relation to the rest of the municipality and the province. Finally, by considering 1,3-D soils data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where Telone™ is applied.™ 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. The need for a distributed model is that inputs 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 standard FOCUS model inputs. This dataset can be updated as necessary. An advantage of the distributed model is that it includes a 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

MO142  Influence of aquifer parameters on groundwater residue concentrations

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FOCUS leaching models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1 m depth (PECgw; “Predicted Environmental Concentrations in groundwater”) from the unsaturated to the saturated zone. These values are used in risk assessments in order 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 the performance of a distributed model is evaluated. A sensitivity analysis focused on estimated input parameters the impact on the resulting residue concentrations in groundwater was quantified. For the sensitivity analysis FOCUS model outputs for selected scenarios were combined with realistic aquifer parameters for some representative regions in northern Italy and Germany. In these regions the relevant shallow aquifers are variable in terms of hydraulic conductivity, gradient and effective porosity and provide a representative parameter range.

MO143  Implications of Dataset Selection and GIS Processing on Modelling

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; M. Guevara, Waterborne Environmental Inc / Modeling

Groundwater assessment guidelines provided by the FOCUS groundwater working group (2009) and EFSA (2014) describe succinctly a multi-tiered modelling framework that includes spatio-temporal assessments in the higher tiers; e.g., tier 3a and 3b. As part of the spatio-temporal assessment several GIS and daily climate
datasets were recommended. These recommended datasets, however, have been superseded by new datasets in the past few years. Specifically, daily weather and soils data have undergone significant updates, which are reflective of the considerable effort in Europe to update this spatial information. Not only does dataset choice, but also how datasets are being processed in a geographic information system, impact modelling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution influence our modelling results. In this poster, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4.0. 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/SEAGFest). The main issues when dealing with groundwater monitoring are related to site selections and related vulnerability, and then of how representative was the groundwater monitoring. In recent case, usefulness of the groundwater monitoring programs submitted at EU level as been questioned. Notably, the groundwater hydrology including its vulnerability and how representative / which situations the test sites might be considered to cover were not seen as not being properly addressed. Monitoring programs have also been submitted and assessed at national level mainly to refine metabolite groundwater risk assessment. Combined information from targeted and public monitoring were keys to address the representativeness of monitoring programs. The French groundwater public network (wells) is vast and the database is available online (www.ades.eaudefrance.fr). This 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. Ulucuic, ICPS; L. Menaballi, International Centre for Pesticides and Health Risk Prevention
The calculation of Predicted Environmental Concentration of pesticides in groundwater (PECgw) is a crucial point in the registration 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, KOM and Freundlich coefficient (1/n). 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 KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically justified. In this work, we will show that variations in input parameters highly influence PECgw outputs and that the determined wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slighly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set.

MO146
European regulatory network on pesticide groundwater monitoring
A. Gimnans, The Danish Environmental Protection Agency / Pesticides and Gentechnology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cmbg; A. Schwen, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tütting, German Federal Office of Consumer Protection and Food Safety
Groundwater monitoring data should be included in the assessment of the leaching risk of pesticides and their metabolites. Monitoring data is generated in most European countries, but their use for leaching risk assessment during pesticide authorization is hampered due to the following reasons: (i) The data is often not publicly available or available only in an aggregated form in a report, (ii) most of the data is not available in the national language of the origin country only, which makes it hard for other countries to understand (iii) the information provided in the 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 the network is to exchange pesticide groundwater monitoring data and frequent updates about the focus of national monitoring, and to assist each other in the interpretation of the data. The network plans to have its first meeting in Copenhagen, Denmark, in September 2018 with an invitation to all interested European countries to participate. The poster will present the thoughts about the network and the status of the start-up, and aims at promoting the network to interested authorities.

MO147
Overview of measured wash-off factors from experiments suitable to derive a refined input for FOCUS modelling
G. Reinken, E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; D. Sausset, 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 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 neglected from an additional point of view, but 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 values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set.

MO148
Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reinken, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Köhler, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamsoefet, 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. In an alternative hypothesis it 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 product classes (e.g. refrigerants like HFCs and HCFCs, anaesthetics, pharmaceuticals, pesticides, pyrolysis of PTFE (used as coating in many products) (TFA). Plant root uptake of TFA under static 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. Recent spray boom 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 trenched treated field, at 2 m. Consequently, the part of drift spray that is applied 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  
Exposure assessment for edge-of-field watercourses in the Netherlands involves spray application techniques that apply the pesticide in upward or sideways direction. Particularly for high avenue trees the downwind loss of pesticides due to spray drift can be relatively large. The upward directed part of the spray that is blown towards the top of the trees may reach heights above the trees, where wind can take the spray cloud and move it far downwind. Usually, the branches and leaves at the lower part of the stems of high avenue trees may pass underneath the tree canopies and reach downwind areas easily. Measurements of downwind spray deposits for tree nurseries indicate deposition levels comparable to those occurring for fruit orchards, which are well above those occurring when spraying arable crops. The current paper deals with the countrywide exposure assessment for pesticides applied to tree nurseries reaching edge-of-field watercourses in the Netherlands. In high avenue trees, nurseries with the younger spindles and transplanted trees are considered as well. Although the total area of tree nurseries is limited, exposure risk to edge-of-field watercourses is important enough to investigate. Spray drift mitigation techniques are considered and evaluated as well.

**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  
In the Netherlands about 90,000 people live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides or whether their health is at risk. Recently, a research project was launched to assess the exposure of residents to pesticides next to flower bulbs fields. This research projects involves both measurements and simulations of airborne spray drift. Volatilization is investigated for several days after spray application. Outdoor and indoor exposure measurements of pesticides and the inhalation exposure are carried out with the exposures to spray drift only. After application using a common boom sprayer ground deposits and airborne distributions of spray drift are measured down to 50 m from the treated area. Airborne spray drift is measured up to 10 m height, using two different sampling techniques. At 50 m downwind, airborne spray drift appears to be up to 100 times higher than ground deposits. Simulations of spray drift are studied using the IDEFICS spray drift model for boom sprayers. The simulations result in downwind ground deposits and airborne spray drift with values in the same order of magnitude as those found in the experiments. The results indicate that potential exposure of residents to pesticides used when treating nearby fields may be significant and further assessment of this exposure route is important.

P. Adrian, M. Liegeois, M. Durrieu, B. Journel, CEHTRA SAS  
Agriculture is one of the main sectors to derive a refined TSCF for compounds with other sorption and degradation properties. 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 on fruit using an Informatic System] however its 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 methylacrylic 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 Brouza, L. Ferrreira, 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 pest control. Maximum residue levels (MRLs) are derived to limit the upper levels of pesticide residues that are legally permissible in food of plant and animal origin. Before an MRL is established, the EFSA assesses the residue behavior of the pesticide and the dietary exposure resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues are estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed throughout the diet. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and its transformation, the possible uptake and translocation of the residue to the edible parts of the crop and degraded products as result of industrial and household processing are considered to set the residue definitions for risk assessment purposes. Secondary metabolites characterized by metabolism studies and degraded products may pose a completely different toxicological profile than the parent compound, being more, less or equal toxic than the pesticide under assessment, and showing a new big picture for an active substance and its residues that should be assessed in detail to avoid consumers’ concerns. The dietary risk assessment of pesticide residues takes into consideration these possible scenarios in order to protect consumers, reason why residue definitions might be different for monitoring and for risk assessment purposes and where the uncertainty due to missing data might play a fundamental role in risk assessment.

**MO154** Exposure and Risk Assessment for Agricultural Applicator to Insecticide Flubendiamide during Cabbage Cultivation using Whole Body Dosimetry  
J. Lee, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National Univ / Agricultural biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; B. Kim, Seoul National Univ.; E. Kim, H. Ryu, Seoul National University / Department of Agricultural Biotechnology; D. Jeong, Seoul National Univ / Agricultural Biotechnology; S. Shin, Seoul National University / Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National University / Department of Agricultural Biotechnology  
Insecticide Flubendiamide belongs to diamide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s exposure and risk were conducted through this study. Methods: Flubendiamide during Cabbage Cultivation using Whole Body Dosimetry (WBD) was performed, which consists of cotton/polyester outer clothes and cotton inner clothes. Hand exposure was measured by washing of nitrite gloves and hands, while head exposure was monitored by face/nape wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL, with good linearity (R2 > 0.99) of calibration curve. Recovery (77-117%) of insecticide from various exposure matrices were reasonable including field recovery (77-109%). Field exposure assessment was carried out by 8 replicates. During application, total
dermal exposure of flubendiamide was 3635.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubendiamide (608.7 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 flubendiamide for cabbage field would be minimum. Keywords: Flubendiamide, exposure, risk assessment, whole body dosimetry, IOM, cabbage *Corresponding author: kjh2404@stau.ac.kr; Tel, 82-02-880-4644

MO155
Multi-focus Surface Water calculations: What do they mean for real regulatory cases?
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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 FOCUS sw 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 existing pre-agreed approaches for surface water calculations. Surface water exposure is strongly driven by individual weather events triggering run-off or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-year FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO156
Effectiveness of grass buffer strips in reducing Spinosan runoff
S. Otto, Italian National Research Council, S. Gottiardi, M. Pasini, Agrea SRL; R. Bondi, From 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 efficiency values may not always hold for longer periods of use. The derived values specific to Spinosan may be useful in demonstrating compliance. A GFL field study was performed in summer 2017 to test vegetated buffer strip removal efficiency, in relation to Spinosan and its major metabolites, and based to the FOCUS Surface Water risk assessment scenarios, but with worse (and prudential) conditions. The selected site was near Verona, in a hilly zone rich in vineyards and famous for high-quality wine production. Runoff containing a known amount of each of the four spinosan 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 area of runoff was on average 17 m² per treatment, 10 m² 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 (total: 12 mm), to simulate rainfall before runon; 2) Run-on/Runoff event: 200 mm of water were released into the buffer area in 2:20 hours using a runoff generator (flow of 55 m/h). Water concomitant precipitation (30%); 3) a spinesan concentration of 1 mg/l was inserted 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 runon (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 prudential that 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, 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 considered in the residue definition for risk assessment. 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 FOCUS sw 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 existing pre-agreed approaches for surface water calculations. Surface water exposure is strongly driven by individual weather events triggering run-off or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-year FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO158
Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Schlotter, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; G. Motz, Swiss Institute for Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esert, A. Schulte, Fraunhofer IME; J. Ebersbach, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; L. 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-vitro 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 bioaccumulation 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 effect of metabolites to the in-silico predictions for BCF values. 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 were determined for 14 to 15 species. It is concluded that the environmental concentrations of fadrozole are comparable among fathead minnow, perch, rainbow trout, and fadrozole minnow despite up to 40-fold difference in sensitivity to fadrozole. This suggests that relative potencies generated for a model species, such as fathead minnow, could be applicable across diverse species, despite great differences in relative sensitivity. Results of this study are being used in the construction of a cross-species quantitative structure-activity relationship (Q SAR) for estimating aromatase bioactivity data as a relative-sensitivity adjustment for prediction of impacts at the individual and population level. This information could guide more objective ecological risk assessments of native species to EDCs that inhibit aromatase. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO160
Fish scales as a tool for temporal biomonitoring of trace element concentrations

D.A. Vignati, CNRS / LIEC UMR7360; G. Masson, Université de Lorraine and CNRS / LIEC UMR7360

Direct measurement of contaminant concentrations in biological tissues is attractive for regulatory purposes because it accounts, in principle, for the environmental factors controlling their bioaccessibility and bioavailability. In the case of trace elements, the validity of this approach is confirmed by its adoption in the regulatory European framework for mercury measurement in fish. For other elements, the current framework privileges measurements in the dissolved (filterable) aqueous matrix. However, this approach provides only a limited temporal resolution of possible trends in elements’ concentrations and, where relevant, neglects uptake via dietary pathways. Furthermore, when fish is the selected matrix for monitoring, one or more individuals have to be sacrificed to collect the material necessary for analysis; a strategy that, apart from the associated ethical problems, may become problematic in situations where the number of resident fishes is limited. In this context, there is a growing interest in the use of fish scales as a non-lethal, rapid and efficient alternative for monitoring trends in trace element levels in a reservoir receiving cooling waters from a nuclear power generation plant. The variations in the concentrations of Cu, Zn and lanthanides were followed in fish scales from archived fish material (Abramis brama) collected annually between 1990 and 2016. Scales were dried, calcinated and mineralized using concentrated nitric acid. After distillation, Cu and Zn were assayed by atomic absorption spectrometry and lanthanides by ICP-MS. For Cu and Zn, triplicate measurements generally agreed to 10% and accuracy, with respect to the standard reference material TORT2 (lobster hepatopancreas), was better than 90%. In the case of lanthanides, analysis were made on one sample per year and only La, Ce, Pr, Nd, Pm, Sm, Eu and Gd could be systematically quantified. Overall, fish scales proved to be a suitable matrix for the biomonitoring of trace element concentrations, including elements of emerging concerns such as lanthanides. Compared with fish muscle (or whole fish), fish scales are easier to preserve (no need for dissection, freezing and lyophilization) and, in some situations, may even allow repeated surveillance of the same individuals. This methodological validation study paves the way to further research to establish relationships between accumulation in scales, internal organs and biological responses.

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 der Merwe, 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 a colony count method tailored to cell lines obtained from sea turtles. 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 ewoS9R in the Ames fluctuation assay

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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 money consuming method using a colony counting technique. Differences between animal cell cultures such as OECD 471 and ISO 11350. In the Ames test the bacterium Salmonella typhimurium, with a lack of histidine-synthesis, is exposed to a sample to determine the mutagenic potential, measured by the ability of revertant bacteria to synthesise histidine. The resulting growth in a histidine-free medium is visible due to a colour change caused by acidification in a pH indicator medium. Nevertheless, it can be further improved and combined with the RAMOS-technique (Respiration Activity Monitoring System). This technique improves the sensitivity and the data output of the fluctuation variant. It enables a precise measurement of the oxygen transfer rate (OTR) and therefore conclusions on growth and metabolism of the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenicity 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 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 money consuming method using a colony counting technique. Differences between animal cell cultures such as OECD 471 and ISO 11350. In the Ames test the bacterium Salmonella typhimurium, with a lack of histidine-synthesis, is exposed to a sample to determine the mutagenic potential, measured by the ability of revertant bacteria to synthesise histidine. The resulting growth in a histidine-free medium is visible due to a colour change caused by acidification in a pH indicator medium. Nevertheless, it can be further improved and combined with the RAMOS-technique (Respiration Activity Monitoring System). This technique improves the sensitivity and the data output of the fluctuation variant. It enables a precise measurement of the oxygen transfer rate (OTR) and therefore conclusions on growth and metabolism of the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenicity 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 alternatives should be introduced. In the present study, we investigate the applicability of a substitution of rat liver S9 with the biotechnological animal-free ewoS9R in the Ames fluctuation assay and the Ames-RAMOS system. Therefore, we investigate 26 promutagens with both metabolic systems. Preliminary results suggest that ewoS9R is a suitable alternative to rat liver S9.

MO163
Q SAR: a predictive approach for electronic cigarettes toxicological assessment

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178 SETAC Europe 28th Annual Meeting Abstract Book
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Electronic cigarettes (e-cigarettes) are devices that typically deliver nicotine, flavorings, and other additives to users via an inhaled aerosol. They are designed to closely mimic the experience of smoking conventional cigarettes. Nowadays, e-cigarettes are the most commonly used tobacco-related product among youth, surpassing conventional cigarettes in 2014. However, insufficient data is available to assess the prevalence and patterns associated with the use of e-cigarettes to which consumers are exposed; at the same time studies evaluating whether e-cigarettes are less harmful than cigarettes are inconclusive. Minimal valid chemistry data are available on e-cigarette emissions and no standardized methods and threshold values exist for e-cigarette analysis. To fill the chemical and toxicological data gap, comprehensive assessment of e-cigarette emissions and toxicological studies are certainly needed. The aim of the present study is to provide, by means of Quantitative Structure-Activity Relationship (QSAR) approaches, a first toxicological screening of several e-liquids ingredients.

Different Ordinary Least Squares (OLS) regression-based QSAR models were developed to define the potential acute toxicological profile of 265 molecules contained into e-liquids ingredients. The reference database contained 5 or more members, and (3) correlation coefficients of the linear regressions are greater than 0.70. Since KATE equips the 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 new databases, which are added each year.

The QSAR models have satisfactory fitting, internal and external predictivity with correlation 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 screened from the chemical structure. However, additional work still needs to be done to make these products safe for human use.

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environmental disease. Epidemiological evidences show that the disease is associated with exposure to hazardous chemicals. However, causal relationship has not been clearly understood. In the present study, we aimed to elucidate the link between occurrence of metabolic or neuro disease and exposure of environmental chemicals. We first screened potential of environmental chemicals on the disease model organisms, C. elegans and Zebrafish. To maximize the advantage of these model organisms, we used mouse cell line screening using C.elegans mutant; oga-1(ok1207), ogt-1(ok1474), nlg-1(ok259), transcriptase, zebrafish, Tg(TKins:nSb-mCherry) and Tg(elavl3:EGFP)kn3. The highly conserved O-GlcNAc transferase, OGT and O-GlcNAcase; OGA genes are related to type 2 diabetes and null mutations cause alterations in C. elegans carbohydrate and lipid metabolism. Neurologin NLG-1 control synaptic function, which is conserved from nematodes to mammals needed to attain normal synaptic adhesion and neurodegenerative disease (ADHD). Tg(TKins:nSb-mCherry) fish express insulin nitroreductase (InsNTR) mcherry fusion protein in the pancreatic β-cell and Tg(elavl3:EGFP)kn3 fish express GFP in most post-mitotic neurons. Various category of environmental chemicals, such as, heavy metals (i.e. arsenic, lead, cadmium), EDGs (i.e. Nonylphenol, Bisphenol-A,DE andFS) and biocides (i.e. Chloroperoxides, CMT/MIT, PGH), were screened using C. elegans reproduction assay and zebrafish transgenic assay. The preliminary results showed CMT/MIT and BPA reduced fluorescence intensity of insulin gene in zebrafish, suggesting possible involvement of these chemicals on metabolic pathways. In brief, our results suggest multi-model approach could complement the limitations of a stand-alone model organism and thus more accurately identify chemical hazard on human health. Therefore, the outcome of the current study could be utilized for efficient chemical screening and better risk assessment of the chemicals. Acknowledgement: This work was supported by the Mid-career Researcher Program (2017R1A2B3002242) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning.

MO168
In vitro effects of two pesticides on the motility and viability of bovine spermatozoa
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The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the inclusion of pesticides. CMIT/MIT, PGH, were screened using C. elegans reproduction assay of the two pesticides, diluted in phosphate buffered saline (PBS), plus a control (PBS). For each bull, three replicates were made. Motility and viability endpoints were measured with a sperm analyzer computer program and viability was measured using an eosin-nigrosin staining procedure. Endpoints were measured at 0, 30 and 90 minutes. Copper sulfate did not induce significant effects on the motility while the first observation period (timelapse) the lowest concentration showed increased motility and viability than the other treatments, suggesting that copper may enhance motility at low concentrations. Glyphosate significantly reduced the motility and viability of spermatozoa. In vitro results are limited, but they are a good starting point for dose calculations and for unveiling primary mechanisms of toxicity without the need to use living beings.

MO169
Assessing the bioaccumulation potential of several pharmaceuticals using fish S9 and hepatocyte assays
L.A. Constantine, Pfizer, Inc. / PDM; M. Embury, ILSI; R. Sharma, Pfizer / PDM
Assessment of Medicinal Products for Human Use, a fish bioconcentration study is triggered in Phase I for pharmaceuticals having a log Ka > 4.5 to support the Persistence, Bioaccumulation and Toxicity (PBT) assessment and in Phase II, Tier A for pharmaceuticals having a log Ka > 3. The recommended protocol for bioconcentration is OECD Test Guideline 305: Bioaccumulation in Fish, Aqueous and Dietary Exposure. However, in Tier A, reducing the number of animals used in environmental testing, 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 vitro assays will be presented along with the in vivo BCF data.

MO170
Chemovailability of Organic Electrophiles - A Nonanimal Approach to Identify Candidates for Reactive Toxicity
A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; G. Schäublin, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry
Organic electrophiles are important components within the exposomes of humans, flora and fauna. Their toxicity toward aquatic organisms is driven by two molecular initiating events (MIE): the hydrophobicity-triggered disturbance of cellular membranes and the chemical reactivity with nuclear receptors, in particular the heterodimer of aryl hydrocarbon receptor (AhR). The results demonstrate that the decreasing Tc with increasing Kow is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemovailability, as a trade-off between log kow and log Kow is shown as promising nonanimal tool to assess whether aquatic toxicity is predominantly driven by the hydrophobic or the reactive MIE, or by both MIEs working in parallel. The authors thank the EU-funded project OSIRIS (GOCE-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüttmann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Laqua A, Schüttmann G 2016. Chem. Res. Toxicol., 29:952-962. [3] Laqua A, Thaens D, Paschke A, Schüttmann G 2009. Chem. Res. Tox., 22: 742-750.

MO171
Local Electroplicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis
D. Schmidt, Helmholtz Centre for Environmental Research - 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 reactive oxygen species (ROS) and high cytotoxicity. Therefore, exposure to electrophilic compounds 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 electroplicity parameters were developed based on a combination of quantum chemical descriptors, which are related to hydrophobicity and reactivity was investigated. For this purpose, their correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which is a Michael acceptor, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on Tc. To this end, reactivity was quantified by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH). Hydrophobicity through the octanol/water partition coefficient and toxicity through the 48-h-effect concentration yielding 50 % growth inhibition of Tetrahymena pyriformis. The results demonstrate that the decreasing Tc with increasing Kow is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemovailability, as a trade-off between log kow and log Kow is shown as promising nonanimal tool to assess whether aquatic toxicity is predominantly driven by the hydrophobic or the reactive MIE, or by both MIEs working in parallel. The authors thank the EU-funded project OSIRIS (GOCE-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüttmann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Laqua A, Schüttmann G 2016. Chem. Res. Toxicol., 29:952-962. [3] Laqua A, Thaens D, Paschke A, Schüttmann G 2009. Chem. Res. Tox., 22: 742-750.

MO172
Using mechanisms of toxic action to classify and predict ester ecotoxicity
P. Bicherg, P. Bauer, KREATIS; P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment
Even though esters are often used and released into the environment, little is known about their mechanisms of toxic action to aquatic biota. Carboxylic acids and their esters are considered to exert a specific narcotics, while some other esters can exert toxicity related to their potential reactivity. Therefore the critical step, before predicting the toxicity of an ester, is to determine its mechanism of toxic action (Mechoa). For this purpose the classification of Bauer et al. (2018) is used in combination with an accurate modelling approach which is derived from empirical data specific to the Mechoa. The acute toxicity of esters to aquatic flora and fauna may be assessed against a hydrophobicity descriptor (i.e. log Kow or water solubility), and compared with similar regressions for non-polar narcotics. The similarity between these regressions confirms non-reactive esters are simple
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 is negligible. The di-esters appear more toxic than mono-esters for fish and daphnids because they can produce two times more metabolite than mono-esters. The more reactive esters are usually 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 related to a model dedicated to soft electrophiles. Rather than model the toxicity only according to structural analogy, a modelling approach is used to develop QSARs for esters based on three pillars: structure, mechanism and species metabolism.

MOI73 Nanosecond pulsed electric field incorporation technique to predict molecular mechanisms of teratogenity and developmental toxicity on fish embryos K. Arizono, Prefectural University of Kumamoto / Faculty of EnV -Symbiotic Systemic A. Yamaguchi, National Institute of Technology, Ariake College; M. K. Arizono, Prefectural University of Kumamoto / Faculty of EnV -Symbiotic Systemic

Impact of test concentration on the in vitro intrinsic clearance using trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals H. Lue, Givaudan Schweiz AG / Fragrances S & T; L. Hostettler, Givaudan Schweiz AG; K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Sanders, Givaudan International SA / Regulatory Affairs and Product Safety; A. Natsch, Givaudan Schweiz AG / Fragrances S & T

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 Pm). 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 benz[a]pyrene, kdep determined at lower concentrations were 4-12 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 (4-6.5) 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 CDBN-glutathione conjugation) and substrate depletion assays with testosteron, 7-hydroxycoumarin, pyrene and Cyclohexyl salicylate as reference chemicals. Decrease of the parent compounds 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 Karanal 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 were measured at 0.2; 1 and 5 µM for the lowest concentration (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.

MOI76 Biological effects of 3 meta ls on "D" larvae of japonese oyster Crassostrea gigas A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; C. Cárceles-Martínez, Universidad Autónoma de Baja California Sur The Japanese oyster is an introduced species from Asia, which is cultivated in the coastal systems of the Mexican Pacific. Due to the fact that in the last 10 years the populations have had problems in their survival, in this work the evaluation of 3 biomarkers was performed in "D" larvae of this species, exposed to the metals Cd, Cr, Pb and its mixture, because these xenobiotics, are in high concentrations in the sites where the oysters are grown. Bioassays (72 hrs) were conducted where the "D" larvae were exposed to different concentrations of metal and their mixtures in a proportion 1:1. With the obtained data, the LC50 was calculated and the evaluation of 3 biomarkers was measured in the surviving organisms: the degree of lipoperoxidation (TBars: Buege & Aust. 1978), the activity of the AcCh enzyme (Ellman et al., 1961) and genetic damage (Comet Test: Singh et al., 1988). The toxicity of metals according to the calculated LC50 values was: (from most to least toxic) Pb > Cd > Cr. The lowest toxic metal attacked to LC50 was Cr. Then, Kruscal-Wallis test indicated that there are significant differences in the degree of lipoperoxidation, inhibition of AcCh activity and genetic damage between the exposed organisms and the control group. The metal with the highest oxidative effect was Chromium (32 ± 8.97 µM Tbars mg⁻¹). And the metal mixture: Cd + Cr + Pb (45 ± 11.89 µM Tbars mg⁻¹). In the evaluation of genotoxicity it was observed that chromium 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 AcCh (56% 38% respectively). The results of this study show that the Cd, Cr and Pb metals in sublethal concentrations have deleterious effects on the "D" larvae of Crassostrea gigas.

MOI77 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Laboratory of Hydrobiology and Arid Ecosystems. 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 maximus. The ostracod Cypris sp. and fishes: juvenile Channa (Channa indicus) and juvenile zebrafish (Danio rerio). In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O:N index, lipid peroxidation 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 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 nM Thars mg⁻¹ and show a direct dose-response relationship, since when increasing the time of exposure to DDVP increased the degree of lipid peroxidation in the tissues. A decrease in AChE activity was observed in connective and nervous tissue 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 vitro bioassays
K. Petersen, NIVA - Norwegian Institute for Water Research; M. Hultman, Norwegian Institute for Water Research; J. Byttingsvik, Akvaplan-niva AS; M. Harju, NILU / Norwegian Institute for Air Research; A. Evensen, Akvaplan-niva AS; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

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 levels 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 extracts from the following fractions: (1) nonpolar pesticides, (2) polar pesticides and metabolites of POPs, and (3) polar POPs (phenolics such as chlorinated phenols 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 methods for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the three fractions, higher induction of Vtg was observed in rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible to cytotoxic 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 performed to identify potential contributors to the observed estrogenic activity. The project was funded by the Norwegian Research Council, project. No. 221373.

MO179 Ultrasound: A novel approach to non-lethally measure hepatosomatic index in sentinel fish for environmental monitoring programs
A. Hauk, University of Saskatchewan / Veterinary Biomedical Sciences; V. Palagi, ISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Hrechuk, ISDExperimental Lakes Area; M. Murdoch, Stantec Consulting Inc; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences

Canada’s environmental effects monitoring (EEM) program studies impacts of metal mining and pulp mill effluents on aquatic receiving environments. The EEM regulations recommend lethal sampling of 20 fish (male and female) of different species to study body condition, liver size (hepatosomatic index-HSI), and gonad size (gonadosomatic index-GSI) during every monitoring cycle. Developing and implementing non-lethal methods for environmental monitoring programs provides an opportunity to protect sentinel endangered fish which might be threatened by resource exploitation. Higher Vtg induction measured in rainbow trout are part of systems with low productivity. Ultrasound is a non-invasive tool that has been tested to assess gonad size in fish. Currently, its potential as a non-lethal tool in environmental monitoring programs is not well explored. We conducted feed withdrawal studies in the laboratory to test the accuracy and sensitivity of ultrasound to measure HSI in sentinel fish with a compact liver such as rainbow trout (Oncorhynchus mykiss). With the ultimate goal of providing empirical evidence of the applicability and ease of this technique in the field, we also tested the accuracy of ultrasound method to measure HSI in lake trout (Salvelinus namaycush) at ISD-Experimental lakes area. Our laboratory studies provide a significant correlation for the accuracy (HSI, r²=0.73, n=16, p < 0.05) and evidence for the sensitivity of ultrasound method (p<0.06, n=7) versus traditional lethal gravimetric method (p<0.05, n=7) to measure HSI within the acceptable critical effect size for HSI mandated by EEM. Our field ultrasound method testing also revealed a significant correlation between the traditional lethal and ultrasound method in measuring HSI (r²=0.81, n=9, p < 0.05) in lake trout. Our field analyses 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 many other fields. The aim 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 cell models in vitro, macrophages and mast cells.
J. Dekker, Wageningen University & Research / Institute of Environmental Toxicology; H.H. van den Berg, N. van den Brink, Wageningen University / Dept of Toxicology

Cadmium can induce toxic effects via different mechanisms, e.g. depletion of cellular antioxidants leading to increase of ROS levels and induction of apoptosis. Such effects have been addressed in different types of tissues and cells, including the immune system. However, these mechanisms of toxicity may have different impacts on physiological and pathological processes. The proposed model is to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europa.eu).

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.
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The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilised. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development of non-destructive biomarkers of exposure and effect is still limited. The usefulness of cell lines along with non-targeted omics has not been well explored in this context despite the potential for these methods to greatly enhance non-destructive biomarker development. In order to assess the potential of these methods for the development of biomarkers of exposure and effect, we optimised exposure and extraction methods and aimed to identify genes that can be used for examining the effect of time and dose on global protein expression in primary green sea turtle (Chelonia mydas) skin cells were exposed to two contaminants known to accumulate in sea turtles - a polychlorinated biphenyl (PCB153) and perfluorooanic acid (PFNA). The exposure was performed over 24 or 48 hours to three environmentally relevant concentrations (1 μg/L, 0.1 μg/L, and 0.01 μg/L). Global protein expression was then measured using quantitative LC/MS resulting in over 1000 unique protein identifications. Our results show that a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (superoxide dismutase) was expressed by cells exposed to PCB indicating that these methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtle cells, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

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 an important model organism for the ecological toxicity assessment of chemicals associated with sediments. More recent work indicates that this worm may have a toxicity that is not only species specific. In order to get a better overview on the potential of the nematode, the baseline impact of a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (superoxide dismutase) was expressed by cells exposed to PCB indicating that these methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtle cells, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

MO184

Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanalal Tool for Mimicking Phase I Metabolism

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The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemicals’ ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduction formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosays, which address this type of MIE, are used for the quantification of a test chemicals’ reactivity towards typical biological targets, and have facilitated the development of e.g. models for the prediction of the aquatic excess toxicity or skin sensitization potential. Apart from chemicals that possess electrophilic substructures in their initial form, there are compounds that can become electrophilic only after abiotic or biotic oxidation. The reactive toxicity of these chemicals, also described as pro-electrophiles, is often difficult to characterize with simplified model systems like chemosays or in vitro bioassays because these methods typically do not sufficiently include an activation step. Our presentation introduces a new tool, based on an Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophilic phenol and dihydroxybenzenes derived from environmental samples. The authors show that this method is quickly trapped by coinoculation with the tripeptide WCG (tryptophan, cysteine, glycine) and analyzed using high performance liquid chromatography coupled to tandem mass spectrometry. Profiling of the obtained adduct patterns enable the identification of formed electrophiles, and provides new insights into the oxidation pathways causing the reactive toxicity of pro-electrophiles. The authors also compare the EU-funded project OSIRIS (GOCE-CT-2007-05017) and the BMBF-funded project ProHapTox (FKZ 031A22A and 031A22B) for financial support. [1] Böhme A, Laqua A, Schürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [2] Mulliner D, Schürmann G 2013. Mol. Inf. 32: 98-107. [3] Chipinda I, Ajibola RO, Morakinyo MK, Rwobuna TW, Simroy MH, Siegel PD 2010. Chem. Res. Toxicol. 23: 918-925. [4] Böhme A, Thaens D, Paschke A, Schürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO185

Integrated assessment of aquatic ecotoxicity for regulatory purposes

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The REACH regulation requires the assessment of the CMR and PBT properties of the chemicals produced or imported in EU in amounts exceeding 10 t/a in order to protect the human health and the environment. The JANUS project aims at the development of a JAVA application to prioritize and assess the chemicals according to the PBT, CMR and endocrine disruption properties with uncertainties estimation. To assess the ecotoxicity part of the T property, we developed six continuous QSAR models for acute and chronic aquatic endpoints for the main trophic levels: EC96h and NOEC 96h algae (Raphidocelis subcapitata), EC48h and NOEC 21d Daphnia magna, LC50 96h fish (Oryzias latipes) and NOEC fish (more fish species). We used gaselet and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R2 > 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.vegahub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARs for fish, three QSARs for specific fish species).

The ecotoxicity workflow is divided in three parts: algae, Daphnia magna and fish. For each part and each endpoint, the workflow integrates the experimental values (if any), the QSAR predictions and their reliabilities. The experimental values have a higher reliability than the predictions. The reliability takes into account the intra- and interspecific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a weighted approach. The experimental values and the predictions are compared to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfill the ecotoxicity criteria. The scheme will be applied to other categories of chemicals, such as the biocides within the LIFE COMBASE project. The authors thank the projects JANUS (contract 6 - 80 710/20 - 3716 65 4140) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/E/416) for the financial support.

MO186

An integrated testing strategy to fill data gaps for environmental risk assessment of iso-alkoalos

G.E. Bragin, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Sciences; B. Hedgnett, ExxonMobil Biomedical Sciences, Inc; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; B. Kelley, D. Letinski, ExxonMobil Biomedical Sciences Inc / Toxicology; E. Butcher, ExxonMobil Biomedical Sciences Inc / Environmental Toxicology and Chemistry Laboratory; M. Lampi, ExxonMobil Biomedical Sciences, Inc / Environmental risk assessments require quality data to provide defensible environmental quality benchmarks. Quantitative Structure Activity Relationship (QSAR) endpoint estimates are often appropriate for alcohols with a very strong correlation to aquatic toxicity test data. However, QSAR estimates require comprehensive justification to demonstrate applicability, and still may not fully meet regulatory requirements, leading to extensive long-term toxicity testing. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isooctanol and isoudecaneol. The study objective was to employ a testing program consisting of long-term fish (limit test), invertebrate and algal toxicity tests to demonstrate that QSAR estimations accurately predict aquatic effects from long-term continuous exposure to these substances, further supporting the use of QSAR models across a range of isooctanol models. The data demonstrate that the QSAR model employed accurately characterized the hazard of iso-alcohols and is a protective of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

MO187
Looking for an alternative to glyphosate-based herbicides
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Glyphosate-based herbicides are widely used in agriculture. When these products were originally introduced to the market, they were not intended to affect only target species i.e. plants. However, over the past decades there is growing evidence on the toxicity and genotoxicity of glyphosate on non-target species. On 27th November 2017 the EU member states agreed on a five-year renewal period for the use of glyphosate based herbicides. However, in case glyphosate-based herbicides become prohibited eventually, the availability of alternative active substances will become an urgent need. Nonanoic acid (a.k.a. pelargonic acid) is a biologically derived substance considered as an environmentally friendly herbicide. Its toxicity to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide against pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrafish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC50 were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was evaluated in EthoVision software. The potential effects 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
Chem assay Profiling of Salicylates to Assess Their Reactive Toxicity
A. Werner, Leipzig University; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Salicylates are widely used as fragrance additives or UV light absorbers in for environmental research. Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry, are important ingredients in various household products. The Xenopus Embryonic Thyroid signalling Assay (XETA) was designed as a screen 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 vitro 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, hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defines by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed 1) Daily variations of the thyroid effect in wastewater samples are linked to ecological quality condition and rainfall. 2) Bioassays could provide useful information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. 3) A minor part of the thyroid effect removal occurs during and decarbonization process. The major removal of the thyroid active molecule occurs during the nitration step of the water treatment.

MO191
Adoptions in locomotion detection of Daphnia magna, Artemia franciscana and Paramecia caudatum
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Animal behavior is complex and multidimensional. Over the past decades, researchers tried to quantify and qualify 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 assessment S. Droge, University of Amsterdam/IBED Institute / IBED
Surfactants are important ingredients in various household products, personal care products and industrial processes. Many surfactants are technical mixtures of ionogenic head groups and linear or branched hydrophobic alkyl chain lengths ranging between C12-C18. As for many ionogenic compounds, the environmental fate and concentration of ionogenic surfactants is complicated because it is not clear how to characterize and bioconcentrate the key parameter of surfactants such as Koc. Koc determination is a key step for the development of surfactants and the control of their uptake in organismal tissue. For example, for one of the most common anionic soap ingredients, SDS, the entry for logP in the REACH registration dossier of ECHA provides a range from 2 (calculated, and recommended) to 1.6 (experimental, but considered erroneous), ranging more than a factor of 3000. Various techniques to determine for surfactants are described in these REACH dossiers, with conflicting argumentations on which is most relevant. It is well known that Koc 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 surfactant for membranes lipids than storage lipids. With data for 19 cationic surfactant structures recently published, we will now present membrane water partition coefficients (Koc) for 15 anionic surfactants, using an optimized solid supported lipid membrane (SSLM) assay. For the anionic surfactant SDS, a logKoc 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 develop a new method that will be less time consuming and will be capable to validate the accuracy of quantum-chemistry based molecular software calculations of Koc for ionogenic structures using COSMOtherm, or to calibrate QSARs for Koc of specific types of surfactants.
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, as behavioral or swimming behavior can be a valid assay 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 Paramecium caudatum. In order to do so, custom-made, available multi-well plates were used. 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
A. Hirose, M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute for Environmental Studies; H. Yanamoto, National Institute for Environmental Studies / Center for Health and Environmental Sciences; N. Tatarazako, Ehime University / Environmental Risk; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; N. Kobayashi, Y. Ikaraishi, T. Yamada, National Institute of Health Sciences
There are some concerns for environmental impacts of the pharmaceuticals due to the unintended environmental effects, which may be different from biological medicinal effects. Therefore, medical regulatory agencies require the assessment reports of environmental impacts by new drugs before marketing. It would be useful to predict the ecotoxicity of the new drug at the developmental stage, because the ecotoxicity studies are usually conducted at the final drug developmental stage just before submission. To validate the current in silico prediction tool, we evaluated the applicability for ecotoxicity prediction by the ECOSAR software, which is a tool for toxicity prediction of industrial chemicals. In the last year, we evaluated the prediction performance of Daphnia magna reproduction and of the fish chronic toxicity. In this study, we evaluated prediction performance of the acute and chronic toxicity for algae. We used the ecotoxicity test data sets of about 100 pharmaceuticals. The EC50 values for the acute toxicity and the ChV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals of which the predictive values are different in less than one digit from the actual measured values are 43% and 44% for acute and for chronic toxicity, respectively. Overall applicability of toxicity prediction for algae was similar to that of toxicity for Daphnia magna or fish. In the case of Daphnia magna or fish, some antibiotics, anti-cancer, central nervous system agents with lower LogPow were underestimated. However, there is little dependency of LogPow in the case of 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
The Sequence Alignment to Predict chemical 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 was evaluated across species to identify key protein targets of early action 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 oxidative stress. These studies demonstrated 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 infers species-specific predictions of chemical susceptibility derived from the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool
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 at key positions (Level 3) of the protein target of a chemical in a known sensitive species to sequences of other species and calculates sequence similarity metrics to predict potential cross-species chemical susceptibility. Level 3 analyses offer the greatest resolution for extrapolation of chemical susceptibility across specific species, but uncertainties into the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made medical interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and ecdysone receptor (EcR) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, while differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabling automatically generated species-specific predictions of chemical susceptibility. These predictions were 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 increasing screening level 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. Zebrafish and organ relative sizes are an essential part of the system, allowing to define a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of endophenotypes, 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 ahernary of concentration of the three doses (Log3 dose/response curve: 100 μM, 33 μM, 10 μM, 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-hexafluoroorosyipropilidenephone, 3-­lodo-2-propynyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methylnercury chloride, rotenone and tetraethylthirium disulfide.

MO196 MPA - an alternative for the standard procedure of Ames Test J. Rossetto Martins Zwarg, School of Technology, UNICAMP; D.A. Morales, State University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LAEG

The Salmonella/microsome assay (Ames Test) is the most widely used mutation test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specially in Europe. It is has similar sensitivity with the standard Ames as well as other protocols and good performance in interlaboratory studies. However, the MFP has some disadvantages such as being difficult to apply with strains with low and high spontaneous mutation frequencies. Another miniaturized version of the Ames test is the microsuspension assay, which is 13 to 20 times more sensitive than the standard protocol. It is performed 5X concentrated bacteria and less sample and S9 mixture but still uses conventional petri dishes (90 x 15 mm). It has been extensively used for environmental samples testing, including in Effect Directed Analysis (EDA). The objective of this study was to miniaturize of the microsuspension Salmonella/microsome assay using agar microplates under the concept of the 3R principle. The conventional plates were replaced by plates with 12 micro wells. For validation of this miniaturization, we selected 13 known more or less potent mutagenic compounds. Six were tested only without metabolic activation (S9) and the other 7 were tested only with S9 using three Salmonella tester strains that were selected based on their different spontaneous 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. Lilliecrap, NIVA Norwegian Institute for Water Research / Ecotoxicology

Bioavailability and realistic risk assessment of organic chemicals (P)

MO198 The necessity of OASIS bead and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration: a case study for alkylphenol monitoring in produced water L. Silvani, Norwegian Geotechnical Institute; C. Riccardi, INAIL; E. Eek, Norwegian Geotechnical Institute; M.P. Papini, Università La Sapienza / Chemistry; N. Morin, Environmental and Food Laboratory of Vendee / Chemistry; g. cornelissen, Norwegian Geotechnical Institute; A.M. Oen, Norwegian Geotechnical Inst. / Environmental Technology; s.e. hale, Norwegian Geotechnical Institute

Produced water (PW) is one of the largest discharges from the oil and gas industry and includes formation and injected water. It contains several toxic compounds such as polycyclic aromatic hydrocarbons (PAHs), alkylphenols (APs), heavy metals, etc. PW is usually treated 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 into the sea; thus an effective tool for monitoring the hydrophilic 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 hydrophilic 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 (P) bioavailability studies can be used to improve risk assessment and legislation related to soil and sediments contaminated with hydrophilic 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 (Cfree). The Cfree 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 between free dissolved in soil pore water and in the soil solid phase (adsorbed). This study demonstrates that the PES membranes on AP uptake and, for the first time, calculated the Rf, following the extraction of both the sorbent and the PE membranes. This study demonstrated that there was a lag phase in uptake for APs, and that APs with logKow>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 hydrophilic APs. This can be very useful in environmental applications because it may justifie 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 N. Bartomeu, Agroscope Reckenholz-Tänikon Research Station ART / Environmental Analytics; I. Hilber, Agroscope / Environmental Analytics; R. Schulin, ETH Zurich / Department of Environmental System Science; P. Mayer, Technical University of Denmark / Department of Environmental Engineering; T. Bacheli, Agroscope ART / Environmental Analytics

Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments contaminated with hydrophilic 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 (Cfree). The Cfree 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 between free dissolved in soil pore water and in the soil solid phase (adsorbed). This study demonstrates that the PES membranes on AP uptake and, for the first time, calculated the Rf, following the extraction of both the sorbent and the PE membranes. This study demonstrates that there was a lag phase in uptake for APs, and that APs with logKow>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 hydrophilic APs. This can be very useful in environmental applications because it may justifie the use of only one passive sampler to monitor a wider range of contaminants.

MO200 Bioaccumulation of native and spiked p,p′-DDE by Eisenia andrei in γ-sterilized and non-sterilized soils I. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Bielska, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX

The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field-culture (sterilization after contamination) and freshly spiked (sterilization prior to contamination) soils for the case of 1,1-dichloro-2,2-bis-(p-chlorophenyl) etylene (p,p′-DDE). Changes in its sorption and bioavailability were linked to the changes in soil organic matter (SOM) chemistry measured by Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy. Qualitative interpretation of obtained DRIFT spectra revealed SOM chemical differences in a reduction of relative intensities of aliphatic moieties (sterilization), in bands of hydroxyl, aromatic, and aliphatic moieties (spiking), and of reduction in bands of aromatic accompanied by an increase of aliphatic moieties (earthworms dwelling). Using DRIFT, changes induced by spiking and earthworms were noted to be more pronounced compared to sterilization. The variation of bioaccumulation factors between sterilized and non-sterilized soils was limited to a factor of 1.5., depending on the incubation time and the particular approach used for BAF calculation. Despite the absence of quantitative effects of γ-irradiation on p,p′-DDE bioaccumulation, the uptake kinetics were shown to vary between
non-sterile and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of p.p.’DDE-soil contact time on bioaccumulation. These effects might be attributed to the effects of γ-irradiation on SOM chemistry alone or in combination with earthworms. Following our findings, γ-irradiation can be recommended as a relatively non-destructive method that is not expected to significantly affect risk assessment of bioaccumulative chemicals. However, in mechanistic studies the possible side-effects brought about by γ-irradiation should be taken into consideration.

MO201
Dissipation in soil and bioavailability to earthworms of two fungicides: comparison of laboratory and field experiments
S. Bart, R. Kühn, J. Alonso, X. Xia, X. Xiong, C. H. de AgroParís-Tech; C. PELOSI, INRA (Institut National de la Recherche Agronomique)

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 fields 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 dimoxystrob 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 issued 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 dimoxystrob and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and, to evaluate their availability, with a milder method engaging hydroxypropyl-β-cyclodextrin. At the same time, the bioavailability of the two fungicides was evaluated by determining their concentrations in exposed earthworms Apolectodea icterica and Apolectodea 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. Highly heterogeneity was observed however; the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO202
Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat
R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism; G. Piskorski, Innovative Environmental Services IES Ltd / Plant Metabolism

Environmetally 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 PELMOT) 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 crucial to result in accurate models and predictions. The plant uptake describes the process of translocation of dissolved compounds in the soil pore water to the plant via the transpiration stream and it can be described using the plant uptake factor (PUF) – uptake into shoots and roots – or the transpiration stream concentration factor (TSCF) – uptake into shoots. Recent work by the ECPA/IVA Working Group “Plant Uptake Factor” has produced a draft working protocol 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 – using the study design proposed in draft working protocol. The set-up of the experiment was chosen to enable optimal growth of the test plants – wheat seedlings – grown in a hydroponic system under controlled environmental conditions. At BBCH 13 (3 leaves unfolded) 434 labelled 1,2,4-triazole was spiked into the hydroponic solution at different concentrations and the plant root system was exposed for 8 days. Mass balance – calculated from the sum of radioactivity found in the hydroponic solution, root wash plus roots and shoot tissue – and transpiration – calculated gravimetrically – were determined. The experimental data obtained were used to calculate uptake parameters – PUF and TSCF – according to the formulas mentioned in the literature.

MO203
LFER Models for Partition Coefficients of Environmental Concern
B. Kühn, Helmholtz Centre for Environmental Research – UFZ / Department of Ecological Chemistry; S. van der Heijden, T.L. Sinnige, Utrecht University / Institute for Risk Assessment Sciences; S. Droge, University of Amsterdam/IBED Institute / IBED; J. Hermens, M. Jonker, Utrecht University / Institute for Risk Assessment Sciences; A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schuurmann, Helmholtz centre for environmental research – UFZ / Department of Ecological Chemistry

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). More sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate sorption and partition kinetic processes, 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. The and the respective predicted models were 0.12, 0.06%, 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 decreasing particle size of the core sediment. This study was financially supported by the European Union 7th Framework Programme SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

MO204
Influence of grain size on the bioavailability and bioaccumulation of sediment-associated cypermethrin to benthic invertebrates
H. Li, J. You, Jinan University / School of Environment

Sediment particle-size distribution is an important factor influencing the bioavailability and toxicity of hydrophobic organic contaminants (HOCs) in sediment. Cypermethrin, a pyrethroid was used as an example in this current study to investigate the effect of sediment particle size on the desorption kinetics and bioaccumulation potential of sediment-associated HOCs. Bioaccumulation test with oligochaete Lumbricus 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. 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. Highly heterogeneity was observed however; the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO205
Effect of suspended particle on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrafish (Danio rerio)
Y. Zhai, X. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University / School of Environment; L. Xiu, x. guo, School of Environment, Beijing Normal University

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 particle size fractions: i.e., <20 μm, 20-63 μm, 63-180 μm, 180-500 μm and >500 μm. 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. Highly heterogeneity was observed however; the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO205
Effect of suspended particle on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrafish (Danio rerio)
Y. Zhai, X. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University / School of Environment; L. Xiu, x. guo, School of Environment, Beijing Normal University

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 burdens 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 Agricultural Bioavailability Data

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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 shell casings were determined to be a source of polycyclic aromatic hydrocarbons (PAHs) at these sites based on results from surface soil analyses and historical information demonstrating that shell casets were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the shell casets 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 B6C3F1 mice were fed diets amended with soil or soil extracts at a ratio 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 the adsorption coefficients 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 will 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


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 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/fit system. Determination of distribution coefficients is done based on the direct method, hence extraction and analysis of the soil phase as well. Apart from the optimized experimental approach the data evaluation is addressed. This includes the elimination of any apparent sources of experimental random errors e.g. by suitable outlier tests. Possible systematic errors have been addressed by the experimental design/data evaluation itself leading always to an understimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e. g. Kf) and of p-values with p=Kf * (mosil/insolution); note: mosil/insolution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFCAS, 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 Koc from isothersms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of that approach.

MO208 Evaluation of the swimming behavior and tac tic response to atrazine of the Pseudomonas sp. strain ADP

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Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against the black banana weevil (Tribolium castaneum). Remnants of spent particles promoted the uptake and elimination rate constants of CLD in ewes (linearity of that whole approach. The determination of accurate adsorption parameters is a critical key parameter for the assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tac tic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tac tic 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 reactions at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tac tic response at low concentrations.

We also observed that the swimming patterns of Pseudomonas sp. strain ADP was affected by the addition of diesel fuel. The results indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.

MO210 Chlordecone elimination kinetics in ewes

M. Saint-Hilaire, Université de Lorraine / UL / URAFPA INRA; A. Fournier, Université de Lorraine / UL / URAFPA INRA; C. Adam, Université de Ligue / LEAE-CART; J. Thoone, Université de Ligue / LEAE-CART; C. Adam, University of Liege / LEAE-CART; J. Parinet, C. Inthavong, ANSES / Unité PB; C. Feito, Université de Lorraine / UL / URAFPA INRA; J. Parinet, ANSES / Unité PB

Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against the black banana weevil (Tribolium castaneum). Remnants of spent particles were usually consumed in the French West Indies. The objective of this study was to characterize the CLD elimination in ewes (linearity of the toxicokinetic, half-life in serum, metabolism, excretion forms and excretion routes). Three groups of 5 ewes received an intravenous single dose of CLD (0.04, 0.2 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 / Unité PB. 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. In feces, CLD and 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 results obtained by T. Guerin and T. Guerin, ANSES / Unité PBM; A. Fournier, Université de Lorraine; U. C. Feidt, G. Rychen, Université de Lorraine; URAFP INRA; J. Parinet, ANSES / Unité PBM were 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
M. Saint-Hilaire, Université de Lorraine UL / URAFP INRA; T. Bertin, C. Inthavong, G. Lavoisie-Boncard, T. Guerin, ANSES / Unité PBM; A. Fournier, Université de Lorraine UL / URAFP INRA; J. Parinet, ANSES / Unité PBM

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 but, because of its long persistence, it still remains in soil. Consequently, farmland 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 cannot be metabolized into chlordecol (CLD-DOH) in human, pigs and gerbils livers. Then CLD and CLD-DOH can be conjugated by the glucuronyltransferase. 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 based on the QuEChERS methodology which is more and more used in the pesticides field. As no conjugated standards were available an update enzymatic pretreatment was set up. The analysis method was performed by liquid chromatography with tandem mass spectrometry using isotopic dilution given a reliable method. The methods were then validated according to the French standard NF V03-110 and the European Union guidelines. At the outcome of the method development, CLD in ewes in its free form can be measured and its bioavailability expressed as CLD concentrations detected in the matrices analyzed. Hence, the foetus health can 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.

MO212 Organic Contaminants in High Mountain Areas: Where and When to find them??
O. Machate, Helmholtz centre for environmental research - UFZ / Plant and Environmental Science; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; D. Schmeller, Helmholtz Centre for Environmental Research UFZ / Conservation Biology; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis

Semivolatile organic contaminants (SOC) are well known to undergo atmospheric long-range transport and enrich in remote high mountain ecosystems. To predict the risk for high mountain ecosystems it is necessary to have knowledge of the present contamination or risk along their bioavailability in aquatic and terrestrial ecosystems. The chemical concentrations of SOC’s 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 research and to facilitate a more realistic approach this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables will be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

MO213 Pesticide occurrence in different apicultural matrices (honey bees, wax and pollen)
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Pesticides applied in beekeeping were the most frequent and with the highest concentrations detected in the matrices analyzed. Honey bee colonies health could be compromised. Assessing pesticides content in these three different apicultural matrices at the same time is a useful tool to understand the magnitude of honey colonies exposure to toxic compounds, which is one of the main causes of the progressive decline in honey bee colonies around the world.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.
N. Puchex, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

One of the main factor in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHè project, the transfer of PCBs and PCD/DPs to plants and invertebrates has been studied: BCF in several plants and in earthworms had been measured and different models were then calculated. The purpose of this work is to propose a second step. In earthworms, 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.

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 quality’ by meeting Environmental Quality Standards (EQSs). Normally, risks to surface waters are expressed in terms of water quality standards 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...
sampling of water. This means that extrapolation to unsampled waterbodies is needed but this is highly uncertain, so national risk assessments are difficult to achieve. This study explores alternative matrices to biota sampling, focussing on sampling of (a) whole water and (b) the dissolved fraction estimated from passive sampling. We describe studies in which chemical analyses of whole water and passive samplers for a range of PBT substances are compared with water thresholds but also with toxicological data. These have been compared with those made using biota samples taken from the same locations in UK surface waters. The utility of these matrices as possible alternatives to biota monitoring is examined, and their implications for future risk assessment is discussed.

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. A review of 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 percentage of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting public.


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 and therefore less uncertain than lower tiers. A purely statistical view of uncertainty often assumes different sources of uncertainty are independent and when this is combined with a focus on high percentiles, uncertainty measures quickly multiply up and inflates the perceived uncertainty. However, biological systems are controlled by a range of feedback and regulating mechanisms aimed at maintaining homeostasis and ecosystems normally have at least some redundancy; systems of organisms represents a landscape with a diversity of 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 (type of soil, type of cereal culture etc.) are included in the site rasterization then the vegetation assessment will be based on a reasonable set of variables. The goal of the project is to identify a set of relevant variables which can be used for a regional scale vegetation assessment using a combination of GIS based methods and geospatial statistics. A first step for the project is to define a core set of variables and to perform a survey in rural areas in North Rhine-Westphalia (Germany) to evaluate the feasibility of the approach. A. L"unenau, Bayer AG / Environmental Safety; R. Wolfrum, Bayer AG / Environmental Modelling; T. Wittwer, Rifcon GmbH

MO220 B-Rice: bird focal species identification in rice paddy

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Pesticide registration in EU (Reg. 1107/2009 EC) requires appropriate risk assessment for non-target organisms including birds. The European Food Safety Authority developed a Guidance Document (GD) to conduct the risk assessment considering a series of exposure scenarios from a combination of crops and growth stages, selecting relevant species at the lower steps of a tiered approach. The actual GD doesn’t include scenarios for pesticide applications on rice; nowadays bird risk assessment is generally performed considering rice as the other cereals. Rice paddy is considered exposed by two cultivation options: 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 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. Azavedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; M. Hubeckost, 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 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 due to the 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.

MO222 Population dynamics of a soil arthropod simulated using an individual based population model and established fate model data

D. Nickisch, T. Wittwer, Rifcon GmbH

The prediction of concentrations of plant protection products in soil, surface and ground water using chemical fate modelling is established since decades and applied in European environmental risk assessments (ERA). Many issues, concerns...
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. Nevertheless, the usability of data on environmental conditions which agree with the established fate models and could as well demonstrate the implications of different environmental conditions on springtail populations. For this purpose, we used an individual based population model which represents the life-cycle of springtails in a temperature dependent framework. Specifically, we calculated soil temperature series with the groundwater model Pearl. Further, we used the established ecological functions of leaching experiments with variable pre-equilibrium times from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

**MO223**

**Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions**

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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 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 combination with the leaching experiments after variable pre-equilibration times (2, 5, 7, 48 days), using leaching solution with different DOC content (tap water vs. a solution prepared with commercial humic acid), at different temperature (25 °C vs. 15 °C) and in saturated vs. pseudo field capacity conditions. Results indicated that equilibration time determined differences in measured PCB concentrations up to a factor of 8, probably due to the lack of equilibration with the endogenous DOC in DOC non-sorbing 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; S. 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 expression. The toxicological sensitivity was derived by indirect prediction based on traits because limited 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 the pesticide. For this reason, we refer to the current guidelines of the Pesticide Risk Assessment Committee (PRAC) which has been well documented and recent scientific opinions of the European Food Safety Authority (EFSA) confirm the need for their inclusion in the environmental risk assessment of plant protection products. As a first step towards this direction, the currently renewed approval of glyphosate includes an obligation to the EU Member States to assess and manage the risk to diversity and abundance of non-target terrestrial arthropods and vertebrates via trophic interactions in the course of authorization procedures of glyphosate products. Therefore, we consider it necessary to develop an extension of the risk assessment to evaluate the indirect effects of specific PPPs in addition to the standard risk assessment and provide guidance to risk managers on how to mitigate them. Due to the large variation in food-web compositions and spatial and temporal implications, we do not consider it possible to achieve a representative and realistic estimate of indirect effects by means of mechanistic models. Instead, we suggest a simple empirical model to complement current risk assessment. However, implementing a risk assessment scheme for an additional subject of protection would not be feasible without offering solutions on how to manage the assessed risk. Otherwise, an adverse outcome of the assessment would inevitably lead to non-authorisations. To solve this conflict, we put forward an approach to manage risk by means of compensating food web effects. In practice, compensation is established by ecological compensation areas such as flowering margins, set-asides and beetle banks in field. To make most out of existing types of suitable measures and to ensure a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the individual measures with regard to their value for supporting in-field biodiversity (and thus to compensate for indirect effects of PPPs).

**MO226**

**Compensating for ecological risks of pesticides**

S. Matezki, K. Swarowsky, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV / plant protection products

Current environmental risk assessment (ERA) of pesticides overlooks a considerable part of existing risks and consequently fails to protect the environment from pesticide effects in toto. Examples of such blind spots are risks to field-dwelling species including wild pollinators, amphibians and farmland birds as well as indirect food web effects. To solve this, we provide a generally well described and highly relevant for the achievement of the legally defined environmental protection goals, eliminating these blind spots in the risk regulation has failed so far. The ‘indirect effect’-issue is an illustrative example for what we would actually regard as a crisis in environmental risks regulation of PPPs. What we recognize is that progress in ERA notably seems to be hampered for types of risk for which no effective risk mitigation measures are established, so that an assessment of such risks would inevitably lead to non-authorizations. To solve this conflict, we wish to put forward a radically new approach in risk management: Compensating adverse effects of pesticides where established methods of risk mitigation fail to prevent them. Once implemented into the iterative process of risk assessment, such new risk mitigation approaches would allow to manage actual risks more adequately than currently possible, thereby preventing an increase of non-authorizations. It has not escaped our notice that our proposal could also make excessive higher tier assessments dispensable, thereby helping to solve the problem of the increase of complexity in ERA.
Fish model species in human and environmental toxicology (P)

MO228
Historical control data of the optimized Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for 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 sacculo/otoliths, head, heart, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted ISO medium). The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development, whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

MO229
Optimization of the Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for the ZEDTA. The aim of this research was to optimize the protocol, i.e. examine which combination of exposure parameters is optimal for embryonic and larval development and is at the same time most cost-effective. An optimal condition should yield normal growth and development with minimal mortality and/or malformations. 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. The following factors and their combinations were investigated: temperature (26 vs. 28°C), exposure vessels (24 vs. 96 well plates), renewal periods (static (no renewal) vs. semi-static (24 or 48 h renewal)), and use of solvent (0.05% v/v DMSO vs. adjusted ISO medium). Development was scored daily, using the Extended General Morphology Score (GMS). This system grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consist of, but are not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf is 18. Teratogenic endpoints such as malformations of sacculo/otoliths, head, heart, tail, yolk, pectoral fins and entire body were scored as ‘present’ or ‘absent’ after 96 hours of exposure. Mean developmental and teratogenic scores were calculated and used to select the most optimal condition for each factor. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not induce more malformations or mortality than exposure to adjusted ISO medium.

MO230
Reliability of ecotoxicological studies in fish

H. Wünnemann, Bavarian Environment Agency; H. Ferling, Bavarian Environmental Agency; G. Dembek, W. Schmidt, W. Koerner, Bavarian Environmental Agency; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

Few recommendations in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established biotests using the three trophic levels - algae, invertebrate and fish - according to OECD Guidelines provide in particular the baseline data for the derivation of the EQS. To obtain the most accurate EQS by use of a low assessment factor of 10 data from all three trophic levels including long-term results are required. Depending on the test substance growth inhibition of algae, immobilization of daphnia as well as deformation and death of fish embryos are not necessarily the most sensitive organisms and endpoints. Fish are in many cases the most suitable test organisms to demonstrate effects of e.g. pharmaceuticals with a specific mode of action in vertebrates. Therefore, prolonged toxicity tests with fish are of great importance. However, the study design has to be adapted to specific endpoints according to the pharmacodynamics of the tested drugs. Thus, in planning and implementing this type of study special care must be taken to ensure that the generated data can be used for derivation of EQS. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not applicable exposure concentrations, missing chemical analysis of test compound concentration in the test water, calculation of toxicological endpoints on the basis of nominal and not real concentrations, or insufficient quality of endpoints. The aim of the presentation is to outline, from our point of view, optimal experimental conditions of prolonged fish tests which can be adapted as a model for other scientific studies, thereby increasing the significance of results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

MO232
Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabit in heavy metal contaminated river

H. Takeuchi, Toyo University / Research Center for Life and Environmental Sciences; Y. Iwasaki, National Institute of Advanced Industrial Science and Technology AIST Japan / Research Institute of Science for Safety and Sustainability; D. Kitamura, Tohoku University / Graduate School of Life Sciences; Y. Kato, Toyo University / Faculty of Life Sciences; Y. Shimizu, Toyo University / Graduate School of Life Sciences; H. Tatsuta, University of the Ryukyus / Faculty of Agriculture; S. Kashiwada, Toyo University / Graduate School of Life Sciences

The Watarase River, running in the northern Kanto region of Japan, had been severely polluted by heavy metals due to Ashio mining activities from late 1800s to early 1900s (e.g. 20 mg Cu/L in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than those in 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 (cystein-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 activity, 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.
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. retio, 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 (0.05%). The metal with the highest genotoxic effect was lead (0.83%), followed by cadmium (0.65%). Copper showed the lowest genotoxicity (0.37%). The metal mixture had a microunecous frequency of 1.23 %. The juveniles of D. retio 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 is possible that they can be used as biosensors in the studies of environmental monitoring.

MO233 Endocrine disruption effects of bisphenol S and bisphenol SIP in adult zebrafish (Danio retio) K. Ji, J. Lee, Yongin University As alternative compounds of bisphenol A (BPA), bisphenol S (BPS) and 4-hydroxy-4-isopropoxyphenylsulfone (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 retio) 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 17β-estradiol/testosterone [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 steroidalgenic 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 hydroxyl 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 (BPO and BFLO) 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-route experiments, DWH surrogate oil contaminated feed, sediments, and seawater, were designed and carried out to examine biological responses of aquaculture reared red drum, Florida pompano, and southern flounder. Environmental pollutants, like polycyclic aromatic hydrocarbons (PAHs) found in crude oil, have the potential to imbalance the antioxidant system of marine organisms. Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and the organism’s ability to detoxify reactive intermediates, such as those generated by metabolism of PAHs by cytochrome P450 (CYP1). Depending on the severity of oxidative stress, this imbalance can lead to DNA damage in a variety of ways, such as oxidized bases, apurinic/apyrimidinic sites (AP sites), single or doublestrand breaks and DNA adducts. Exposure to PAHs can lead to increase DNA damage, such as those created by AP sites (purine loss) and the formation of DNA adducts, in which PAH metabolites intercalate into the DNA. Total PAH concentrations were analyzed in exposure matrices, as well as fish livers and whole bodies to determine specific dosages. Multiple assessments have been carried out to examine oxidative stress, total antioxidant power analysis, 2-Thiobarbituric Acid Reactive Substances analysis, GSH/GSSG ratio determination, AP site quantitation, and 8-OHdG quantitation. Evidence of oxidative stress will be discussed comparing multiple pathways of exposure, and resulting impacts in terms of biological and ecological implications.

MO235 Impact of PAH/oxy-PAH mixtures on heart development in zebrafish V. Cinha, K. Dreij, Karolinska Institutet Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxy-PAH mixtures on cardiac development in zebrafish (Danio rerio) embryos (ZFEs). ZFEs (24 hpf) were exposed to a dose range of single PAH (benzo[a]pyrene, BP), oxy-PAH (the ketone 4H-cyclopenta[a]/diphenanthrene-4-one (4H-CPO), benzo[a]fluorobenzene (BF), and 6H-benzo[c/l]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 exposure to 6H-BPO and BF and BP were more potent than single exposures. The heart rate and blood flow was significantly decreased, 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-monomonotonic 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 in vivo and in vitro tox, in combination with the expression of PAHs with BP. Notably, the up-regulation of these two genes correlated with the formation of string heart. In summary, the binary mixtures were more potent then oxy-PAHs alone in inducing cardiotoxicity, except in the case of 6H-BPO which seems to be a very potent oxy-PAH. The oxy-PAHs and PAHs interact and thereby influence the latter effect as single compounds or as a mixture treatment for 1, 3, 7 and 14 days. Body length and yolk (energy) consumption were measured and the hearts collected and pooled at the end of every exposure period. Using transcriptomics, proteomics and metabolomics, cardiototoxicity was investigated at molecular level. Our results shows that fry exposed to retene and the mixture treatments, in relation to control, became shorter and in retene’s case, had used more yolk by day 14. Exposures to PAH alone did not effect growth or energy consumption by day 14. Microarray analysis showed that the different treatments caused very different alterations in the transcriptome, both in terms of the number of changed genetic expressions and when in time. The only gene (up-regulated at all sampling times and treatments was cycp1a. In addition, cept and ctlq and tbl-like-domains expression were found similarly changed across all treatments but not at all sampling occasions. Using over-representation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Proteomic analysis is underway but protein expressions are suspecte to show a low transcript to protein correlation (based upon literature). Heart tissue metabolomic analysis revealed that across all treatments only two out of 33 metabolic terms were found significantly in vivo. PAH tox has been studied for over 100 years and it is currently known that different PAHs have different modes of action (MoA). PAHs like retene and pyrene are aryl-hydrocarbon receptor agonists that up-regulate CYP1a expression and thereby induce their own metabolism, while other PAHs like fluorobenzene directly inhibit CYP1a activity. In we exposed newly hatched rainbow trout fry (Oncorhynchus mykiss) semi-statically to retene and fluorobenzene the latter effect as single compounds or as a mixture treatment for 1, 3, 7 and 14 days. Body length and yolk (energy) consumption were measured and the hearts collected and pooled at the end of every exposure period. Using transcriptomics, proteomics and metabolomics, cardiototoxicity was investigated at molecular level. Our results shows that fry exposed to retene and the mixture treatments, in relation to control, became shorter and in retene’s case, had used more yolk by day 14. Exposures to PAH alone did not effect growth or energy consumption by day 14. Microarray analysis showed that the different treatments caused very different alterations in the transcriptome, both in terms of the number of changed genetic expressions and when in time. The only gene (up-regulated at all sampling times and treatments was cycp1a. In addition, cept and ctlq and tbl-like-domains expression were found similarly changed across all treatments but not at all sampling occasions. Using over-representation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Proteomic analysis is underway but protein expressions are suspecte to show a low transcript to protein correlation (based upon literature). Heart tissue metabolomic analysis revealed that across all treatments only two out of 33 metabolic terms were found significantly in vivo. PAH tox has been studied for over 100 years and it is currently known that different PAHs have different modes of action (MoA). PAHs like retene and pyrene are aryl-hydrocarbon receptor agonists that up-regulate CYP1a expression and thereby induce their own metabolism, while other PAHs like fluorobenzene directly inhibit CYP1a activity.
includes detoxification enzymes induction (CYP1A), hemorrhaging, cardiovascular defects, pericardial and yolk sac edemas, craniofacial deformities or growth attenuation. The cardiovascular tissue is one of the most sensitive to PAHs, and all the aforementioned symptoms are caused by the activation of the aryl hydrocarbon receptor (AhR). However, the mechanisms involved downstream of the AhR activation by PAHs are still unclear. Some weak AhR agonists such as phenol or pyrene can also produce cardiovascular effects (e.g., arrhythmia) via unknown AhR-independent mechanisms. In this study, we aimed to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhynchus mykiss) ELS by the use of an integrated OMICS approach, i.e. the combined use of transcriptomics, proteomics and metabolomics. The use of OMICS can lead to evidence of which pathways are altered by PAHs, and thus help choosing candidate genes for further mechanistic investigation 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 wellestablished PAH bioactivation pathways. Exposure to a mixture of phenanthrene (P50), 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.1 Ezemanye, University Benin / Animal and Environmental Biology; N.O. Ezemanye, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; P. Adebayo, University of Benin / Animal and Environmental Biology. The study investigated the developmental toxicity of Acetaminophen, a non-steroidal Anti-inflammatory Drug on the early life stage (0 to 96 hpf) of African Catfish (Clarias gariepinus). The 96 hrs fish embryo acute toxicity (FET) test was carried out according to the modified OECD 236 guidelines. Newly fertilized embryos were exposed to different concentrations (0, 0.5, 1, 5 and 10 µg/L) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural alterations were wellestablished. Exposure to Acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more 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 C. Espinosa, S. Maneguerra, M. Morghese, Unipa / DiStEm; A. Cuesta, M. Esteban, University of Murcia / Fish Innate Immune System Group, Department of Cell Biology and Histology.; A. Santulli, Consorzio Universitario della Provincia di Trieste/ Università di Trieste (University of Trieste); F. Vincenzi, University of Innsbruck, Department of Inmunology Molecular (IBIM); A. Cuttitta, M. Sprioveri, CNR / IAMC-CNR Capo Granitola, Mazara del Vallo, Trapani, Italy; C. Messina, Unipa / DiStEm 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 on Health and Human Health” is to understand the mechanisms underlying the interaction between conventional (heavy metals, POPs, radionuclides, etc.) and emerging contaminants (e.g., PBDE, antibiotics, pharmaceutics, 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 induced by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecules/ enzymes, seems to be the crucial event influencing the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible of cancer promotion. Acknowledgements: the project 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 (Oncorhynchus mykiss) proteins. D. Delgi Esposti, Iriesta / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iriesta Land / Casadio, University of Bologna / Department FaBi; M.P. Babut, Iriesta / Water Perfluoralkyl 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. PFASs 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 (L-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 the abundant one of the hypothalamic nuclear translocator of PFCs 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 perfluoralkyl acids (Perfluorooctane Sulfonate, PFOS, perfluorohexane sulfonate, PFHxS) and perfluorobutane sulfonate, PFBS) for the abundant one of the hypothalamic nuclear translocator of PFCs in fish. 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 posess potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C4H14N2O6Cl) according to OECD test guideline 236 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. ‘n

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 Organisal Studies The biguanide metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its antihyperglycemic effect, metformin is one of the most abundantly prescribed pharmaceutical treatments of 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 possesses potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C4H14N2O6Cl) according to OECD test guideline 236 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects.

MO242
Pyrgolgallo 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 Pyrgolgallo is a benzenotriol being a brownish solid, and is used for hair dyes after mixing with copper sulphate. A recent report on mutagenicity of pyrgolgallo-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, caffèic acid, quinic acid, and chlorogenic acid. For the inhibition of zebrafish COX, pyrogallol was the strongest chemical among the tested ones. Taken together, benzenetriol including pyrogallol may be caused an unexpected inhibitory effect on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

MO243 Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos
C. Parenti, A. Ghilardi, M. Mandelli, University of Milan; C. Della Torre, State University of Milan / Biosciences; S. Magni, University of Milan / Department of Biosciences; L. Del Giacco, University of Milan; A. Binelli, University of Milan / Department of Biosciences

Triclosan (TCS, 5-chloro-2-(2,4-dichlorophenoxy) phenol) is the most common antibacterial agent used in personal care products, including soaps, body lotions, laundry detergents, toothpastes and deodorants. For its properties it is also added to several household items such as food packaging materials, toys and textiles. Since TCS is not completely removed by WasteWater Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters, with concentrations ranging from ng/L to µg/L. 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 EU. The aim of this study was to investigate the adverse effects of TCS at environmental concentrations on zebrafish embryos up to 120 hours post-fertilization (hpf). It is the first time that environmental levels of this contaminant were taken into account, instead of evaluating the effects of sub-lethal or lethal concentrations. The experimental plan consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPX) and glutathione S-transferase (GST), and glutathione (GSH) levels were evaluated as the occurrence of the micronucleated cells (MN test). Results show a significant increase in all biomarkers measured, indicating that this chemical is dangerous for aquatic species also at environmental concentrations.

MO244 Comparative study of acute toxicity of a Microcystis aeruginosa bloom containing microcystin-LR on common carp Cyprinus carpio and Wistar rat
Z. Hadjer, R. Bondj, H. Nasr, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria; N. Bouaich, UNIVERSITE PARIS

Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in water bodies throughout the world. Their mechanism of toxicity consists of a potent inhibition of protein phosphatases 1 and 2 A, which causes disruption of the cytoskeleton and consequent cell death. They can also alter the antioxidant system and induce oxidative stress in various organs of many species. Microcystin-LR (MC-LR) is the most studied variant due to its high toxicity and frequent occurrence in surface waters. In this study, we used a Microcystis aeruginosa bloom extract consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPX) and glutathione S-transferase (GST), and glutathione (GSH) levels were 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 extracting containing the microcystin-LR congener on the common carp Cyprinus carpio
R. Bordi, Z. Hadjer, H. Nasr, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria; N. Bouaich, UNIVERSITE PARIS

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 weight) 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 study and biomarkers of oxidative stress have been observed. In addition, the results of the histological study and biomarkers of oxidative stress have shown that male fish are much more sensitive to the bloom of cyanobacteria containing microcystins than females. Key words: MC-LR, Cyprinus carpio, oxidative stress, histological study.

MO246 Diluted bitumen vs. conventional crude oil: effects of developmental exposure on first- and second-generation zebrafish
D. Lyons, University of Alberta; D. Philibert, K.B. Tierney, University of Alberta / Biological Sciences

The Canadian oil sands industry produces a heavy, viscous crude oil called bitumen. Due to its viscosity, bitumen must be diluted with natural gas condensates to create diluted bitumen or ‘dilbit' that is transportable by pipeline or rail. Dilbit and conventional crudes have varying effects on earthworms (Eisenia fetida) and zebrafish, an omnivorous fish species. Bitumen is acutely and chronically toxic to aquatic organisms and it was already determined by Waste Water Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters. The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters. In this study, we used a Microcystis aeruginosa bloom extract consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPX) and glutathione S-transferase (GST), and glutathione (GSH) levels were 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.

MO247 Effect of skatole and its metabolites on piscine Phase I metabolism
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Research Center of Aquaculture and Biodiversity of Hydrocenoses Vodnany Czech Republic; G. Zamaratskaia, Swedish University of Agricultural Sciences / Department of Food Science

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 aquatic organisms and its effects on their organism 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 weather skatole and its metabolites, 2-aminoacetophenone, indole-3-carbinol, 3-methylindolone, and 3-hydroxy-3-methylindolone, can interact with fish CYP isoforms. 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-Aminoacetophenone, 3-methylindolone and 3-hydroxy-3-methylindolone 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.1.05/2.1.00/0001.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15002S) and Swedish University of Agricultural Sciences.

MO248

Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Environmental Sciences; N. Munz, University of Applied Sciences and Arts Northwestern Switzerland

The herbicide glyphosate and the pharmaceutical linsoprin are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of linsoprin, 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 (linsoprin: 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 malformations. 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.1.05/2.1.00/0001.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15002S) 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) and other 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 developed in vitro reporter cell lines based on both human (h) and zebrafish (zf) NRs: hAR, hGR, hMR, hPXR and hPR. The hGR receptor was found to be the most sensitive in both, human and zebrafish. Cross-species differences occurred (PXR, PPARy, PR) while for other receptors the differences were lower (ER, AR, GR, MR) or almost absent (AhR, ERRy). For instance, promegestone acts as a full agonist of the hPR but as partial agonist of the zfPR whereas the dihydroxy-4-pregnen-3-one -reference ligand of the zfPR- antagonizes the hPR. In the same way, none of the reference ligands of the hPXR (T091311) modulates the zfPXR whereas the clotrimazole -a bromine ligand of zfPXR- modulates also the hPXR but with lower potency. Then the hAR was more sensitive to the agonist mifepristone and the antagonist OH-flutamide than the zfAR whereas the dexamethasone was a more potent agonist of the zfGR than the hGR. Also significant differences in selectivity were noted among h and zf ER subtypes. Finally, the in vitro profiling of an urban WWTP confirmed these cross-species differences in terms of level, type (agonist vs antagonist), distribution along the WWTP. For instance, h and zf estrogenic activity was differentially detected in the sludge and the suspended material. In the same way, strong zf anti-androgenic activity was detected in the effluent while no human one can be detected. Also, strong zf mineralocorticoid activity was detected in both influent and effluents whereas only slight zf mineralocorticoid activity was detected. Altogether, our results showed that h and zf NRs are, for some of them, differentially modulated by individual chemicals and environmental mixtures. Also, interaction of EDCs towards NRs cannot always be extrapolated between these species highlighting the need to further document NR modulation between human and fish and associated responses, to improve human health and environmental risk assessment of EDCs.

MO250

Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
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Triclosan (TCS) constitutes a common household product, 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), seawaters and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgently required to evaluate its potential 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 high throughput toxicology biomarker to incorporate in different toxicity assessment approaches, for a comprehensive toxicity assessment of environmental stressors in aquatic organisms. The zebrafish embryo toxicity assay was used to calculate the LC50 value of TCS as well as to perform the morphological phenotyping. In addition, a liver specific fluorescent transgenic line (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 up 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. The results of this study will allow to better understand the metabolism of TCS in the embryo and the associated responses, to improve the involvement of unexpected metabolic pathways.

MO251

Isoprostanes in fish mucus - a non-lethal biomarker for oxidative stress
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Isoprostanes (F2 isoPs) arising from both oxidative and conjugative pathways. This approach is an alternative to the classic targeted methods, as it did not focus on a few metabolic pathways, for which we already know that are affected by the specific stimulant and enables to unravel the involvement of unexpected metabolic pathways.

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extract was then centrifuged, filtered and reconstituted in methanol. Separations were performed on C18 (2.1 mm x 50 mm, 3.5 μm particle size) using methanol (0.1% formic acid) and water as the mobile phase. Negative ion electrospray ionization and specific multiple reaction monitoring ion transitions were used to detect F2-isoPs in mucus. Mass labelled internal standards were used to monitor recovery of native compounds during sample work-up and also to quantify native F2-isoPs. Native F2-isoP standards class II and VI F2-isoPs were measurable in Cruppie (Pomoxis). This work demonstrates that mucus has the potential to be used as an 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) 
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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 an apparent risk for suffering the detrimental effects of Se. The objective 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 a short-term fish species, the fathead minnow (Pimephales promelas). 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 mg Se/kg bloodworms dry weight (dw) and bred for 28 days. Embryo Se concentrations increased immediately upon onset of exposure and Se concentrations reached approximately a 1:1 ratio in food:embryo after 28-30 days on the diet. There was a significant difference in mean embryo Se concentrations from the control (1.18 mg/kg embryo dw) in the medium (8.75 mg/kg embryo dw) and high (29.58 mg/kg embryo dw) treatments. Embryos collected on days 26, 27 and 28 were reared to swim-up and assessed for morphological abnormalities. Preliminary assessment revealed an increasing, although not significant, trend in the frequency of 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 risk for studying the maternal transfer of Se. This embryo injection model could also support mechanic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as walleye, brook trout and northern pike.

MO253 Preliminary characterization of the rainbow trout intestine using omics based approaches. 
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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 (Onchorhynchus 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. RNAseq 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 variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased markedly between the pyloric, anterior or mid intestine (~6 genes), however this variability increased 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variability increased markedly between the pyloric, anterior or mid intestine (MO254 Persistent organic pollutants alter the expression patterns of epigenetic factors in the Zebrafish Liver (ZF-L) Cell line. 
M. Blanc, Orebro University / MTM Research centre; N. 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, including fish. It is of high biological interest since epigenetic changes are 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 mammals; therefore, it was proposed as an alternative model for epigenetic research. The focus of the present study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to 8 selected compounds. The cells were exposed to the LC10 values of pesticides (methoxychlor (MXC), permethrin (PER)), plastic additives (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluoroctane sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-diethylamino-4-methylcoumarin (DEMCC) and to the non-drug protein inhibition values (20 μM) of a series of genes encoding enzymes and factors involved in DNA methylation and histone modifications were monitored using RT-qPCR. The DNA methyltransferases were selected to target DNA methylation (dnm1l, dnm3aa, dnm3ab, dnm3ab2). They were analyzed together with 2 histone deacetylases (hdac1, hdac3), one demethylase (jarid1b), and one chromatin remodeling factor (spod6). At the selected concentration, 83% of the selected genes showed an inhibition of expression. Of these compounds, the selective effects of ZF-L cells were more susceptible to epigenetic disruption. They brought further evidence on the potential of chemicals to interfere with both DNA methylation and chromatin accessibility. However, further studies are required to investigate to which 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" 
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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 DIO, notably DIO1, as a key event along the AOP and evaluated the potential of the well-known BPA and PFOS. Overall, the results showed that ZF-L cells were more susceptible to epigenetic disruption. They brought further evidence on the potential of chemicals to interfere with both DNA methylation and chromatin accessibility. However, further studies are required to investigate to which extent the observed changes are reflected in DNA methylation and chromatin accessibility themselves, together with their correlation in in vivo models.

MO257
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 comparison to its endocrine activity, it is known that DRP can interfere with other processes in fish, such on regulation of circadian rhythm. Thus, the present work aims to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical level. Zebrafish embryos were exposed to 0.01 – 100.0 µg/l of DRP during 96h to evaluate lethal and sublethal parameters. Survival, heartbeat, length and impairments on normal development such as malformations and hatching were evaluated at apical and physiological endpoints. Alterations on enzymes related with neurotransmission (acetylcholinesterase, AChE, energy production (lactate dehydrogenase, LDH) and oxidative stress (catalase, CAT and glutathione S-transferase; GST) were assessed. The oxidative damage was also assessed by alterations on lipid peroxidation levels (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease of a number of chemicals were identified as DRP. Biochemical processes were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

MO258
Fish caging experiment as a tool for detection of in situ effects of untreated wastewaters: General stress and endocrine disruption

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A direct discharge of untreated municipal wastewaters from the city of Novi Sad into the River Danube made a location a focal pollutant hotspot within the framework of FP 7 funded Solutions project. A study conducted previously at this site provided detailed chemical characterization of water samples. Recently, high concentrations of a number of chemicals were identified as DRP. This potency 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 (1 km), downstream (2 km) and discharge point (0 km). 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 s-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (cox1), metallothionein (mt), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor β (erβ), androgen receptor (ar), cortisol receptor (cr) and vitellogenin (vtg) as endocrine disruption related genes; interleukin1β (il1β) and tumor necrosis factor α (tnfa) as immune response related genes, while light chain 3 β (lc3β) and dyein (dyn) were selected as autophagy related genes. Expression activities were higher in specimens caged at downstream locality, while catalase was lower at sewage discharge point. General stress and endocrine disruption representative genes at downstream site follow the trend of overexpression vs control (reference site), while the vtg was down-regulated at discharge point. Expression of tnfα 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). A battery of reference genes was used to normalize the qPCR data. Relative expression levels were calculated using the comparative –ΔΔCt method. The availability of teleosts as model species for developmental neuroendocrine research and for applications, such as ecotoxicology.

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 fishes in Antarctica remains scarce. Among these, information about their potential impact on fish physiology is still very limited. 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. Nototoboth fish are the dominant group in the coastal waters of the Magellanic sub-Antarctic region, playing a key role in these ecosystems. The black southern cod, Patagonotothen tesselatus is widespread in the Beagle Channel, lives in the intertidal zone, and possess paternal care. The aim of the present work is to validate vitellogenin (vtg) and estrogen receptor (Reen) as biomarkers of estrogenicity in skin samples of this species in order to provide a helpful tool to develop and perform field studies. Samples were collected from different water locations and analyzed for certain unrestricted testis and intense cytoplasmic basophilia in hepatocytes. No vtg was detected in plasma samples of control males or before E2 injection; however, three days after treatment, males showed plasma
MO264 Evaluation of the deleterious effect of 2 pesticides on juveniles of the zebrafish Danio rerio
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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 (lipoperoxidation), 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 (LC\(_{50}\)). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC\(_{10}\) and LC\(_{30}\)). The resorption of yolk, the activity of the enzyme and the frequency of malformations (OECD 907), were evaluated. Dichlorvos (LC\(_{50}\) = 5.3 mg L\(^{-1}\)) was more toxic than Dichlorvos (LC\(_{50}\) = 5.3 mg L\(^{-1}\)). In the sublethal bioassay it was observed that the toxicity of these xenobiotics increased with the time of exposure. The degree of lipoperoxidation in the imiprotrin tests varied from 64.7 to 147.5 mTbars mg\(^{-1}\) and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 mTbars mg\(^{-1}\)). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of the AChE enzyme was observed and from 14% to 64% in the juveniles exposed to imiprotrin. The juveniles of zebrafish that showed a decrease in the activity of the AChE greater than 35% had changes in their swimming behavior and in their feeding. The energy content of the fish exposed to pesticides decreased by 64% in the Imiprotrin tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imiprotrin are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.

MO265 Effects of Omeprazole on zebrafish embryos (Danio rerio)
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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 acute rebound hypersecretion, decreased absorption of nutrients, osteoporosis and neurological disorders. Its toxic effects have been evaluated in mice and rats only, for this reason in this work was made an evaluation of the toxic effects of Omeprazole in zebrafish embryos. Bioassays were performed (OECD test 236) where the embryos were exposed to 5 concentrations of the drug (200, 100, 50, 25, 12.5 mg L\(^{-1}\)) plus a negative control, to determine the LC\(_{50}\) (24 hours). The embryos were subsequently exposed to the LC\(_{10}\) and LC\(_{50}\) to evaluate the degree of lipoperoxidation, by means of the evaluation of Tbars (Buege and Aust, 1978), the activity of the enzyme AChE as an indicator of effects neurotoxic (Ellman et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the LC\(_{50}\) value of 193.87 ± 18.48 mg L\(^{-1}\) was obtained. In the sublethal bioassays at 72 hours of exposure it was observed an increased in the degree of lipid peroxidation (52%) in embryos exposed to LC\(_{50}\). The LC\(_{10}\) was estimated to amount to hundreds of billion euros per

MO266 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges
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MO263 Identification of toxicity pathways predicting adverse outcomes of chlorpyrifos in fathead minnows
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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 this 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 as endpoints, 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 protein-based (hotgun proteomics) technologies will be used to 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 in 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\(^{-1}\) of 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\(^{-1}\) 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\(^{-1}\) 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).

199 SETAC Europe 28th Annual Meeting Abstract Book
year. Considering the ecosystem services/principle, effects on single species, communities and whole ecosystems would increase that up 'tto hundred times, similarly to when considering other chemicals such as neuroactive pharmaceuticals. 'Antidepressants such as venlafaxine are of increasing environmental neurotoxic concern. Venlafaxine is one of the most prescribed antidepressants in Europe and the U.S. and a know aquatic pollutant. 'Ufn is a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations/in 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 'in eighth-light dark transition test and thigmotaxis were evaluated in 5 dpf larvae exposed to 24 h to 10 nM, 100 nM and 1000 nM venlafaxine, using DanioVision® and EthoVision. A significant difference/in the swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome level were verified in zebrafish chronically exposed to Venlafaxine/n1 mM, 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) to find based target genes and single nucleotide variations involved in circadian rhythm regulation, muscle processes and responses to abiotic stimuli. Behavioral results indicate decreased swimming distance and increased thigmotaxis/in fish exposed, in agreement with previous own data for continuous venlafaxine exposure. Results in qPCR indicated modulation of some of the pre-selected target genes such as sklp5, and currently 'unconfirmatory qPCR is being conducted. Further investigations for zebrafish zebrafish larvae are planned to proteome 'and metabolome analysis. This study is expected to play a be part of a bigger overview and understanding of 'in different effects of chemicals and pharmaceuticals on neuronal development.

**MO267**

Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models

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Ayahuasca is a psychoactive concoction prepared with the plants Banisteriopsis caapi and Psychotria viridis and used ancestrally by Amazonian Indian populations, and recently, by Christian religions in Brazil and other countries. The present study aimed at identifying the ayahuasca effects in early fish development and compares its neurobehavioral effects in the zebrafish embryo and rat models. Toxicological testing for zebrafish larvae was planned to occur at 0 to 1000 mg/L during 96 h of exposure. Effects on locomotor activity of zebrafish larvae were assessed using the automated video tracking system Zebrabox 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 (OTF), 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 abnormalities 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 OTF 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. Further 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.

**MO268**

Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.

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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 neurotoxicological 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

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Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure have attracted great attention in 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 h (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 C8), associated with mitochondrial metabolism, at 120 hpf. This comprehensive analysis could suggest the involvement of the embryonic zebrafish model on the methodology and a set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.

**MO270**

The NeuroBox Project

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The societal impact of neurological disorders like Alzheimer’s disease or neuropsychiatric deficits like autism is immense. Consideration of the above-mentioned endpoints, 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 disrupters 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 possible to define how to assess neurotoxicity. Considering the increasing use of chemicals and the physiological and morphological complexity of the nervous system, it is a major challenge to test all substances for their neurotoxic potential, new advanced neurotoxicity assessment strategies need to be developed to fulfill these demands. The bmbf funded project NeuroBox (02WRS1419; coordination UBA, T. Grunmint) aims to develop novel assessment strategies for neurotoxicity assessment of anthropogenic 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 bellow 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, generation of offspring within 48–72 h, but also a small body size and conserved 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 behavioral 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.

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

**MO272**

Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water

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Iodinated X-ray contrast media (ICMs), used in medical imaging, are poorly metabolized by humans and enter wastewater. As they are incompletely removed during wastewater treatment, ICMs are released to the aquatic environment and have been detected in drinking water sources. ICMs have been identified as iodine containing or iodine precursors that may form disinfection byproducts (DBPs) during drinking water disinfection. This work investigated the effect of different ICMs, iopamidol (IPAM), iopromide (IPR), diatrizoate (DTZ) and iohexol (IHX), in the formation of different classes of DBPs during source water disinfection by either free chlorination or chloramination. To do this, we performed large-volume (~120 L each), laboratory-controlled, headspace-free disinfection reactions with 5 μM ICM and 100 μM as Cl₂ disinfectant concentrations. The resulting DBP mixtures were chemically characterized for 21 targeted non-I-DBPs, 11 targeted I-DBPs, and non-targeted I-DBPs by means of gas chromatography coupled to low- and high-resolution mass spectrometry. The presence of ICMs in source water had no apparent effect on either the concentration or speciation of the four regulated trihalomethanes (chlorofrom, bromodichloromethane, chlorodibromomethane, bromoform). IPAM, but not other ICMs, induced formation of trihaloacetonitrile and dibromoacetanitriole during chlorination. I-DBPs formation was slightly enhanced in the presence of ICMs, particularly in chlorinated water containing ICM, where the highest levels of I-DBPs were formed, and in chloraminated water containing IPR or IHX. The presence of DTZ did not appear to affect I-DBP formation. Non-targeted analysis of the DBP mixtures revealed the formation of novel I-DBPs in chlorinated and chloraminated ICM treatments, including chlorodibromoacetanitriole, chloroiodoacetanitriole, trichlorodimethane and several iodo-acids. Our results indicate that ICMs enhance the formation of both I-DBPs and non-iodinated DBPs when present during chlorination and that IPAM, in particular, is a relevant iodine source in water undergoing chlorination or chloramination. Acknowledgments: CP acknowledges support provided by EU FP7 (No. 274379, Marie Curie IOF) and the Government of Catalonia and the COFUND programme (Marie Curie Actions, EU FP7) (2014 BP B00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF124865 to SDR.

**MO273**

The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection

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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 (IPAM) [3] bound on 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 to achieve a different flow preconcentration of As(V) 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 μL 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% NaBH₄ and 0.5% ascorbic acid. This is followed by arsenite generation using another reagent stream incorporating 0.5% NaBH₄ and 0.05 M NaOH. The generated arsenite is transported across the hydrophobic membrane of a gas-diffusion cell into a solution containing 0.02 mM K₂MnO₄ and 0.05 M NaOH where it is oxidised thus producing a decrease in the K₂MnO₄ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system allows a detection limit of 0.02 μg L⁻¹ with a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 μg L⁻¹) and 2.8% (n=5, 50 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. **References** [1] Villaescusa I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sci Biotechnol 7:307–323. [2] World Health Organization (WHO). 2011. 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. jimenez-melia, Catalan Institute for Water Research (ICRA); J. SEVERYNS, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICRA

Asin as a case study and diclofenac as the unregulated microcontaminant. The algorithm optimized the number of WWTPs in this catchment requiring an upgrade from 5 to 13 M€/year (upgrading 18 WWTPs, for fullfilling an EQS of 100 ng/l) to 13 M€/year (upgrading 18 WWTPs, for fullfilling an EQS of 30 ng/l in the entire catchment). Such a reduction in WWTP upgrading costs is a result of the trade-off between the selection of the Environmental Quality Standards (EQS) for unregulated microcontaminants, and hence there is a need for 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 diclofenac as the unregulated microcontaminant. The algorithm optimized the number of WWTPs in this catchment requiring an upgrade to reduce the EQS exceedance of diclofenac in environmental and drinking waters.

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 optimization of WWTP treatment by selecting the optimal EQS for diclofenac was a trade-off between the cost and quality of the treated water. 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 optimization of WWTP treatment by selecting the optimal EQS for diclofenac was a trade-off between the cost and quality of the treated water.
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.
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Drugs are more and more consumed worldwide (ONUDC, 2017). The French Caribbean is a hub of world cocaine trafficking and an important place of consumption of cocaine in the form of crack. The local population is particularly affected by this scourge. The consumption of illicit drugs induces the excretion of parent compounds or metabolites (markers of drugs uses) in 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). The present study that takes place in the SENEUR Project and explores the use of passive sampling techniques to monitor illicit drugs in WWTP. Polar Organic Chemical Integrative Samplers (POCIS) were exposed in situ in a Waste Water Treatment Plant in Martinique (French Caribbean) during ten days. First an analytical development by ESI-LC/MS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaïne, heroin, amphetamine, cannabis, their main metabolites in the whole and some substances products such as methamphetamine) and in POCIS (LOQ from 0.01 to 0.1 pg/g). Secondly triplicates of POCIS were exposed in WWTP for calibration during 10 days. POCIS were collected at different times T1 = days, T2 = days, T3 = days, T4 = days, T5 = days, T6 = days. Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaine, benzoylecgonine, cocaethylene, ecgonine methyl ester), cannabis markers (11-OH-CBZ, THC-COOH, 11-nor-9-COOH) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L2 J−1 for cocaine.

**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. Pittois, 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. For that purpose, a catchment delineation method published in U.S. EPA Method 332.0 for determination of perchlorate in wastewater input. Carbamazepine concentrations proved to be highly selective non-ionic compounds, techniques like the Hydrophilic Interaction Liquid Chromatography (HILIC) or morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L2 J−1 for cocaine.

**MO277** Determination of Perchlorate by U.S. EPA Method 332.0 Using a Compact Ion Chromatography System Coupled with Mass Spectrometry (IC-MS).
B. Huang, Thermo Fisher Scientific / marketing; T. Cross, Thermo Fisher Scientific; J. Rohrer, Thermo Fisher Scientific / Chromatography and mass spectrometry division

Perchlorate has been used as an oxidizer in rockets, munitions, and fireworks since the 1950s. It has been found to cause thyroid dysfunction, and has been linked to tumors in humans. Perchlorate is regulated under the Safe Drinking Water Act (2011). Massachusetts and California have established standards for drinking water of 2 μg/L and 6 μg/L respectively. Determination of perchlorate in environmental samples has also gained the attention of the International Standards Organization (ISO). U.S. EPA Method 332.0 — Ion Chromatography with Suppressed Conductivity and Electrospray Ionization/Mass Spectrometry is one of the most sensitive and robust characterization methods available for perchlorate determination (MS) providing detection limits in high-ionic-strength matrices as well as conductivity detection alone. These low detection limits are achieved without sample preparation. Our study updates the IC-MS method published in U.S. EPA Method 332.0 for determination of perchlorate in environmental waters. The method uses a Thermo Scientific™ Dionex™ IonPac™ AS20 column set, on a recently introduced compact IC system coupled with a recently introduced single-adaptor Hydrophilic Interaction Liquid Chromatography (HILIC) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L2 J−1 for cocaine.

**MO279** NEW OPPORTUNITIES FOR THE NON TARGETED ANALYSIS OF ENVIRONMENTAL CONTAMINANTS USING GAS CHROMATOGRAPHY- ORBITRAP MASS SPECTROMETRY.
P. Silcock, Thermo Fisher Scientific / GC-MS; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

Since the middle of the 20th century GC-MS has made a long journey towards its current status as 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 this technology can be used to provide a new approach to routine environmental analysis. Primary applications to be highlighted are the discovery of new disinfection by-products (DBPs) resulting from water treatment processes, using a non targeted approach, as well as the potential for addressing the difficult analytical challenges for a complex class of emerging persistent organic pollutants: short chain chlorinated paraffins (SCCPs).

**MO280** HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters.
S. Veloutsou, Technical University of Munich; S. Bieger, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich / Chair of Urban Water Systems Engineering

Trace Organic compounds (ToOCs) in water can be biogenic or anthropogenic. These compounds can range a lot in terms of polarity. Reverse Phase Liquid Chromatography (RPLC) is the most common and widely used tool for the separation of non-polar and mildly polar compounds. However, for the separation of very polar compounds, techniques like the Hydrophilic Interaction Liquid Chromatography (HILIC) are needed. HILIC has been established since years as an analytical tool, capable to separate effectively very polar molecules. Using a serial RPLC-HILIC system coupled with ToF-MS the analytical screening of samples comprised of solutes with variability in structure and polarity can be achieved. Full-spectrum acquisitions in non-target screening approaches are producing large datasets with the detected features of the samples. 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) a 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 24-hour 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 in STOFF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine very polar compounds, of which six have not been reported previously in water surface samples.

MO281 Analysis of Per/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements
T. Anamol, L. Toelgyesi, T. Sosienski, Agilent Technologies GmbH / UFZ; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research - UFZ, Potsdam, Germany

Although the dwHA values are non-sensitive, in 2015 the USEPA announced an ag.

 Employing this methodology has shown improved detection and analysis of compounds. In this study, various solid phase extraction techniques have been employed focussing on isolating benzodiazepines in wastewater matrices.

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; Y. S. Somerset, CPUT / Chemistry

Per/polyfluoroalkyl substances (PFASs) are organic molecules that have a C-F bonds 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 published public health guidelines in drinking water for two PFASs, namely perfluorooctane sulfonate (PFOS) 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 (PFASs), sulfonamides (FOSA), sulfonamide acetic acids (FOSAs) and others were separated on a liquid chromatograph (LC) using a reversed phase C18 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. Moreover, high detection limits were shown for several different PFASs and PFOA at concentrations as low as 70 ng/L. This LC/MS/MS method with 12 MCs that meets the EPA’s quality assurance/quality control (QA/QC) criteria. MC concentrations were measured in samples from freshwater lakes and drinking water. Sample 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 detection curves from 0.5 – 5000 ppt 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 untargeted analysis needs to be considered.

Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS-based method for screening of non-targeted chemicals of potential concern in northern pike
L. Tian, McGill University; J. Reinling, Université du Québec à Montréal / Département 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 relevant signal 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
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Per/polyfluoroalkyl substances (PFASs) are organic molecules that have a C-F bonds 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.

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Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.
Annotation. These sulfur-containing compounds could be identified as various derivatives of naphthalene sulfonic acids and have to be considered as a site-specific contaminants, as they were not present at any other sampling site. Thus, the proposed approach is suitable to rapidly characterize surface water samples and allows for a prioritization of sites or compound groups for further in-depth studies.

MO286
Analysis of Phenanthrene Transformation Products Using High-Resolution Mass Spectrometry Coupled to High-Performance Liquid Chromatography
M. Leonard, Oregon State University / Environmental & Molecular Toxicology; J. Schrlau, Oregon State University / Environmental and Molecular Toxicology; S.L. Monterey Simonic, 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 provided a more complete picture of PAH TPs in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C18, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxypheanthrene (OH-Ph) isomers. Baseline resolution of 2-, 4-, and 9-OH-Ph was achieved with the C18 and phenyl-hexyl columns using a gradient of water in 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-Ph 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 biologic and physico-chemical processes. Data analysis 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 toxicological challenge of identifying TPs, which occur in concentrations occurring 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 carbamazepine, clofibric acid and metolachlor during the rapid sand filtration and ozonation, two readily applied technologies. Further investigation will determine whether the florao-phenyl column is suitable for separation of OH-Ph isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

MO290
Removing the potential of a partial nitritation/anammox biomass towards micropollutants biodegradation
In the past few years, anammox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of 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 conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitritation), iii) aerobic with acetate (optimal for heterotrophic bacteria), iv) anoxic with acetate (optimal for nitritation/anaerobic ammonium oxidation bacteria), v) anoxic with acetate (optimal for heterotrophic denitrification). 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.
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 0.08 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the influent 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, atrazine and isoxaben removal was attributed to co-metabolism (enhanced acetate). Metoprolol, ipomeolan, diclofenac, propanolol and sulfamethazine removal were reduced 1) at lower acetate concentrations by co-metabolic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed independently on acetate addition, which could be converted as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioreactor’s performance.

MO291
Investigating inhibitory effect of anti-inflammatory pharmaceuticals on activated sludge
M. GREEN, E. Topuz, G. Yuksek, E. Ubay Çokgör, D. Okutman-Tas, Istanbul Technical University / Environmental Engineering
The consumption of pharmaceuticals increases 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 is mainly performed in index and inventories. Since there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale full-scale 10 L aerobic sludge reactor (sludge age of 5 days: @22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in Istanbul. The culture was fed daily with a synthetic wastewater (ISO 8192) (600 mg COD/L) and 200 mg nitrate/L and 20 mg nitrite/L. To assess acute inhibitory effects, three micropollutants respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75 g/L of each: Naproxen, Diclofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and AQUASIM 2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10 g/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75 g/L) there was an increase in the initial substrate consumption rate and decrease in the OUR curve. A removal efficiency in the range of 33-55% was observed for tested pharmaceuticals at the end of the respirometric assays. Measurements showed that pharmaceuticals were not accumulated in sludge phase (< 0.2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD (kh1) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50 g/L. When the concentration of PMx increased from 10 to 50 g/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75 g/L PMx result in differentiation in organic matter structure which caused a change in the carbon and oxygen linkages. A new carbon source type has been observed as a result of hydrolysable COD (S0). The results of this study will help to clarify toxic effects of micropollutants on microbial systems as well as provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEIBIP Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.

MO292
Elimination of tramadol and methadone in model ozonation experiments: removal kinetics and identification of transformation products
P. Kostanjsević, Rudjer Boskovsk Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. Matosic, Faculty for Food Technology and Biotechnology; M. Abel, S. Terzic, Rudjer Boskovsk Institute;
Since the conventional wastewater treatment has proven to be ineffective for a number of pharmaceutical compounds, 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 membrane process, have been developed in order to decrease the concentration levels and/or to minimize the possible overall ecotoxicity of the effluents. Therefore, the aim of this work was to examine the removal of two opioid angesics, tramadol and methadone, using ozonation. The experiments were performed in three different matrices, including pure water, phosphate buffer and secondary effluent from the Central wastewater treatment plant of the city of Zagreb. The removal rates of both angesics was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed by ultra-performance liquid chromatography/ quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two major transformation products characterized by molecular ions at 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.

MO293
Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water
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Potable reuse of wastewater is becoming more common as populations increase and fresh water resources become more scarce. Producing safe drinking water from treated wastewater is challenging due to the presence of contaminants that are not removed during conventional wastewater treatment. 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 toxicity, persistence through wastewater treatment, and environmental water concentrations. This project is investigating the removal and/or transformation of 21 of these priority ECs through UV/CH2O, 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 (a homologue of the aromatic chemical AOTs) that are used in potable reuse treatments. These contaminants can be removed in various treatment plants, but removal efficiencies vary. Microfiltration/UV systems have been used as post-treatment for advanced wastewater treatment systems. The objective of this work was to study what combination of technologies would be needed to produce water suitable for direct potable reuse. Results from this project will be used to identify treatment combinations that can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioreactor’s performance.

MO229
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 important from a view of large-scale pollution caused by agricultural, domestic and industrial 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 implemented with chitosan to form bimetallic iron-silver nanoparticles (CS/FeAgNPs) 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 reuse while implementing—efficient and affordable strategies for IPR—are needed to minimize impacts from a broad range of contaminants of environmental concern (CECs) and to preserve ecosystem services and human health. The project FRAME (A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse) is funded by the European research initiative “Water JPI (Joint Programming Initiative, Water Challenges for a Changing World).” Principal objectives: (i) to evaluate treatment processes with combined analytical, toxicological and microbiological approaches; (ii) to evaluate advanced treatment options in a multiple barrier approach to remove CECS and inactivation of pathogens; (iii) to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECS; (iv) to provide a decision support tool for stakeholders, considering process performance and feasibility assessment for treatment scenarios. Advanced treatment options are applied in a multiple-barrier 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) from complex biological processes. Multi-residue analysis methods were developed for sensitive analysis of 176 CECS, including 12 PFAS. The majority of quantitation limits are in the range of 0.5 ng/L to 50 ng/L. Sorption of charged CECS onto Fe-oxides and other minerals was simulated with the goal to create a sorption model for complex soil compositions. Treatment process models using kinetic modelling of CEC and pathogen inactivation were developed for integration into a decision support system for stakeholders. Results at laboratory and full-scale showed that a sequential biofilter 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
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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 for drinking 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 their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by local populace in Owerri (Metal drum tank, Concrete underground tank, PVC tank and coated basin for rainwater). The physicochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with trace metals in 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 physicochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes. Keywords: Harvested Rainwater, microbiological analysis, physicochemical analysis, storage facilities, trace metals

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health
C. Allen, L. Jones, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; R.U. Halden, Arizona State University / Biodesign Center for Environmental Security; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute
Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 213M kg of phthalates are produced globally each year with end use products including food packaging, coatings, paints, tubing and medical devices. Due to their high production volume and continuous release, phthalates are emerging contaminants ubiquitously in the environment. Research has shown that the widespread exposure to these chemicals has been associated with numerous adverse health effects including impaired reproductive health in males, decreased neurological development in children, cancer and obesity. As a result, some phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys). As new research emerges indicating that substitute plasticizers also contribute to adverse health effects, these restrictions are likely to increase. The present project constitutes the first application of sewage epidemiology to determine phthalate exposure in an Irish population. Phthalate levels in influent, effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC/MS analysis, tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in influent to assess phthalate exposure. A meta-analysis on health risk data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. Results will inform on the feasibility of using sewage biomarkers for future compliance monitoring. Metabolites from the following phthalates are considered in this project: benzylbutyl phthalate (BBP), diisononyl phthalate (DINP), diisodecyl phthalate (DIDP), and diocetylphthalate (DOP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assaying the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

MO299 Phthalates and their metabolites in the environment
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Phthalates, or phthalate esters, are esters of phthalic acid, and their chemical structure consists of one benzene ring and two ester functional groups linked with two consecutive carbons on the ring. These compounds are stable, liquid in ambient temperature, while the density of higher molecular weight phthalates is slightly soluble in water. They are a group of synthetic organic chemicals that are used as additives, or plasticizers, to enhance the flexibility, transparency, stability, longevity, and durability of plastic materials and as non-plasticisers in consumer products. They are most commonly used as plasticisers in polyvinyl chloride (PVC) and phthalates have been used in the plastics industry for more than 80 years. As phthalates are so commonly used, their impact on the environment and human health has been extensively studied. Phthalates have been found to be recalcitrant, ubiquitous within the environment, and in many cases, detrimental to human and animal health. This project represents an important collaboration between three research centres (DCU, ASU, & NIVA) with support from Irish Water, Panda and Friends Co., to assess the potential sources and environmental fates of priority phthalates in Ireland. This project is supported by several by studies carried out in Ireland already (DCU) and a vast array of literature in the area of priority pollutant monitoring. The impact of such study would be the analysis of these eleven phthalates from source to fate, in order to inform environmental policy on the risks posed by phthalate usage. The phthalates included in this study are Diethylhexylphthalate (DEHP), Dibutylphthalate (DBP), Diisooctylphthalate (DOP), Diisodecylphthalate (DIDP), Di-2-ethylhexylphthalate (DEHP), Dihexylphthalate (DHP), Diisobutylphthalate (DIBP), Di-n-octylphthalate (DONP), Disononylphthalate (DNP), and Dimethyl phthalate (DMP). A selection of phthalate monoesters has also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, and while phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers may also contribute to deleterious health effects. This research is timely as the
extent of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300 Poly- and perfluoroalkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluoroalkyl acids

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This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFASs) found in wastewater in a French city (Bordeaux, Metropolis). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted both by industrial and commercial activities were collected within the sewage network upstream typical and representative treatment plants; in addition 4 samples of runoff waters were also targeted in order to explore the input of this type of potential source. PFASs were also analyzed in the influents, the effluents, and the sludges of the 4 main wastewater treatment plants (WWTP) of Bordeaux Metropolis to quantify global inputs to the natural aquatic environment. The results highlight distinct patterns and levels of contamination between different types of samples and potential sources. Overall, wastewaters impacted by industrial inputs have the highest levels (ΣPFAS = 4.6-501.7 ng.L⁻¹) with the predominance of PFOS, PFHxS, C₆-C₁₂ PFCA and 6:2 FTSAs. High levels of 8:2 and 10:2 FTSAs (>10 ng.L⁻¹) were found in wastewaters from the harbor area and a major industrial area. Domestic wastewaters have the highest levels of 6:2 diPAP (median concentration of 4.5 ng.L⁻¹), probably related to its use in food packaging. Concerning runoff waters, the highest levels are found in the airport area with ΣPFAS of 227 ng.L⁻¹. The comparison of the profiles with those found for WWTP influents using a principal component analysis made it possible to highlight the importance of the industrial and commercial discharges on the global contribution to WWTPs. It has been possible to quantify global fluxes of PFASs to the four WWTPs and they were estimated at about 14 g.d⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only the C₆-C₁₂ PFCA, the PFOS and their precursors with more than 8 perfluorinated carbons were shown to be partially or totally removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoroalkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Slednick (2012) was applied to each of the matrices. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₁₂ PFCA 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 pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds in wastewaters and in receiving water bodies. The aim of this study was to quantify and identify different classes of contaminants in wastewater and in receiving waters in order to 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, and 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 and CPC and CTAB as well as other compounds such as chlorhexidine, benzotriazole, ciprofloxacin and fluconazole. QACs and chlorhexidine were not detected at concentrations below 60 ng.L⁻¹ but the majority remained in the digested sludge. The total yearly loads in the treated effluent in three studied plants was 29.4 kg and 2900 kg in the digested sludge. For more polar compounds such as trimethoprim and fluconazole, almost half of the amount found in the incoming sewage water was found in the treated effluent. To our knowledge this is the first detailed mass balance study for CPC and chlorhexidine reported. The study provides not only new scientific evidence but also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO302 Herbicides and fungicides in watersheds of agricultural regions of Ontario

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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 herbicides and herbicides in 5 major rivers and 13 smaller streams within regions of intense agriculture in southern Ontario, Canada. The Polar Organic Chemical Integrative Sampler (POCIS) was selected as a principal monitoring technique, although grab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling 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). Inorganic nitrogen and phosphorus were analyzed by ion chromatography 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 oxozaxystrobin (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 crop 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.

MO303 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 particulate suspended solids of 125.0 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
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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 total of 38 of their metabolites were detected in particulate suspended solids within the Turia River. Suspended solids were collected throughout the year (April 2012 and 2013) from sampling sites that are distributed along the river. The analysis of the target illicit drugs was performed using solid phase extraction and liquid chromatography coupled mass spectrometry (SPE-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 assessment of drug abuse distribution was performed through calculation of toxicity ratios. The results show that the levels of biomarker in the river are below the established limits. In order to assess long term toxicity, further studies are also needed in order to assess long term toxicity.

**MO308**
Occurrence, fate and environmental risk assessment of benzophenone-type UV filters in a tropical urban watershed
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A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic products that are exposed to sunlight. Following use, BPs can enter ambient environments directly via septic tanks, indirectly from sewage discharges. Numerous studies have been conducted to detect the occurrence of BPs in the aquatic environments. However, the occurrence and fate of BPs in tropical waters remains poorly understood. In this study, occurrence and fate of seven BP-type UV filters (i.e., 2,4-dihydroxybenzophenone (BP-1), 2,2'-4',4'-tetrahydroxybenzophenone (BP-2), 2-hydroxy-4-methoxybenzophenone (BP-3), 2,2'-dihydroxy-4,4’-dimethoxybenzophenone (BP-6), 2,2'-dihydroxy-4,4'-dimethoxybenzophenone (BP-8), 4-hydroxybenzophenone (4OH-BP) and 4,4'-dihydroxybenzophenone (4DHB)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L\(^{-1}\) in dissolved phase and < LOQ to 2774 ng L\(^{-1}\) in solid phases. Suspended solids in the water column contained significantly higher amount of BPs than sediments, while the concentration difference between bulk water and pore water was insignificant. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at estimating the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.

**MO309**
Formation of disinfection byproducts through various drinking water treatment processes
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This study investigates the formation of disinfection byproducts (DBPs) throughout the treatment processes operating in the various drinking water treatment and desalination plants and distribution system that supply drinking water to more than 4.5 M inhabitants living in the city of Barcelona and its metropolitan area. For this, DBP formation potential tests with chlorine were performed with the water entering each plant and produced after the individual processes carried out in each plant to treat the water. DBP mixtures were generated for each investigated matrix at two different temperatures (15°C and 25°C) and reaction times (0, 24 h, and 48 h, and also 72 h in the plant effluent) so that different scenarios in the drinking water distribution network were simulated. Six different DBP classes in total were investigated in the DBP mixtures generated by means of gas chromatography coupled to mass spectrometry detection. The list included the regulated (Halogenated methanes (4TMs), Halogenated dimethanes (4DMs), Halogenated trimethanes (3TMs), Halogenated tetramethanes (2TMs)), unregulated and unreported (Mono-, Bi- and Trimethoxybenzophenone (M1BPs, B2BPs, T3BPs), Mono-, Bi- and Trimethoxybenzophenone (M1BPs, B2BPs, T3BPs)), halogenated esters (HACEs), HAHs, and halocarbons (HACs), as well as their metabolites. Overall it could be concluded that the potential of the water entering the plants to form all investigated DBPs decreased throughout the treatment process, due to the removal of DBP precursors in the different treatment steps. The work performed contributed to evaluate the risk associated with changes in the water treatment process and prevent population exposure to DBPs in the event of scenarios that may alter the good performance of the whole process. Acknowledgments: C.P. acknowledges support from the Secretary for Universities and Research of the Ministry of Economy and Knowledge of the Government of Catalonia and the COFUND Programme of the Marie Curie Actions of the EU's FP7 (2014 BP_800064). 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-nitosodimethylamine during water treatment for potable use: an update
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Nitrosamines can form in water in specific conditions. N-nitosodimethylamine (NDMA) could be formed in the drinking water treatment in the presence of primary amines (methylamine, dimethylamine) and halogenated methanes (4TMs), but not all can be present in significant amounts in the source 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 methylamine or dimethylamine and halogenated methanes to form nitrosamines, with the formation of typical secondary amine precursors; b) chloramination of nitrogen in the presence of nitrosamine precursors; c) catalytic formation on activated carbon, from secondary amines; d) UV or sunlight photolysis of nitrosamines. 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 coagulation polymers and some anion exchange resins constitute the main source of NDMA precursors. Although NDMA is the most prevalent nitrosamine detected, according to the surveys conducted until now, it may account for only a minor fraction of all nitrosamines formed during chloramination. More research is required in order to establish ways to avoid NDMA and other nitrosamines formation.

**MO311**
Presence and environmental hazard of psychoactive pharmaceutical compounds in coastal waters and biota from North-Western Spain
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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 (PPAs) in coastal waters and marine biota (Spáčil et al. 2018) has increased. Our work represents the first attempt at monitoring these compounds in the Rias Baixas area (North Western Spain). This area was chosen as the location for this study due to its economic and ecological importance as a national and global leader in shellfish (especially mussels) production. In this study, the presence of 16 PAs (benzodiazepines and anxiolytics) was studied in samples of sea water and tissue from 7 economically valuable and highly consumed marine species. Samples were collected from 22 sites along the three main Rias Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citalopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citalopram (92.50 ng/L). Only 3 PAs (alprazolam, citalopram and venlafaxine) were present in the collected biota samples (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 and AMPA were 1.8 µg/L 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 samples coming from diverse areas purchased in local markets has shown little variability. This biological aim was to investigate the occurrence of glyphosate and AMPA levels in biological tissues and then to determine the contamination of an freshwater fish, the European chub (Squalius cephalus) by glyphosate and AMPA. Fish were fished 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 directly from the gallbladder and transferred to 13C-AS-1 cartridges added before extraction with multiQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMC-OI) 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.

Determination of glyphosate and AMPA in fish bile from the Marne River, France H. Blanchoud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Goutte, UMR METIS EPHE 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) by glyphosate and AMPA. Fish were fished 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 directly from the gallbladder and transferred to 13C-AS-1 cartridges added before extraction with multiQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMC-OI) 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.

Detection of glyphosate and AMPA in fish bile from the Marne River, France

Psychoactive compounds in mussels: analytical method development and occurrence assessment E.L. García, IDAEA-CSIC / Department for Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Earth and Water Research IDAEA-CSIC / Department of Environmental Chemistry It is well stabilised 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 evaluate the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

Psychoactive compounds in mussels: analytical method development and occurrence assessment

M3014 New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)


MPHunter: a dedicated software for mFTIR-Imaging Microplastic data analysis. First development steps and future perspectives
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 calculated correlation coefficients between selected spectra and the library 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 accessing the boundaries. Potential MP can then be marked, measured (main axes, area) and saved. MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpke et al. (2017) and use it as the searching engine.

MO316
From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany
Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently used by the JPI Oceanic Futures Base Study (JPI-Oceans). 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
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The detection of microplastic particles in an environment sample in the wide range from 1 µm to 5 mm nearly quantitatively in a reasonable time is a challenging matter. This task is complicated with well-defined sampling procedures and sampling locations. Next task is the sample preparation procedure to remove organic and inorganic parts in such a manner, that the microplastic particles will not be destroyed. A further important point is the subsequent loss free transport to an analytical lab and the use of blind samples from the sampling location through all steps until the lab. Starting from this point our poster describes the following principal steps to identify microparticles by the mentioned methods in environment samples. All operations and analyses are performed in dust-free rooms in flow boxes and all equipment is plastic-free. First procedure is a three-step vacuum filtration to divide the particles in four fractions, above 500 µm, from 500 to 50 µm, from 50 to 10 µm and below 10 µm. After filtration the particles of the different fractions are on silicon filters made from wafers which are IR transparent. Now 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 manually with 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 range, 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. Storeseth, L. Sorensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, Norwegian University of Science and Technology; O. Brakstad, A. Booth, SINTEF Ocean / Environmental Technology
Pyrolysis gas chromatography coupled to mass spectrometry (pyGC-MS) is a promising tool for identifying and quantifying trace amounts of microplastic (MP) in environmental samples. For pristine plastic samples, it has been demonstrated that polymer type and additive chemicals can be elucidated from the obtained pyrograms and their underlying mass spectra. However, the approach requires manual interpretation of the data, which requires a high level of competence and is time-consuming. Pyrograms obtained from environmental samples are typically complicated by the presence of naturally occurring organic compounds and the presence of multiple polymer types. Furthermore, weathering processes such as oxidation and biodegradation may alter the chemical composition of the polymers, especially at the surface. In the current study, 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 chromatoographic 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 and composition. This is particularly the case 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 (≤3 mm) for use in fate and effects studies. Weathered marine plastic litter (351 items) was collected from the coast of the island of Texel (The Netherlands) and carefully identified and categorised (fibre-based, packaging, foam, plastic boxes andJerry cans, bottles, gloves and miscellaneous) prior to sampling for mass and particle size analysis. The materials were ground and sieved 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 microplastics was performed by different techniques: particle size measurement, light scattering and imaging. The particle size analysis revealed that 68% (by mass) of the particles were in the range between 0.5 and 2.0 mm. Particle number increased with decreasing particle size fraction. Scanning electron microscopy revealed a wide range of particle sizes and shapes reflecting the properties of the different polymers. ICP-MS and ICP-OES analyses revealed the presence of a broad range of metals and other elements (e.g. Al, Cr, Fe, Mg, Pb, S and Zn) associated with the final sample. Many of these represent common inorganic plastic additives used as colourants, fillers and stabilisers. The additive organic chemical profile of the microplastic mixture was also determined by GC-MS following extraction by ethyl acetate and ultrasonication. A broad
MO320
Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by stereoscopic and confocal microscopy.

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A non-complex procedure has been developed for preparing HDPE microplastics as standard for microplastic determination in sediments. Always keeping enough plastic in microplastics to prevent collapse, bottle caps from several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). With this procedure, 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 in the standard. To prepare two different standards, 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, 4x lens, using a mesh for counting with sections of 3x3 mm prepared for this study) and, confocal microscopy (Zeta Instruments, model Zeta 300). The last one, included object detection algorithms (Mathematica 10) which not only allows quantification of plastic particles but also their classification into size groups.

MO321
First Report of Microplastics in Pacific-side Arctic Ocean

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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/m^2) and can be transported by wind and ocean currents. Previous research on the Arctic has concentrated on the waters associated with the Atlantic Ocean (for example, the Barent Sea), while the Arctic (e.g., the Chukchi sea, East Siberian sea, etc.) linked to the Bering strait has never been studied. To do this, we purchased and analyzed the sea salt samples sold in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) in four continents. Each salt sample was selected in different parts of the country. Total 37 salt samples were analyzed, including sea salt, lake salt, rock salt. As salt is an essential human/animal food-item, microplastic contamination in salt has been studied (e.g., in China, USA). Additionally, sea salt, which is produced through the evaporation of seawater, can represent the degree of contamination of microplastic remaining in seawaters. This indicates that sea-salt may be a monitoring media for global seawater contamination of microplastics. The purposes of this study are 1) to identify the contamination of microplastics in commercial table salt products sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and seawater, and 3) to calculate the human exposure of microplastics resulting from the consumption of commercially available salt products. To do this, we purchased and analyzed the salt samples in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) in four continents. Each salt sample was selected in consideration of the salt production area, production method, and salt consumption patterns. Total 37 salt samples were analyzed, including sea salt, lake salt, and rock salt. Each sample was duplicated (n = 2) and two blank samples were analyzed for each batch to check contamination during the analysis. Size, color, polymer, and shape of each microplastic were determined under microscopic and spectroscopic analysis (FTIR). Thousands of microplastics were detected per 1 kg of the salt samples of this study, and the predominant forms were fragment and fiber, which were frequently detected in the order of PP > PE > PET. Significant correlation was observed between microplastic discharge rate via the rivers near the sea-salt production and microplastic contamination in the sea-salt. After further analysis, human exposure, characteristics of microplastic distribution, and application of sea-salt as an alternative monitoring medium will be announced.

MO322
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 yet crucial to determine their persistence and potential risks associated to their exposure. In this study, we assessed the biodegradability of car tire rubber (90-125 µm) under controlled laboratory-scale conditions. Standardized batch tests (OECD 301 and ISO 14851) were used to determine complete mineralization under
aerobic conditions of pristine and UV-weathered tire rubber in the presence of three different microbial inocula, i.e. activated sludge, soil particles and soil supernatant. Acetate and poly(D,L-lactide-co-glycolide) (PLGA) were used as positive controls in terms of readily degradable substrate and degradable plastic material, respectively. Pristine and weathered rubber exhibited low but measurable biodegradation levels in the presence of activated sludge (3.8–7.6% THOD) and acetate, but none when soil was added to the medium. We also conducted experiments without 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 final biomass produced was negligible. No noticeable effect 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.

**MO325**

Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (pplFER)

M. Wehrhan, University of Vienna / Environmental Geosciences; T. Hüffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences

Tire materials are common representatives of microplastics found 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 crumb 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 vulcanizing chemicals (e.g., zinc oxide and sulphur (1–2 %)).4 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 as fillers in construction material or as recycled rubber in rubber-based composites.5 The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (ppLEERs) provide the opportunity to describe the contributions of individual molecular interactions to overall sorption processes taking into account both the physico-chemical properties of the sorbate as well as the sorbent.7 They have been successfully used to describe and predict sorption of organic compounds to various sorbents.8 This work hence intends to investigate sorption properties of tire crumb rubber using poly-parameter linear-free energy relationships. [1] B. Liebmann, Mikroplastik in der Umwelt. 2015. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo. Sci. Total Environ. 2009, 407, 2183. [3] C. Lavoie, 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-Noile, 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.

**MO326**

Particle toxicity in the dagga blade grass shrimp (Palaeomunida pugio): micronized tire wear particles and microplastics


For our TWP assays, we conducted a 96-hour acute toxicity test and an immune challenge test. The aim of the present study was to investigate the toxicity of well-prefared TWP in adult grass shrimp (P. pugio) and compare it to that of other microplastic particles. For our TWP assays, we conducted a 96-hour acute toxicity test and an immune challenge. Acute mortality was not observed at concentrations up to 100 g/L (1.9x1017 particles/L). In our immune challenge, grass shrimp were exposed to TWP, polypropylene fragments, polystyrene spheres, polyester fibers, or sediment for 96-hours. Grass shrimp were then injected with either HEPEs-buffered saline or VHS (10 µg/ml, 10% CPM) (shrimp). After 48-hours, no significant decrease in immune function was observed in exposed shrimp (p=0.8). We also conducted assays examining the size and shape dependent effects of microplastic particles (spheres, fibers and fragments), including TWP, on grass shrimp. Grass shrimp were initially exposed to various size fractions of plastic spheres (30, 35, 59, 75, 83, 116, and 165 µm), fragments (34 and 93 µm), fibers (34 and 93 µm), and TWP (50, 106, and 302 µm) at a concentration of 50,000 particles/L for three hours. Following exposure, grass shrimp were placed in particle-free water and monitored for survival, ingested and ventilated particles, and residence time in the gills and gut. Grass shrimp readily ingested and ventilated all tested particles. The time for microplastics to be cleared from the shrimp gut was measured and ranged from 43±4.8 hours at 43±4.8 hours. Gut clearance for the TWP was 25.2±3.0 hours. Within the gill chambers the time for microplastics to be removed ranged from 27–45 hours with an average of 36.9±5.4 hours. Gill clearance for TWP was significantly longer at 25±12.2 hours. Mortality in these assays ranged from 0–55%, with microplastic spheres and fragments under 50 µm not acutely toxic. All sizes of TWP were not acutely toxic. Fibers were acutely toxic at both size fractions tested (34 and 93 µm) with mortalities of 55 and 35%, respectively. Results from the present study suggest that well prepared TWP are less acutely toxic than that of other synthetic particles, especially fibers.

**MO327**

Acute and chronic toxicity of micronized tire rubber to Hyalella azteca

F. Khan, L.L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment

An average car tire lasts for 40000 km and during its life time 30% of the tire tread will emitted into the aquatic environment. Inevitably it interacts with aquatic biota. In comparison to the wealth of research on the impacts of microplastics (MPs), there is little on micronized tire rubber (microrubber, MR). Recent reports have suggested that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHs), phthalates and diverse volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aqueous environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceive 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 (342±172 particles/mL for MR and 362±872 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 dissimilar to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

**MO328**

Acute and chronic effects on Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine micronized car tire to previous data on worn car tire particles


In comparison to the wealth of research on the impacts of microplastics (MPs), there is little on micronized tire rubber (microrubber, MR). Recent reports have suggested that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHs), phthalates and diverse volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aqueous environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceive 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 (342±172 particles/mL for MR and 362±872 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 dissimilar to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

**MO329**

Applying nuclear techniques to study the biokinetics and toxicodynamics of...
microplastics and co-contaminants in marine biota

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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 nanoparticles on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters overtime. As such, these tools will allow us to address important knowledge gaps, including the (1) the biokinetics, biotransformations and on 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 vehicle for contaminants transport in the marine environment under low irradiation exposures. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO330

Aggregation kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media

A. Lusher, EPIC, University of Bordeaux / UMR EPOC 5805; J. Gigault, University of Rennes 1 / Laboratoire Geosciences Rennes; M. Baudrion, Université Bordeaux 1 / UMR EPOC 5805

Release of plastics debris in the environment has been catching more and more concern in recent years, particularly in aquatic environment. It has been observed recently, that plastics break down to produce nanoparticles by photochemical degradation in marine waters. However, there is a lack of suitable analytical tools, and the environmental fate and transport mechanisms of nanoparticles have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous medium, whereas (1) the biokinetics, biotransformations and on their biological aggregates 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 vehicle for contaminants transport in the marine environment under low irradiation exposures. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

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 as single cells. Besides their involvement in several biogeochemical processes, biofilms are sites of accumulation and transformations of mercury (Hg). Their natural assemblage of heterotroph and autotroph microorganisms makes them an important entry of Hg into aquatic food webs. The objective of the present study is thus to better understand the mechanistic processes that control Hg accumulation in biofilms and we focused on the elucidation of the role of biofilm composition on the kinetics of Hg uptake. For that end, two couples of biofilms were exposed to IHg (~ 100 PM, precisely measured) using microcosms. The first couple of biofilms was obtained using different times of colonisation e.g. 85 and 127 days whereas the second couple (bottom/surface biofilms) was obtained after a different colonisation depth in the Versoix River (CH). Prior Hg exposure, biofilm biomass and microbial composition (chlorophyll content and abundance of 16S rRNA gene) were determined as well as EPS total P content. The main water quality parameters (pH, concentrations of dissolved organic carbon, Hg, anion and cation) of the exposure media were also analysed. Accumulation of total Hg and non-extractable Hg (determined after a 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 IHg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the younger biofilm was measured to be 10 times higher than that of the older biofilm. That same ratio was also obtained between the bottom and the surface biofilms. Except for the older biofilm, Hg accumulation reached a plateau at ~6 Hg exposure. A decrease in the EPS thiol concentration was observed in the bottom biofilm upon Hg exposure, suggesting a change in Hg bioavailability in the microorganism environment living in that biofilm. Our study demonstrated that biofilm microbial and EPS composition as well as thickness influence Hg uptake by microorganisms living in biofilms.

MO334

Gaseous elemental mercury concentration and diurnal evasional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea

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Among pollutants widespread in the environment, mercury (Hg) is specifically recognised for its toxicity, mobility and bioaccumulation potential. In coastal areas, the presence of this element generates conficts with important resources of valuable nature such as fisheries and aquaculture. The Marano and Grado Lagoon (Adriatic Sea) experienced a double Hg impact. The first is due to the mining activity conducted at Idrija (western Slovenia) for approximately 500 years, whereas the second is the result of discharge of a chlor-alkali plant effluents. Fish farming is a

SETAC Europe 28th Annual Meeting Abstract Book
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 continuous in situ mercury concentration monitoring coupled with a routine chemicallysorbed atomic absorption spectrophotometry (Lumes-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 uncontaminated area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these measurements, the background level of chemicallysorbed Hg concentrations 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 A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IAI); F. Sprovieri, A. Macagnano, E. Zampetti, P. Papa, G. Esposito, CNR - Institute of Atmospheric Pollution Research Italy; P. Nicola, Institute of Atmospheric Pollution Research (In-APRI) of Athens is aiming to support the policy process in relation to the Minamata Convention implementation. 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 2013. 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 capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

MO336 Assessment of Hg impacts on mountain river ecosystems S. Le Faucheur, Institute F.-A. Forel, University of Geneva / Département F.-A. Forel des sciences de l'environnement et de l'eau; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; C. Monicouert, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Boulellant, 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 anal 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 (GOSM)”. Therefore, CNR-IAI and WHO has 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 capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

MO339 Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure E. Junqué, Institute of Environmental Assessment and Water Research (IDAÉA-CSIC); M. Gari, IDAÉA-CSIC / Environmental Chemistry; R. Llull, General Direction of Public Health and Consumption; J. Grimalt, Institute of Environmental Assessment and Water Research IDAÉA CSIC / Department of Environmental Chemistry

Organochlorine compounds (OCs) and mercury (Hg) have diverse deleterious health effects and are persistent in the environment. They tend to bioaccumulate and biomagnify along the food chain. Diet is the major source for the incorporation of these pollutants into humans, especially trough 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 for by the European Union MRL for human consumption. The concentrations of OCs and Hg between trophic levels have been compared. Except for HeCB, the values were higher in the upper trophic level with statistically significant differences for ΣDDTs and ZPCBs (p < 0.05). The relationship between fish weight and pollutant concentrations were also studied. A positive relation between Hg concentrations and weight was found (R²=0.58; p-value< 0.001). This trend was not observed for any other OC. The concentrations found in dusky grouper from the Mediterranean Sea and Atlantic Ocean were also compared. The former group presented higher levels for ΣDDTs, ZPCBs and Hg (p < 0.05). The estimated weekly intake of OCs were well below the reported Tolerable Intakes. However, for Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the provisional tolerable weekly intake (PTWI) of 0.3 µg/kg bw set by EFSA in 2012. 4 µg/kg bw. The equivalent estimations for MeHg, involving provisional tolerable weekly intakes of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intakes in adults and children (7-12 years of age), respectively.


Fish consumption is linked to the prevention of some human diseases, especially cardiovascular and attherosclerotic disorders, due to the content of high-quality protein, vitamins and n-3 fatty acids. At the same time, fish consumption is considered a major pathway of mercury (Hg) exposure in human. More than 90% of this Hg present in fish tissue is found essentially in its organic form (methylmercury (MeHg)), which is the most toxic form of Hg. Due to the potential adverse human health effects, international agencies have established Reference doses (RDi) as recommendations to Hg intake. Some studies have been associating the fish consumption with the Hg bioaccumulation, in areas along the Mid-Atlantic Ridge (MAR) exposed to active hydrothermal fields. The Azores archipelago is located in the North Atlantic Ocean close to the MAR. The last fishery statistics for fish consumption per capita in the Azores archipelago shows that, each Azorean consume about 80 kg of fish per year being the region with the highest consumption of fishery products in Portugal. This study is the result of a review of all published articles indexed in Web of Science that presented Hg concentration in the muscle for fish species captured in the Azorean Exclusive Economic Zone, and additional new data from fish obtained by recreational fish. The selection of species was based on the fish landing reports (1994-2015) of Azores Fisheries Statistics (SIDAF). The total number of samples from all the Azorean ports, at about 10 000 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 Morus moro exhibit higher values than the permitted for fish consumption and carranovíes fish species generally exhibit higher concentration of Hg than omnívores fish species. On the other hand, demersal fish species demonstrated higher Hg concentration than pelagic fish species. Finally, the target hazard quotient (THQ) is ≤ 1 for all fish species, meaning that the level of exposure is lower than the reference dose, and indicating that the daily exposure is not likely to cause any negative health effects during a lifetime in the human population.

MO341 Mercury concentrations in black from the Gippsland Lakes, Victoria, Australia. L. M. DEFalco, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudie, 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 black 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 from sea bass (S. chrysocephalus), tilapia, and red emperor in 1990. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury over time with respect to the fish collection sites. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.

MO342 Mercury health risks due to the substitution of fish meat with shark meat. P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiologia; L. Elizalde Ramirez, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia; H. Barrera Villa Zevallos, UAM Iztapalapa / Hidrobiologia

A previous three years study of mercury content in a variety of edible marine fish from Mexican coastal areas was conducted by the CINVESTAV, Mexico. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury over time with respect to the fish collection sites. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.

MO343 Mercury in trophic webs of estuaries in South-Eastern Brazil. T. H. Trevisani, Universidade de Sao Paulo / Oceanografia Quimica; M.C. Vedolin, Instituto Oceanografico da Universidade de Sao Paulo / Oceanografia Quimica; R.C. Figueira, Instituto Oceanografico da Universidade de Sao Paulo / Instituto Oceano Grafico; C. Domit, Universidade Federal do Para / Centro de Estudos do Mar

The estuarine regions of Brazil are susceptible to anthropic pressures due to urban,
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 title 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 brasiliensis and Isopisthus parvipinnis) and marine mammals (Sotalia guianensis and Pontoporia blainvillii), 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-FIGA), 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 a 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 this estuary can accommodate 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.

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. Anacloto, 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. Maulvault, 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, raising human health concerns through seafood consumption. Nevertheless, the overall concentrations 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/MeHg concentration in seafood does not reflect Hg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, Atlantic wrekfish and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioactivity, as these species and their components are relatively stable. 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. Petranič, University of Trieste / Dept. of Mathematics & Geosciences; L. Terrinelli, University of Trieste; S. Covelli, Dipartimento di Matematica e Geoscienze / 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 are deposited from different sources and can accumulate 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. Aleksandryan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Nonoosher Studies NAS RA; G. Tepanosyan, Center for Ecological-Nonoosher 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 - Zn/Mg iron smelting production - Ceramics - Consumer goods and other intentional use (luminous/fluorescent lamps, thermometers, manometers and gauges, etc.) - Use and disposal of other products - Production of recycled metals - Waste incineration and open waste burning The key mercury releases here are releases to air (the atmosphere), to water (freshwater bodies, including via waste water systems), to land, to general waste, and to sectors specific waste treatment. An additional output pathway is “by-products and co-products” which designate mercury flows back into the market with by-products and products where mercury does not play an intentional role. In 2016-2017 studies were carried out in Vanadzor City of Armenia: at the territory of Chemical Combine and at the adjacent area. The highest content of mercury (3.3 mg / kg) has been recorded in dust of air sampled from the industrial area of the Combine. In air samples from adjacent urban area mercury content made 0.027-3.5 mg / kg.
hispindula in the upper Felida river basin, Colombia

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The upper basin of the Felida River, located in the Paralones National Park of Cali, Colombia, is subject to different anthropogenic stressors, such as mercury, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in samples of the riparian fern Thelypteris hispindula, 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 in the root of the riparian fern (p < 0.03), 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 = 0.000). These results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

MO349 Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Deûle River, northern France

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Due to several metallurgical plants along the river, the Deûle 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. Instead, 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 Deûle 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 ammonium (NH4+; 0.3-3 to 33 mg/L) and dissolved oxygen (70% decrease of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >95% after 1, 3 and 6 months, the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water MeHg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.

MO351 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 south-west of Ciudad Real (Spain) with a population of 5,675 inhabitants. 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 cinnamon 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 poses a health risk or not. In order to carry out this assessment, a probabilistic human health risk assessment was carried out on 15 August 2017. As Minamata Convention includes a ban on new mercury mines, and the phase-out of existing ones, this methodology could be used to establish if mercury contamination after mercury mines closure around the world endanger human health. E-mail contact: david.bolonio@upm.es, https://orcid.org/0000-0002-9166-1861

MO352 Concentrations of mercury in two offshore skates: sandy ray and shagreen ray

J.E. Nicolaus, Cefas Lowestoft Laboratory / Environment and Ecosystems Mercury concentrations in muscle and liver tissues from two offshore species of skate were examined. Concentrations of mercury in muscle of Leucoraja circularis (n=60) (furthest from shore 10.5 cm total length, 157–490 m water depth) and L. fullicincta(Gulf of Mexico 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 specimen >90 cm long, and further studies on contaminants in larger-bodied skates could usefully be undertaken.

MO353 EMPIR project "MercOx - Metrology for oxidised mercury"

I. Fettig, Federal Environment Agency (Umweltbundesamt); M. Horvat, Jozef Stefan Institute; I. de Krom, VSL; D. Douglas, LGI; T. Rajamaki, VTT

Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Emissions Directive (IED) 2010/75/EU, the Air Quality Directive 2004/107/EC, the Waste Incineration Directive 2000/76/EC and the Minamata Convention adopted in 2013; which is a global treaty to protect human health and the environment from the adverse effects of Hg. In addition to its elemental form Hg 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 Gunnevik fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations, with varying loadings. Bulk concentration and stoichiometric data in the sediment samples 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. Anoxic sediment was treated with Hg solution and an aragonite diffusion gel and a spheroid-thion resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/l within the first month, but it then drops off to 147 and 18.4 ng/l after 3 and 6 months respectively. Compared to the control, an initial reduction of 86% MeHg in pore water is seen for the AC treatment, that increases to >95% for the 1, 3 and 6 month time series. The BC treatment cause an initial 55% reduction of MeHg but after 1, 3 and 6 months the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water Me-Hg-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(0) concentration in generated elemental and oxidised Hg reference standards are required, as well as issues/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 inorganic mercury (Hg(II)) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg(II) on freshwater fish is lacking. The purpose of this study is to develop a physiologically-based toxicokinetic/toxicodynamic (PBTK/TD) model to assess bioaccumulation of Hg(II) in freshwater tilapia. A PBTK model consisted of six interested compartments can be constructed including blood, gill, liver, muscle, intestine and egg. The effects of physiological 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/organ, kidney had the highest internal exposure doses of Hg(II) ranging from 0.0208 – 0.1348 µg g−1 ww. In contrast, muscle had the lowest internal exposure doses of 0.0001 – 0.0003 µg g−1 ww(Hg(II)), indicating that Hg(II) was more efficiently transferred to other tissues below levels required at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) was in gill (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 fair quantitative agreement between model predictions and experimental data was also reached. Sensitivity analysis indicated that the amount of Hg accumulated in tilapia whole body was most influenced by sediment uptake rate, indicating that sedimentborne Hg exposure was the most influential factor on accumulation of tilapia that is bottom-feeding fish. We suggest that more dose-response data of sublethal and chronic effects are required to improve future risk assessment in a mechanistic and practical way. In a broader way, our model can be applied to predict continuously chronic Hg accumulation in fish that are deemed safe for human consumption.

MO355

Mercury in fish, fish intake and fish consumption recommendation

K. Jager, DEBtox Research / Dept of Theoretical Biology

Fish is a rich source of omega-3 fatty acids and protein, yet concerns over Hg exposure in fish and its potential effects on human health and 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 risk that. JECFA established a PTWI for MeHg of 1.6 µg kg−1 bw·week−1, whereas USEPA pointed a lower value of MeHg intake, setting the RfD at 0.14 µg kg−1 bw·day−1 (equivalent to 0.7 µg kg−1 bw·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·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 rather 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)

R. Ashauer, University of York / Environment; T. Jager, DEBtox Research / Dept of Theoretical Biology

The additional information and insight gained through the application of toxicokinetic-toxicodynamic modelling can strengthen the environmental risk assessment of chemicals in consumer products or plant protection products. For the endpoint survival the most suitable and powerful tool is currently the General Unified Threshold Model of Survival (GUTS), which consists of two complimentary models: GUTS-SD (stochastic death) and GUTS-IT (individual tolerance). In order to ease the use of GUTS and increase trust and acceptability we recently carried out a ring-test of eleven different implementations of GUTS. The frequency of erroneous results due to programming errors and less appropriate settings for numerical solvers or parameter search and convergence algorithms indicated that user training and experience is key. However after correction of user errors all software implementations resulted in comparable and similar results. Estimated parameter values generally agreed well and the implementations returned similar results in scenario tests. Recent toxicodynamic models, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus, a mechanistic effect model is a powerful tool to improve future risk assessment in a mechanistic and practical way. In a broader way, our model can be applied to predict continuously chronic Hg accumulation in fish that are deemed safe for human consumption.

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 in consumer products or plant protection products. For the Toxicodynamic (TK-TD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory have been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus,
predicting effects on feeding and assimilation is a crucial characteristic for a TKTD model to predict sublethal effects in the context of ERA. We present here the results of the i-ERA project (integrated ERA) on the responses to low food conditions / feeding impairment in four fish species (rainbow trout, fathead minnow, zebrafish, and medaka). We tested the DEB model for predicting organism level responses of juveniles (rainbow trout) and adults (all others) under low food conditions. We find that fish exposed to low food conditions, fish do not change their food acquisition to stabilize 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 handle the effects of 2 low food exposure levels. We suggest that 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 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 examine the whole range of conditions, fish do not change their food acquisition to stabilize 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 handle the effects of 2 low food exposure levels. We suggest that 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.

MO359
TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish

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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 HC5) may occur in a scenario where the LC50 values 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 characteristic to short-term pulses, margins of safety were above 10 to reach a 50 % inhibition of the growth rate over 7 days, the endpoint used in Tier 1. For the simulated field tests, maximum deviation of biomass under control and exposure conditions was used as assessment endpoint. If up to 25 % deviation of biomass of an exposed population from a control population is considered a negligible effect, the Margins of Safety was above 20 all analysed scenarios. The experimental results with juveniles and adults for short exposure conditions and organisms as well as adult microphytes showed that 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.

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 seek 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 latest achievements 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. Braun, 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 states 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 test results. Particularly for invertebrate test organisms, effects are derived from exposure 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 designated 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 invertebrate, 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

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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. Apparent toxicity endpoints, such as the LC50s, have been reported to depend on ambient temperature and partly in aquatic invertebrates and aquatic plants 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 temperatures and water uses. 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.

MO365 The use of population models in copper risk assessment: a case study with Acipecerus transmontanus
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Current metal risk management consists of assessing single-species data on metal toxicity and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effects on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (Acipecerus transmontanus) population model to predict population level effects of copper toxicity. The white sturgeon is a fish species particularly sensitive to copper during early developmental life stages. An individual-based model (IBM) was implemented using the software platform NetLogo. Copper effects were integrated by adjusting the mortality rate for the sensitive life stage (age 0- individuals) For different scenarios (i.e. environmental configurations, exposure profiles, etc.) population-level effects were assessed as a function of the copper concentration. As expected, population equilibrium density decreased with increasing copper concentrations. Effect concentrations (EC values) for population alternative effects in ecological risk assessment. In this contextual 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. Hereby, 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
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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 contextual 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 Daphnia magna biomass through three model substances: a heavy metal (Cu), a pesticide (endosulfan), and a poly-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 models 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 Deriving predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model
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Health and environmental risks posed by perfluoroalkyl acids (PFAAs) have been established 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

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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 environments are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing the ecological risk of chemicals considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to test a new methodology for deriving PNEC by use of the US- EPA AQUATOX ecosystem model, and to evaluate the risk posed by PFAAs (represented by two long-chained and two short-chained compounds) in the ecosystem of the Po, the greatest river in the Northern Italy. Through AQUATOX, water concentrations of PFAAs resulting in a non-negligible biomass loss for each modelled population of the ecosystem were assessed, thus connecting biomass density (a model output) to a “safe” concentration (PNEC). The resulting PNECs were compared to PNECs derived with conventionally used AF and SSD methods to assess the performance of the proposed novel methodology.

MO368 Incorporating spatially explicit metapopulation models as the endpoint of an Adverse Outcome Pathway-based Bayesian Network-Relative Risk Model J.D. Stark, Washington State University / Dept of Entomology; C. Mitchell, Washington State University / School of the Environment; V. Cha, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advising WorthyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackeberg, NEK Associates LTD / Department of Environmental Health Population viability analysis is useful for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) insecticides on ESA-listed chinook (Oncorhynchus tshawytscha) and coho (Oncorhynchus 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 modelled populations of OPs to % Acetylcholinesterase inhibition which is then linked to sublethal impacts that are incorporated into matrix metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The preliminary results from 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, URAFP-INRA / URAFP INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFP INRA; M. Delannoy, URAFP-INRA / URAFP INRA; A. El Hajj, T. Œster, C. Malaplate, Université de Lorraine UL / URAFP INRA; N. Tran, Université de Lorraine UL / École de chirurgie, Faculté de Médecine; C. Cakir Kieffer, Nancy; F. Yen-Potin, C. Feidt, Université de Lorraine UL / URAFP INRA Chronic low dose exposure and possible cumulative effects of various pollutants could affect consumer health and may contribute to the development of neurodegenerative pathologies. Due to the highly complex and long exposure, a clear link between pollutants and neurodegenerative diseases is often suspected, but rarely proven. An additional drawback is the high diversity of in vitro models (cancer cell lines, stem cells, primary embryonic cells), bringing additional complexity in the deciphering of the observed effects of pollutants. To properly assess the risks and to reevaluate the maximal acceptable dose of specific pollutants in the food chain, there is a need for efficient modeling of pollutant effects on the central nervous system (CNS). To address this need, we are developing a new approach to evaluate the consequences on neuronal health of long time exposure to pollutants. We are actually re-evaluating the neurotoxic effects of chlordecone (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primary neurons isolated from different postnatal CNS areas. We then assessed neuronal functions using specific markers for neuronal death, neurite development and synapse formation. In parallel, we produced cerebrospinal fluid (CSF) from pigs exposed to CLD via contaminated food. This CSF containing CLD and its by-products that are able to cross the blood brain barrier could then be used on the same cultures to compare its effect with that of CLD. Using this follow-up 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 (MechaA) 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 MechAoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechAoAs. Consequently, a new method to predict MechAoAs 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, Enoch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be progressively enhanced with the addition of new rules and minor corrections as needed.

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

MO371 Biocide leaching from building facades: Pseudo-persistence in soil due to reoccurring emissions U. Bollmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Brøndt, 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, algalicides and fungicides are added to the materials. Nevertheless, active ingredients leach from the materials. 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 classical and two chained and two decomposed transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio Fischeri than the
respective parent compounds. Nevertheless, for most biocides the degradation half-life is longer than time intervals between rain events in Northern Europe. Hence, though many of the used biocides are degrading relatively rapidly in soil most of the compounds residues may accumulate in soil surrounding biocide treated buildings, due to repeated input with every driving-rain event. Consequently, most biocides can be considered as "pseudo-persistent"-contaminants in this context. This was verified within the present study by (sub)urban soil screening, where concentrations of up to 0.1 µg g⁻¹ were detected for parent compounds as well as tertbutryn 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. Botho, Dr. Robert-Murjahn-Institut; U. Schoknecht, BAM Federal Institute for Materials Research and Testing; K. Bester, Aarhus University / Environmental Science
Biocides are common additives in façade coatings to protect the materials against biological deterioration. In- and outdoor exposure scenarios or sub scenarios 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 photoproducts and phototransformation was investigated. The latter was based on a revised Environmental Emission Scenario Documents (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 dumping scenario, the suburban area scenario from the original ESD for PT 14 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 PT 14. 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.

**MO373 New Developments in Environmental Emission Scenarios of Biocides - Rodenticides**
E. Petersen, German Environment Agency (UBA) / Section Biocides; K. Wege, A. Friesen, German Environment Agency UBA; M. Anthe, S. Hartt, 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 biocides in contact with driving-rain. The latter is based on a revised Environmental Emission Scenario Documents (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 dumping scenario, the suburban area scenario from the original ESD for PT 14 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 PT 14. 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. 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 tertbutryn degradation products in soils below biocide treated facades.

**MO374 New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage**
K. Michaels, 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 revised Environment Scenario Documents (ESD), whereas the existing ESD for in-can preservatives does not contain calculations for the variety of all end-products. Consequently, the German Environment Agency (UBA) initiated a research and development project for the further development of the evaluation method of in-can preservatives. The draft for the revised ESD has been prepared by SCC GmbH on behalf of the German UBA. Due to the variety of different applications of in-can preservatives, a differentiation in 6 sub-categories was defined. Additionally, for a complete environmental emission estimation different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the uses of the end-product (application and service life) within a subcategory have to be considered. To reduce the workload and to standardize 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 of a few worst-case emission scenarios for each product type. Using a prioritization 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**
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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 prioritization 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 behavior of biocides entering the environment through sewage STPs. It will give us a more 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**
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Biocidal products Regulation, applicants can apply for authorisation of biocidal product families (BPPs), which consist of products with similar uses, the same active substances, similar compositions within specified variations and similar levels of risk and efficacy. Especially when consortia are formed and products from multiple companies are grouped into a single dossier, building a dossier that demonstrates safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the BPPs, in the interest of the applicants as well as the competent authorities. BPPs are typically subdivided into subfamilies called 'meta SPCs'. The subgrouping inmeta SPCs considers a.o. the composition, formulation type, product type (PT), risk mitigation measures (RMM), classification and labelling (C&L) and shelf-life of the different products. The results of the environmental risk assessments, however, most often do not coincide with the factors that determine the meta SPC structure. Instead, other grouping strategies are more fit for purpose. The risk envelope approach is a strategy routinely applied in...
plant protection product dossiers. It entails that - for each area of risk assessment - the key parameters driving that risk assessment are identified. Subsequently, the uses are grouped and ranked according to these key parameters. As such, one or more worst case or 'critical' uses can be identified. It if can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental and risk assessment for a BPF of 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 ECETOC 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, degradation rate, and acute aquatic toxicity data for fish, invertebrates, algae and WTPP 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 60% of the 185 metabolites found, probably due to, in some cases, their commercial unavailability. Another identified problem was that some data were developed with formulated products or with active substances for which purity was not reported. Data already analyzed for the acute toxicity indicated that, 62% of the biocides were located in category 1 for invertebrates, 54 % for fish and 52% for algae. Only 2% biocides belong to this category for the microorganisms group. Metabolites are mainly less toxic than the parent biocides, however many of them present the same toxicity and very few (< 7%) are more toxic. The ongoing work indicates that biocides and a considerable percentage of their metabolites present a high toxicity for the aquatic species. It also identifies data gaps related to the ecotoxicological potential for metabolites.

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MO380 Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015
Imposex is TBT-induced malformation of male sex-characters in female dogwhelk (Nucella lapillus). This biological effect is quantified by the Vas Deferens Sequence Index (VDSI). Levels of imposex and TBT in N. lapillus have been monitored annually in Norway since 1991. Populations around the North Sea were critical reduced in the 1990s, due to increased use of TBT-based antifouling paints. Before the global TBT-ban in 2008, increased TBT-levels coincided with increased imposex prevalence at many monitoring sites located close to high maritime activity. After 2008, decreasing TBT-trends at former impacted sites, lead to population recovery of N. lapillus. The observations in N. lapillus further corroborated by monitoring data showing decreased TBT levels in blue mussel (Mytilus spp.). This monitoring data confirm the rationale of implementing strict ambiental regulations on industrial chemicals when this can be linked to ecological perturbations in coastal ecosystems. The TBT/imposex monitoring was conducted at eight coastal stations representing the Norwegian coast from the Oslofjord to the Varangerfjord, following the guidelines given by OSPAR and ICES. Subsequently, 50 specimens from each station was analysed individually for imposex/VDSI and pooled (only females) for TBT and other organotin like tributyltin (TBTN). TBT and VDSI (≤ 0.3 & ≤ 8.224 mg 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= 8.28) was found at the shipping channel Karmøsundet, 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 algaecides under BPR**
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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 biocidal 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-related worst case scenarios to emergency assessing the leading behaviour. In the case of biocidal products applied in swimming pools to disinfest 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 algaecide applied in swimming pools. The poster will focus on following key steps: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of environment including new studies and risk management measures.

**MO382 Could a spatially distributed modelling approach enhance post approval considerations for veterinary medicines?**
C. McMillan, G. Hughes, J. Carnall, Cambridge Environmental Assessments
Tiered chemical risk assessment framework adopted in Europe for assessing the surface and groundwater risk from veterinary medicines used to treat livestock follows a tiered approach. The initial exposure assessment is a simplistic approach, with the FOCUS suite of models (FOrurn for Co-ordination of pesticide fate models and their USE) often subsequently required for higher tier surface and groundwater refinement. Standard FOCUS scenarios defined within the guidance are intended to represent worst case scenarios to emergency assessing the leading behaviour. In the case of veterinary medicines, only 42 from 232 substances were included of concern. The initial approach for a prospective environmental risk assessment methodology to algaecide applied in swimming pools. The poster will focus on following key steps: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of environment including new studies and risk management measures.

**MO384 Quick scan to monitoring data of veterinary pharmaceuticals in the Netherlands**
S. Kools, T. ter Laak, KWR Watercycle Research Institute
On the Dutch market, approx. 260 active substances are used in different veterinary medicines. In a quick scan, we investigated the potential contribution of veterinary medicines to environmental issues. We also see that current monitoring schemes are not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. We further noted that the origin of a detected compound cannot always be properly traced back to the particular use to which is attributed. We noted that degradation compounds are also used in human medicines or as pesticides. Admission to the market, based on active substances, is therefore sometimes regulated in different rulemaking and also, usage data is scattered. This makes priority setting difficult when performed in a segregated view on the universe of chemicals.

**MO385 Comparing methods for estimating environmental emissions**
The environmental risk assessments consist of information on exposure and hazards of veterinary medicines to environmental compartments. Environmental emissions from veterinary medicines products (VMPs) are used in livestock production to preserve animal health or to promote growth in certain categories of animal; feed additives (FAs) are products aimed at improving the quality of feed and the quality of food from animal origin, or to improve the animals’ performance and health. These substances may not be put on the market unless authorisation has been given following a scientific evaluation demonstrating that they have no harmful effects, on human and animal health and on the environment. In particular, according to European Framework Directive 2001/82/EC, the environmental risk assessment (ERA) procedures for VMPs are based on technical guidance documents which propose a tiered approach to calculate PECsoil and PECgw of VMPs from livestock manure spread on the field. On the same way, the ERA procedure for feed additives is reported in a technical guidance document from EFSA which describe a two-tiered approach to calculate PECsoil and PECgw from spread manure. Calculation of PECsoil proposed by the two ERAs in the first tier is directly related to the “annual nitrogen (N) emission standard” which is the amount of nitrogen per Hectare spread on or into the field. Both ERAs propose a default value of 170 kg N Ha^{-1} as is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZs are measured, and in total 23% of the areas is under such zones higher thresholds of N inclusion standard are allowed. Both ERAs could therefore underestimate the PECsoil with a potential environmental toxicity for non-target terrestrial organisms. This study is aimed to evaluate if PECsoil, calculated using standard models currently used in the authorization procedures of VMPs and FAs, are sufficiently accurate to protect soil quality and international water databases, so that becomes available for other purposes, including prioritization. We also see that current monitoring schemes is not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. We further noted that the origin of a detected compound cannot always be properly traced back to the particular use to which is attributed. We noted that degradation compounds are also used in human medicines or as pesticides. Admission to the market, based on active substances, is therefore sometimes regulated in different rulemaking and also, usage data is scattered. This makes priority setting difficult when performed in a segregated view on the universe of chemicals.
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387

Recommendation on Steam Cracker allocation for the sake of comparability of petrochemical products datasets used in LCA studies

G. Castelan, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different main products, like ethylene, propylene, toluene, xylene, etc. They are all basic building blocks of many chemicals and polymers used in nearly all products and sectors. Thus LCA data of steam cracker products directly influence a huge amount of further downstream products. It is therefore important that LCA data for steam cracker products are modelled consistently, enabling a reduction of uncertainty and a better interpretation by LCA experts, particularly in perspective of comparability, in LCA studies of these downstream products. Basing on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensus 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main “products” fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same product will have slightly different LCI results depending on different amounts of products derived from the steam cracker. Such a collaborative work towards streamlining should be engaged for all chemicals, and should be applied within all database both to background and foreground parts, like for example in the European EF compliant database.

MO388

Actual versus default uncertainty in ecoinvent database

F. Bellizario, L.A. Oliveira, Institute for Technological Research IPT; M.R. Saade, V. Gomes, University of Campinas UNICAMP; M.G. Silva, Federal University of Espirito Santo; G. Moraga, Universidade Federal do Rio Grande / NORIE; A.B. Passuello, Federal University of Rio Grande do Sul; V.M. John, University of São Paulo USP; O.S. Yoshida, Institute for Technological Research IPT

Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecoinvent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecoinvent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance; 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations, CML 1-A method and ecoinvent v.3.2 “Rest of the World” datasets for upstream processes. Results show that the sample weighted average and the geometric mean differed significantly. Therefore, using the sample weighted average as a proxy for the lognormal geometric mean may overestimate impacts, in our case by approximately 10%, considering only the effects of the concrete block production process flows. Since existing datasets may have followed this approach, the results effect need to be also considered in LCI reports for different amounts of products. Further, basic 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 lead to errors in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, performing automatic conversions in the submission software or simplifying the provision of uncertainty data using simpler probability distributions.

MO389

Life cycle assessment of battery systems with harmonized life cycle inventories considering different storage applications

X. Zhang, Paul Scherrer Institute / Laboratory of energy systems analysis; C. Bauer, Paul Scherrer Institute / Laboratory for Energy Systems Analysis; T. Terlouw, Utrecht University / Copernicus Institute of Sustainable Development; M. Beuse, ETH Zurich / Energy Politics Group, Department of Humanities, Social and Political Sciences

The penetration of renewable electricity has greatly increased in the past decade. Battery is a key storage technology to balance supply and demand and to facilitate the world’s transition towards a sustainable energy system. However, having a comprehensive overview of batteries’ 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 nanomaterials as 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 of Europe. Overall of the conducted 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. Bahrami, 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 nanomaterials as adsorbents is still an emerging technology at the early stages of development. Hence, this study enables an environmental assessment of nano-adsorbents as an emerging product/technology based on the results from the laboratory. Two nano-adsorbents with graphene-based (MGO-NH-SH) and FeO@Sio2-based (FeO@Sio2-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are comparatively different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of them, it also results in 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’-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of a test comparing the impacts between MGO-NH-SH and Fe-O@Sio2-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change; water use, energy use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis was employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethanol and DCC can reduce the impacts significantly.

MO391

Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of showering

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Radboud University Nijmegen; H. King, Unilever; H. Hendricks, Unilever RD Colworth; R. University, Radboud University Nijmegen / Department of Environmental Science

Life Cycle Assessment (LCA) has been used as a tool for environmental footprinting of a wide range of household cleaning activities. Even though differences in the way household activities are performed by consumers may alter the outcome of LCAs, the variability in consumer behaviour is generally ignored in LCAs, which use the average consumer as the basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle of showering. The variety of showering methods were modelled in 4 countries namely Austria, Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country and intra-country variability is crucial for determining the variability in the life cycle environmental impacts. Inter-country variability – the ratio between the highest and lowest median footprint and the lowest median footprint over the four countries in the 20 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.4, 2.2, 1.4 and 5.8 respectively. Intra-country variability – the ratio between the 25 percentile and the 75 percentile of the distribution was significantly higher than the inter-country variability and ranged between factors of 5 and a factor of 20 depending on the process and indicator considered. Sensitivity analysis showed that consumers’ reasoned choices – particularly heater type and shower flow rate – and their habitual behaviours – particularly shower duration – are the dominant sources of variabilities. Reducton 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.

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

MO394 Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments


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 result in an increased impact of NM on soil and water. However, there are other scenarios like the exposure of the terrestrial environment via runoff. Therefore, our aim was to investigate the ecotoxicity and fate of Ag2O-NM and Ag-NM under environmentally relevant conditions in outdoor lysimeters over around 2 years (CeO2-NM) and 3 years (Ag-NMs). Nanomaterials of the OECD Sponsorship Programme, namely NM-212 (CeO2) and NM-300K (Ag), were used for the experiments. Two concentrations for each CeO2-NM and Ag-NM were applied via sewage sludge into the top 20 cm of lysimeter soil. In addition, CeO2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Subsamples of the soil were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere influence Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammonium oxidizing bacteria and substrate-induced respiration) was observed over about 3 years in the lysimeter study, while there was no effect at the lower Ag-NM concentration. The observed ecotoxicological results of the laboratory experiment over 180 days reflect the findings of the lysimeter study. For Ag-NM and CeO2-NM the results indicate that a hazard assessment based on data from laboratory tests is acceptable.

MO395 Long term effects of three different silver sulfide nanomaterials, silver nitrate and bulk silver sulfide on soil microorganisms and plants


Silver nanomaterials (AgNMs) are subjected to various transformations along their way into the sewage treatment plant (STP). Hereby the AgNMs are mainly transformed to silver sulfides (Ag2S) (Kaege et al., 2011). Slightly soluble Ag2S is considered as toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schlicht et al., 2013) and the arising biosolids will be applied in large quantities on agricultural land within the European Union. The main goal of the present study was to determine, if different types of sulfidized AgNMs evoke a
With the advancement of analytical techniques, such as single particle (sp) content (both NPs and metal ions) was analysed in diets of enchytraeids. These organisms are well interrelated. Our previous work showed that there are mostly ions present in the digestive glands, but NPs were also detected when the animals were exposed only to solution. This points to the formation of secondary NPs inside the organism. In vitro digestion model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isopods as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

Eisenia andrei after exposure to zinc in nanoparticle or ionic forms

The energy budget is an indicator of the organisms’ overall condition and the changes in the energy reserves and/or energy consumption rate have been used as biomarkers of toxic stress. To understand better the effect of different forms and concentrations of Zn and possible costs connected with the effective Zn regulation by the earthworm Eisenia fetida, we used Eisenia fetida as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

Energy reserves and respiration rate in the earthworm Eisenia fetida after exposure to zinc in nanoparticle or ionic forms

Z.M. Švasti et al. Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Studies; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation

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hemocytos, isopods were injected with gold NPs and then left for 48 hours to recover from the injection; in previous experiments 48 hours was shown to be enough time for hemocyte numbers to return to pre-injection levels. The total number of cells, viability and the proportion of hemocyte types were counted. These counts were then compared to the animals which had been fed NPs and to others that had been injected with a non-lethal dose of LPS. Preliminary data shows that the isopods cellular immune response is altered upon direct injection of NPs, but no such effect was found after their ingestion. The study is still ongoing.

MO402 Toxic Effects of Silver Nanoparticles and Its Transformation Product in Soil Applied with Biosolid

E. Topuz, I. Koyuncu, Istanbul Technical University / Environmental Engineering Biosolids, which are produced as a result of biological wastewater treatment, need to be managed as a separate waste stream. Land application of these biosolids on 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 (AgSNPs) due to the reducing conditions present in the wastewater treatment plant (WWTP) [4]. Recent studies suggest the possibility of AgNP residues because of the partial sulfidation of AgNPs [5]. Land spread of biosolids might lead to the transfer of AgNPs and AgSNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs (AgNP, PVP, PEI coated) in comparison with AgSNPs using the nematode Caenorhabditis elegans. Caenorhabditis elegans is a model species in vivo and in vitro for assessing the potential ecological risk in 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 vitro study is to understand the effects produced by AgNPs (5.082±2 nm sized and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO3) at different exposure times. E. fetida were in vivo exposed to different concentrations of Ag-NPs and AgNO3. The results from these experiments show that AgNPs and AgNO3 are toxic to E. fetida at different exposure times. E. fetida is the most studied species in environmental toxicity testing and is considered a suitable species for predicting the effects of nanomaterials on soil organisms.
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO₃ induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTs at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in coelomocytes that precede other responses at higher levels of biological organization. The responses in translational 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 used as a chemical-plannerization agents in production of silicon wafers. This study investigated the toxicity of CeO₂-NPs with polymer coatings in different charge in coelomocytes of Eisenia fetida earthworms. The CeO₂-NPs (2-5 nm primary particle diameter) were coated with dextran to confer a neutral charge (DEX-CeO₂(-)), diethylaminoethanol dextran to confer a positive charge (D-AminoDEX-CeO₂ (+)) or mercaptotetraethylen glycol an negative charge (CM-CeO₂(-)). The range of exposure concentrations were 0.02-1562.5 mg Ce/L. The coelomocytes were exposed ex situ for 1 h for each treatment. Then, the transcription levels of genes associated with stress (catalase and heat shock protein 70) were determined by q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DAAE-CeO₂ (+) were more toxic that negative and neutral CeO₂-NPs. The results show that initial surface chemistry had a profound impact on the toxicity of CeO₂-NPs to coelomocytes.

MO405 The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure

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The long-term use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs (AgTM) on biochemical markers of neurotransmission, oxidative stress and anaerobic metabolism in Daphnia magna. Organisms (14-d old) were exposed to 25-125 µg/L of NM-300K for 96 h in a WWTP effluent or in ASTM medium. Daphnids were analysed for changes in acetylcholinesterase (AChE), glutathione S-transferase (GST), catalase (CAT), lactate dehydrogenase (LDH) activities, and lipid peroxidation (LPO). Results showed a significant increase of CAT activity in control comparatively to ASTM, thus suggesting induction of oxidative stress by effluent. 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 dispersant-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent 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 significance of LDH activity in NM-300K medium in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unfortunately, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersing agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviours in standard test media and (ii) there is a distinct biomarker response-pattern in daphnids exposed to WWTP effluent containing NM-300K and ASTM supplemented with pristine NM-300K. In
The aquatic ecotoxicity of a marketed nanosilver product with both extraction procedures. For evaluation of the methods, nanoparticles were applied (i): enzymatic digestion with Proteinase K and (ii): additional alkaline extraction procedure had to be developed. Both techniques can deliver complementary information about size and concentration of nanoparticles. Measurement of number by the detection of individual particles is more accurate than optical microscopy. The derived accumulation factors and the rate of released nanoparticles were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F-FFF) coupled to ICP-MS. The study was carried out with five replicated test vials with two groups of amphipods each.

MO411
Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca

S. Kühn, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / BioNano Interactions; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

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 smaller silver nanoflour with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comprising the effects of this silver nanoflour with silver nitrate using the following internationally standardized ecotoxicity tests: 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 ‘unconventional’ dissolved silver (3 kDa centrifuge filtrate) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 μm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F-FFF) 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 of particulate Ag and/or bioconcentration of dissolved ionic silver 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.
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 how and when to intervene to regulate the toxicity 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 not many studies about the effect of ENPs on hyporheic copepod species and less related with DOM concentrations. The hyporheic zone is a region underneath streambed 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 *Microcystis aeruginosa* a widespread hyporheic 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 qualitative 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. Manarioti, University of Patras / Civil Engineering

Nanoparticles (NPs) have always existed in the physical environment. The rapid development of commercial applications involving the use of a large variety of synthetic nanoparticles has resulted in the introduction of higher amounts of nanoparticles in the environment. As the use of NPs increases, their effect to the coastal food chain and ecosystems is crucial. The aim of this work was to investigate the toxic effect of zinc oxide (ZnO) NPs on freshwater microalgae in batch and semi-continuous feeding mode for longer period than the time used in typical toxicity tests. *Scenedesmus rubescens* was selected as model microorganism since it is a common freshwater microalgae. *S. rubescens* exposed to ZnO NPs concentrations varying from 0.081 to 810 μg/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 exposure was assessed by growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of *S. rubescens* was greater in the presence of ZnO NPs, and the lipid content was higher.

MO414 Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms
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Sunscreens represent one of the main sources of engineeredTiO2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare metal TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of TNPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae (*Pseudokirchneriella subcapitata; Dunaliella tertiolecta*) and crustaceans (*L. stylirostris*). Two different Microcystis growth rate, nutrient removal and lipid production; the toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of *S. rubescens* was greater in the presence of ZnO NPs, and the lipid content was higher.

Silver nanoparticles affect the early development of *Tisbe battagliai*: pristine vs aged particles
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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 transformations 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 (PVP 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 both particles types were stable in the seawater. After 4 days of aging the size of the particles were decreased due to dissolution and aggregation for Ag, and aggregation in TiO2 particles were found to be more stable in seawater after the aging process, which can affect their impacts on exposed organisms.

Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanoparticles and silver chloride
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The relatively recent development of engineered Ag nanoparticles has expanded silver’s use considerably. Silver nanoparticles (AgNP) tend to agglomerate 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 in pristine or fish feed. Fish (3 groups of 24 fish per group) were fed for 7, 14 and 28 days. After exposure, the haemolymph was collected using a thin glass capillary, weighted and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a Graphite Furnace Atomic Absorption Spectrometry (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 mg kg⁻¹ in comparison to 3.7±1.0 mg kg⁻¹ for AgCl at the longest exposure time. The increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable to *P. hawaiensis* as AgNP than when it is in its salt form. Data strongly suggest that nanoparticles were uptake by the gut and distributed in the
haemolymph causing this increase in Ag content. More studies are required to verify the Ag form present in the haemolymph and how it will induce damage in the exposed organisms.

MO417 Toxic effects of multi-walled carbon nanotubes on bivalves: comparison between functionalized and non-functionalized materials

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The use of carbon nanomaterials (CNMs) has increased rapidly in the last years, namely due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmokinetics. 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 CNT configurations, their impacts on aquatic organisms, especially on invertebrate species, are still limitedly known. To our knowledge, no information is available on how surface chemistry alteration (functionalization) of CNTs may impact the toxicity of these CNMs to invertebrates. For this reason, we exposed clams (Mercenaria mercenaria) for 28 days to non-functionalized MWCNTs (NM200) 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. Furthermore, 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. Furthermore, oxidative stress responses (LPO) and antioxidant enzymes activities (SOD and GPx) compared to Ni-MWCNTs. In the present study, it was clearly demonstrated that nanomaterial toxicity can be attributed to core structure and surface functionalization, which have been shown to alter the level of toxicity.

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 genotoxic-oxidative and inflammatory effects of two amorphous silica NPs (precipitated NM200 and pyrogenic NM203) and two anatase TiO2 NPs (NM100 size 50-100 nm and NM101 size 5-8 nm) used by JR. NM conditioning was performed by TEM and DLS. Human bronchial (BEAS-2B) cells were exposed for 24h to 0.1-100 mg/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 TNFa release by ELISA). In culture medium NM200 was better dispersed than NM203, NM100 resulted better dispersed than NM101 at 100 g/ml and both titania showed similar agglomerate sizes at 10 mg/ml. We found lack of cytotoxicity for all NPs. Slight direct DNA damage at 10 and 100mg/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 mg/ml and oxidative DNA damage at low concentrations. NM100 induced dose-dependent direct DNA damage and oxidative DNA damage at 1 and 10 mg/ml. Direct DNA damage, statistically significant at 10 and 100 g/ml, and induction of oxidative DNA damage at 100 mg/ml were found for NM101. Both silica NPs induced slight IL-8 release at 100 g/ml, NM203 induced also IL-6 release at 10 and particularly at 100 g/ml (262 fold of control). Both TiO2 NPs induced slight IL-8 release at 100 g/ml but only NM101 induced significant IL-6 induction at 100 g/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 TiO2NPs 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-NANoREG project, Grant n. 310584.

MO419 Transformations of engineered nanomaterials during wastewater treatment: the role of engineered surface coatings and the impact on environmental fate

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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 paper we will demonstrate the approach to evaluate the extent to which WWTPs modify ENM properties and how this may be translated into the aquatic environment.

MO420 Freshwater sediments as an environmental reactor: defining biologically relevant fate parameters to provide context for nanomaterial bioaccumulation

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As the field of nanotoxicology matures there is a call for the research focus to promote the development of more ecologically relevant endpoints for testing. One area of key interest is the risk that engineered nanomaterials (ENM) pose as they undergo a range of transformations in the environment. This will require test designs prioritising environments most at risk of contamination, and which not only measure ecologically relevant endpoints, but also characterise the fate, transformations and behaviours of particles within the test system, providing the context for differences observed between treatments. Freshwater sediments present an ecosystem in need of further research, as these are predicted to be major sinks of ENMs entering the aquatic environment though waste water treatment and terrestrial pathways during material production, use and disposal. Whist freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of ENMs entering these sediments. We present a simple separation method to isolate the colloidal (< 200 nm) and dissolved (> 1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO2NP) and silver nanoparticles (AgNP) routes we find that while the majority of 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 paper presents the successful application of this method to investigate the implications different core compositions and surface coatings (e.g., electrostatically stabilised citrate and sterically stabilised PEG coatings) have upon the 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
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 localisation of particles at the worms’ surface.

MO421
Examination of the role of TiO2 nanoparticle surface transformations on transport and toxicity
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Titanium dioxide nanoparticles (TiO2 NPs) have great potential for use in a variety of commercial and environmental applications, including the photocatalytic treatment of contaminants. While processes like microbial inactivation and the generation of reactive oxygen species (ROS) have been studied under a variety of irradiation and water chemistry conditions, there exists limited mechanistic insight as to how these processes are related to the molecular-level surface transformations that may occur under different environmental conditions. This study is using surface-sensitive characterization techniques, including x-ray photoelectron spectroscopy (XPS), to examine the impact of UV irradiation, temperature, and water chemistry exposures on the metal oxide surfaces of both pure anatase and mixed anatase-rutile TiO2 NPs. Initial XPS studies of the impact of simulated solar irradiation revealed that solar irradiation resulted in a decrease in the aliphatic carbon present on the TiO2 surface and an increase in the oxygen-bonded carbon, with no observable effect on the oxidative properties of the metal oxide. Additional studies will be undertaken in the future to elucidate the molecular-level processes that are occurring at the surface and how these processes are related to the photocatalytic activity.

MO422
Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles
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Organic compounds that are released to the environment and engineered nanomaterials (ENM) will inevitably come into contact with different types of dissolved organic matter (DOM). It has been shown in a large number of studies that DOM influences the colloidal properties of ENM, which in turn impact subsequent transport and transformation processes. Sulfidation, as an important environmental transformation process, has significant implications for the fate and the ecological effects of metal oxides. Previous studies have shown that DOM can significantly change the reactivity of copper oxide nanoparticles (CuO NPs) and reduce their oxidative properties. However, to date, our knowledge on the influence of DOM on the kinetics and mechanisms of this transformation reaction are very scarce. For copper oxide nanoparticles, the sulfidation reaction and its kinetics have been described in detail. However, the influence of DOM on this reaction has not been investigated, yet. Due to their high content of bisulfide (HS-), wastewater systems represent major sulfidizing environments, whereas DOM can significantly change the reactivity of these compounds and humic substances. In this study, we therefore selected three organic model compounds (Bovine serum albumin (BSA, model protein), Alginate (model polysaccharide) and Polyacrylic acid (natural organic matter analogue)) and investigated their influence on the sulfidation of CuO NPs. All experiments were conducted in solutions buffered to pH 8 at concentrations of 1.3 mM CuO and 40 mg L⁻¹ DOM. Reacted CuO NPs were collected at selected time points and characterized using Uv C-edge X-ray Absorption Spectroscopy (XAS). In addition, selected samples were characterized using analytical electron microscopy. XAS analyses revealed that at a concentration of 10 mg L⁻¹ none of the selected organic compounds affected the sulfidation rate and observed reaction products. However, at BSA concentrations >100 mg L⁻¹ a reduction of the reaction rate was observed. In addition, at these high concentrations, BSA hampered the recrystallization of amorphous CuS to covellite. Electron microscopy also showed that in the presence of BSA, amorphous CuS was the dominating particle type. Our results show that at high concentrations, processes such as the aquaferic oxidation and the reaction pathway of the CuO sulfidation. In real municipal wastewater, however, lower protein concentrations and thus a complete sulfidation of the CuO NPs can be expected.

MO423
Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes
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The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanometrometry, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NNPs) and nanominerals far outweigh the expected released concentrations of engineered nanoparticles (ENPs), making their detection by single element spICP-MS and their subsequent risk assessment a challenge. The introduction of (sp)ICP-time-of-flight-MS (spICP-TOF-MS) has the potential to overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 460sec, covering nearly the entire atomic mass range (7-250 m/z). By examining differences in the chemical composition on a particle-by-particle basis, NNPs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique, we have undertaken a series of 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 the advances made in multi-element monitoring by time-of-flight, single particle analyses were performed on both a quadruple ICP-MS and an ICP-TOF-MS, and using 3ms and 100µs dwell times on both instruments. Particles analyzed consisted of mixtures of well-defined AuAu 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 selected to demonstrate the feasibility and application of this technique for both fundamental research and for the characterization of ENPs in the environment. In addition to confirming the efficacy of spICP-TOF-MS as a characterization technique, spICP-TOF-MS demonstrates considerable advantages over traditional spICP-MS and has the potential to examine the geochemical realm on an individual particle basis. The further development of this technique may also lead to a better assessment of ENP exposure in test systems and nature, improving on environmental risk assessment and gaining a better understanding of ENP interactions with naturally occurring colloids.

MO424
Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy
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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 functionalisation allows for great improvements in drug efficacy. Nanomedicines can cross a wide range of biological membranes and barriers (including the blood brain barrier facilitating the diagnosis and treatment of life threatening diseases such as cancer. Although nanotechnology may help to reduce the toxicity and side effects of drugs, the actual carriers themselves may also have the potential for inducing toxic effects, depending on their composition. This raises the need for safety evaluations of these drug delivery systems both in patients, but also with respect to their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their carrier systems into the environment, although some studies have begun to investigate the potential toxic effects of various nanoparticle shapes and coatings in aquatic organisms. Using various sizes of gold nanoparticles (between 10 and 100nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebrafish and light sheet microscopy. We have constructed a light sheet system based on the OpenSPIM platform, (SPIM - Selective Plane-Illumination Microscopy) which allows us to create 3D images and 4D videos in real-time. Using this rapid image acquisition technique we showed a size selective uptake of the nanoparticles into the kidney and minimal uptake in other organs. Depuration studies indicate a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

MO425
SETAC Nanotechnology Interest Group
C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology
Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)

233
SETAC Europe 28th Annual Meeting Abstract Book
MO426
Effect of ageing on polycyclic aromatic hydrocarbon composition of biochar
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The influence of ageing on biochar properties has been investigated by comparing three biochars produced from different materials, aged artificially by either H2O2 thermal oxidation or horseradish peroxidase enzymatic oxidation. In addition, a field-aged counterpart 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 the bioaccessibility of PAHs when they were freshly produced and that the risk of PAH release decreases with ageing. Therefore, well-produced biochars that meet European Biochar Certificate (EBC) and International Biochar Initiative (IBI) quality thresholds for total PAH concentrations are unlikely to present a risk with regard to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO427
Field testing of a new calibration approach for silicone passive samplers: Comparison of the concentration ratio method using samplers of different thicknesses with the PRC approach
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Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often, silicone samples 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 in the field. The sampling location was a storm water retention pond collecting storm water run-off from a motorway. The pond has two basins, one of which is equipped with a Floating Treatment Wetland (FTW) for cleaning the run-off. Two sets of duplicate samplers with 3 different thicknesses were installed in the inflow, after the FTW and in the reference basin without a FTW. One set of samplers was taken out after the first and the second after five weeks. These were extracted and analyzed for PAHs, with the concentration ratios for the different thicknesses used to calculate the field dissolved concentrations. All samplers had been additionally loaded with PRCs, with the decreases also used to calculate the field levels. These were compared to the results from the concentration ratio approach, underlining its suitability as a complementary calibration method and its application domain.

MO428
Use of biochar for hexachlorocyclohexane sorption: a mechanistic approach
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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 widespread concern and an adequate remediation approach is therefore necessary. The sorption behavior of the HCHs is related to physicochemical properties. Preliminary results have shown the adsorption performances are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429
Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers
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Concentrations of waterborne hydrophobic pollutants in the environment. Often, the total PAH sediment concentration reported for a sample has been based on 16 individual priority pollutants according to the U.S. EPA Method 8310. For pyrogenic sources of PAHs (e.g. incomplete burning processes), the parent PAHs are the predominant species. In contrast, PAHs from petrogenic sources (e.g. crude oil) are dominated by alkyl PAHs. Therefore, the U.S. EPA narcosis model was developed for investigating alkylated PAHs in marine and limnic sediments and used for risk evaluations of both pyrogenic and petrogenic PAHs. The method is based on solid phase microextraction (SPME) with different silicone materials (PDMS coated glass fibers and hollow fibers). Partitioning coefficients for the PDMS coated fibers (K_{PDMS}) were calculated for selected target alkylated PAHs which have previously not been available. K_{PDMS} for additional alkylated PAHs of interest were then predicted based on the experimentally reported K_{PDMS} values. Finally, the new method was demonstrated by in-situ deployment at seven field stations of different pollution levels. Further insights between in-situ and ex-situ EPSM deployment were obtained by comparing the results of in-situ C_{free} measurements with corresponding laboratory derived measurements using sediments collected from the same stations.

MO430
Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site
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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 manufacturing of these compounds, such as the widespread contamination of the Palos Verdes Shelves by DDTs and PCBs, which continue to pose health hazards to occurring organisms and human health. Fish from the shelf are often current use pesticides, such as fipronils 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 pyrethroids and fipronils in the top 2 cm of sediment on the Palos Verdes Shelf by DDTs and PCBs, which continue to pose health hazards to occurring organisms and possible routes of human exposure. The concentrations of total pyrethroids (\( \text{Pyrethroids} = \sum \text{bifenthrin}, \text{fenpropathrin}, \text{cypermethrin}, \text{cyfluthrin} \)) and total fipronils (\( \text{Fipronils} = \sum \text{fipronil desulfinyl}, \text{fipronil} \)) were measured in 2 cm samples of sediment from the top 2 cm of the Palos Verdes Shelf Superfund Site. Concentrations of total pyrethroids and total fipronils ranged between 1 and 500 ng/g and total fipronils ranged from n.d. to 170.15 ng/g. On-going research also aims to understand the spatial distribution of legacy HOCs (PBDEs, DDTs, PCBs) in the shelf sediments and assess their bioavailability in order to determine their risk to both organisms living on the shelf and possible routes of human exposure. These findings will be made available to the federal and state agencies for use in environmental risk assessment and designing management strategies.

References
Delle Site, A. Factors affecting sorption of organic compounds in natural...
MO431 PAHs in water and sediment samples from Douro River estuary and Porto Atlantic coast (Iberian Peninsula, North Portugal) — Risks for biota and human health?

M. João Rocha, ICBAS  U.Porto, CIMAR  CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CIMAR  CIMAR LA, Porto, CEF  FCUTC  U.Coimbra; E. Rocha, ICBAS U.Porto, CIMAR  CIMAR LA The paper shows the occurrence 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/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography—mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (Σ216PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained = 52 µg/g dry matter in suspended fraction and 24 µg/g dry matter in dissolved fraction. The studies in the evaluated concentrations, the surveyed areas were classified as highly polluted by these organics, suggesting that both mutagenic and carcinogenic responses can occur in both humans and aquatic animals living in these areas. This statement is supported by the measurement of carcinogenic PAHs for humans (group 1) dissolved in water (= 5%) and in surface sediments (= 6%) in biologically significant concentrations. These data are the first reported in this geographic area and can be used as a starting point for future control of the PAHs levels either locally either at the European scenario. Acknowledgements: European Regional Development Fund (ERDF) through COMPETE. Framework of the Structured Program of R&D&I INNOVAM – Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0145-FEDER-000035). Research Line ECOSERVICES, supported by the Northern Regional Operational Programme (NORTE2020), through the ERDF. ICBAS – U. Porto. Keywords: PAHs, carcinogenic, estuary, sea, monitoring.

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; C. Vitale, University of Insubria / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites, and occur as complex mixtures of thousands of PAHs and heterocyclic compounds (NSO-PACs) among others, collectively referred to as polycyclic aromatic compounds (PACs). The contaminant composition differ widely due to contamination sources and the specific properties of each pollutant. Despite the high complexity in PAC-contaminated areas, current risk assessment of PACs is commonly based on chemical analysis of the 16 US EPA PAHs. Consequently, many PACs are unknown. There is an urgent need of improved and applicable analytical methods to assess environmental levels and fate of potential toxic PACs to evaluate risk to human health and the environment. An important concern regarding sites contaminated with PACs is the risk of groundwater contamination by release of the compounds from soils. The aim of this study was to investigate the occurrence of 77 PACs including PAHs, alkyl-PAHs, oxy-PAHs and NSO-PACs among total aryl hydrocarbon receptor (AhR)-agonists in soils from historical contaminated sites and to assess the availability of the compounds in the soils. A novel approach combining chemical (GC/MS) and bioanalytical measurements (H4IE-luc) combined with characterization of availability by use of a column leaching test and passive sampling was used. This approach allowed screening of potentially toxic metabolites of PACs in soils during remediation. The results show that chemical analysis of 16 US EPA PAHs to determine the degree of contamination of PACs in soils greatly overlooks toxicologically relevant PACs. Agonists in concentrations >10^2 are not detectable, while the current analysis was able to detect concentrations of PACs in all soils, indicating low availability of the compounds in soils. Theachable fraction was greater widely for more hydrophobic PACs, such as more polar PACs composed of two or three rings. Contribution of the analyzed PACs to the overall AhR-mediated activities detected in soils, leaches and passive samplers was pretty small and confirms presence of several other AhR agonists in soils. Only a small fraction of AhR agonists were available in soils, indicating an overestimation of the risk, if only total initial concentrations in soils would be considered in risk assessment. However, the results show that analysis of available fractions based on only 16 US EPA PAHs have the potential to underestimate the risk of the soils.

MO434 Verification of read-across for aquatic hazard properties of Petroleum Substances in REACH registrations

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Petroleum substances are examples of UVCBs (substances of Unknown or Variable Chemical Composition). Complex mixtures of biological, physical and chemical composition will vary depending on, amongst other things, the source of crude oil, the refinery processing and climate conditions. These substances present additional challenges when conducting environmental hazard and risk assessments under regulatory schemes such as REACH, and Concawe has developed bespoke models for these purposes. However, for purposes of hazard classification and labelling there is still a need for experimental aquatic toxicity test data on petroleum substances. Concawe substances have been organised into categories, based on similarities in refinery processes and physicochemical properties, resulting in a clustering of comparable chemical compositions and related hazard profiles. Applying read-across within a category is an established concept to fill in data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data on Concawe substances using a worst-case approach. ECHA recently released its Read-Across Assessment Framework (RAAF) for environmental endpoints, however the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hydrotreated gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (BE-SPME) screening studies. The latter is a technique which measures bioavailable hydrocarbon fractions, and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a weight of evidence upon which to justify category approaches to the read-across of experimental toxicity data.

MO435 Automated Solid Phase Microextraction (SPME) for measuring freely dissolved concentrations of hydrophobic chemicals in soils, sediments and other solid matrices

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In risk assessment of hydrophobic chemicals that are strongly associated to the soil/sediment organic matter, freely dissolved concentrations (C_free) are more representative than total concentrations (C_total) of their actual bioavailability, potential for bioaccumulation and toxicity. Such freely dissolved concentrations can be measured by Solid Phase Microextraction (SPME) or if operated in the equilibrium and negligible depletion mode. Furthermore, in order to reduce the measurement variability, increase sample throughput and to produce high quality data, automated SPME methods are promising. The aim of this study was thus to investigate (1) how to operate automated SPME on solid samples, (2) how to achieve equilibrium sampling for hydrophobic organics within a practical time span and (3) how to calibrate the new approach. Polychlorinated biphenyls (PCBs) served as model compounds and matrices included soil, sediment and sludge.

MO436 New approaches for determining solubility of volatile liquid chemicals

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Water solubility is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals in the liquid state, the main challenge is to establish equilibrium between the pure liquid phase and the water phase within a reasonable time frame, which is resolved, and negligible depletion mode. A slow-slit method for solubility measurements has previously been developed for this purpose, however it is time consuming as it requires weeks to equilibrate. In this work, two new approaches were developed for solubility determinations. Both methods were originally developed for toxicity testing at the saturation level. Both approaches avoid direct contact between the pure substance and the water, thus minimizing the risk of droplet formation. The first approach uses passive dosing from a saturated silicone oil droplet formation. The second approach equilibrates the water with the pure liquid phase through the headspace. Equilibrium time in the range of minutes to hours is expected for the two methods. Four liquid hydrophobic solvents and/or aqueous solutions were examined and it was found that the two new methods provide accurate solubility data at reasonable levels of accuracy.
MO437
Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals
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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 Raphidocelis subcapitata and the terrestrial springtail Folsomia candida to terpenes and alkanes in toxicity experiments. The headspace passive dosing method applies a liquid partitioning donor placed in the headspace of the closed test vial for controlling exposure while avoiding direct contact and introduction of pure phase micro-droplets. Passive dosing from the pure liquid compound was applied for toxicity testing exactly at the solubility limit, and a dilution series of test chemicals prepared in purified vegetable oil served as donor for dose-response testing. The terpenes S(-)-Limonene and a(+)-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
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Environmental hazards of petroleum substances differ in response to variable substance composition. In this study, 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 aquatic toxicity. In this study, the extractions were performed on the water containing water accommodated fractions (WAF) via solid phase microextraction (SPME). The method was performed on WAF spiked with a panel of 20 different compounds to test the feasibility of the method. The compounds were chosen based on their level of variability in toxicity and levels of bioaccumulation. The results are used to support hazard classification of petroleum substances.

MO439
Bioaccumulation factors of synthetic musks and other hydrophobic contaminants in mangrove mussels.
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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 mussels. In the present study, bioaccumulation factors (BAF<sub>WAF</sub>, wet weights) were calculated for all the samples/sites and log BAF<sub>WAF</sub> averaged 4.0±0.3, 4.4±0.3, 4.7±0.3, 3.9±0.7 and 4.3±0.4 for galalactone, traseolate, phantolide, celastolide and tonalide respectively. Overall, the empirical models fit reasonably well the bioaccumulation of polycyclic musks in both caged and native mussels 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
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There is a multitude of pollutants that combine persistent and hydrophobic properties. In aquatic environments, they are largely deposited in sediments. The amount and characteristics of the organic carbon determine how strongly they are bound to sediments and organisms. In addition, the compound's lipophilicity and the level of affinity (e.g. by polar bonds) towards the hydrocarbon skeleton. In this study, the occurrence of various target compounds was investigated. The pollutants can be accumulated by aquatic organisms and biomagnified to higher trophic levels. Hence, it is important to explore the composition, activity and effects of environmental mixtures of pollutants in sediments of different origin, characteristics and pollution history. Sediments from Sweden, the European Arctic (coastal Svalbard vs. open sea), Queensland (Australia) and a French-German river were collected. The freely dissolved concentrations (C<sub>free</sub>) of the chemicals were determined using equilibration with thin coatings of silicone on the inner walls of glass jars with subsequent solvent extraction. Total sediment concentrations (C<sub>total</sub>) 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 (ERα); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were employed in 2012, the remaining three were included in the study. The three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between C<sub>free</sub> vs. C<sub>total</sub> will enable assessing the actual risk (C<sub>free</sub>) vs. the potential hazard of those chemicals that might be released in future scenarios (C<sub>total</sub>). 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
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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 bioadsorption (uptake via food). This long-standing obstacle obstructs understanding of HOC 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 advancement relative to the traditional ones, since it aims at expressing the data on a common basis to enable direct comparison among compartments. Passive Sample Devices (PSDs) are a good candidate for a portable analytical window for measuring chemical activity. PSDs have been explored to compare contamination of sediments and biota with high lipid content and offer great potential to assess contaminant transfer in aquatic food webs. The presented work is one subproject of the ERC-funded project “CHEMO-RISK” which aims, amongst others, to address the bioaccumulation of HOCs in aquatic biota on a thermodynamic basis. We will develop silicone-based PSDs in order to broaden the use of these devices to those media that are equilibrating slowly, as is the case in lean tissues. For this purpose, homogenated fish tissues from the German Environmental Specimen Bank, with different lipid contents (ranging from 1 to 5%...
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 the so-called non-persistent ones (Polycyclic 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. Pthalates were the most abundant chemicals, with concentrations in fish muscles in the range 41.6-22000 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 exposed in the Marne hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pompomus pomatus latus were not contaminated. In the study 60 chubs were analysed for PCBs and OCP and pthalates. Further validations are needed to confirm the transfer of these pollutants from host to parasites and to investigate the potential benefits of this detoxification pathway for parasitized chubs.

MO445 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the North and Baltic Seas
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Organic UV stabilizers are of emerging environmental concern due to their large production volumes and extensive end-use in consumer products. 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 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 for UV stabilizers in marine and estuarine environments are scarce, yet UV stabilizers are widely distributed in aquatic environments and concentrations detected in lipid based PSDs for sampling in lipids are high. For this reason, stable reference phases are proposed by Rusina et al. [1], in order to avoid the local depletion of the sample in contact with the silicone, and both, kinetic and equilibrium approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180) have been selected as target compounds, covering a Kow range from 5.66 to 7.15. 

MO446 Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish)
M. Monzoni, University of Insubria (Como) / DiSTA; A. Bufò, 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 oligotrophic 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
MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain  
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 chui), rotifers (Brachionus sp.), and copepods (Asparcalanus sp.) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-2.4 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-2.4 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 from higher molecular weight PAHs (PA and PY) which 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 linear dimensional 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?  
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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 effect of weathered MWCNT on PAHs in aquatic ecosystems, proactive research is needed to estimate potential risks, especially for sediment-dwelling organisms as a part of the 'Trojan Horse' effect. In the present study MWCNT were irradiated by simulated sunlight (300-400 nm) for 90 days. The weathered MWCNT (wMWCNT) were used to investigate their influence on fate and distribution of the biocide triclocarban (TCC) in a sediment-water system. This substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in natural water. 100 μg and 1000 μg wMWCNT/L in Milli Q water led to an adsorption (log KOWMWCNT in OECD medium: 7.6 L/kg) of 10% and 65% ΣC-TCC respectively. We will report experiments on the distribution of TCC in water-wet MWCNT and in sediment-wet MWCNT. A scenario with wMWCNT at 5 mg wMWCNT/L was shaken with 1 mg TCC for 1 h and subsequently incubated in a sediment-water system in the dark for 180 days. A scenario with ΣC-TCC only will serve as control. TCC is sorbed to sorb on the wMWCNT and accumulate in the natural sediment by fast sedimentation of wMWCNT-TCC complexes. Production and release of carbon based nanomaterials are predicted to further increase in the near future, thus the interactions of nanomaterials with organic pollutants will be of growing importance to assess environmental consequences. Acknowledgements: The work is supported by the European Project NANO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule  
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Face 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 different compartments (soil, water, sediment, air), to predict exposure levels in risk assessments. Pharmaceuticals represent a specific category of substances as they are often difficult to analyse in environmental samples more 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. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group).  
Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the target chemical compounds are both hydrophilic and hydrophobic, and the effect of the chemicals on 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: identification of the target chemical compounds and assessment of the environmental occurrence  
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The use of large amounts and a broad variety of chemicals that are potentially harmful to the environment (including persistent organic pollutants (POPs), pharmaceuticals and personal care products (PCPs)) has been a focus for assessments in terms of fate and behaviour in soil, sediment and biota. 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 southern-basin Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained by surface sediment samples from São Paulo coastal areas through micro-wave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyses (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHMCS) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction salvents 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
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To assure safety of fragrance ingredients in consumer products, International Fragrance Association (IFRA) cooperates with 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 (Salviato et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank materials in terms of risk. To further refine the RIFM Environmental framework, 5 different sampling methods were used 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. Radjabh, King Fahd Security College / Forensic Science Department; A.A. Stec, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing; Y. Badjah-Hadj-Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing.
Highest 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 polyyclic 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, tetralin 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 tetralin bags and sorption tubes, they did not give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such asacenaphthene, naphthalene, anthracene and pyrene.

MO455
PbTk modelling of super-hydrophobic chemicals W. Latiesch, 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 uptake 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 diffusive transport through aqueous boundary layers in the gastro-intestinal tract and in the blood is indeed the limiting process. Good agreement of the predicted model results with measured values indicates that there is no principal hindrance for the oral up-take of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Ellsberry C, Perdu-Durand E, Demmerle S, Cravedi J-P. 2008. In vitro biotransformation of surfactants in fish. Part 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 factor 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. 

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. Crome, Wildfowl & Wetlands Trust

MO459
Main scientific gaps in 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. Odin, 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 Bosalid F. Shaab, BASF SE; J. Roembke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF SE; S. Braeker, BASF France S.A.S.
In order to place a plant protection product on the market, the product and its active substances need to demonstrate an acceptable risk to earthworm communities. The current European risk assessment scheme follows a tiered approach using worst case environmental concentrations and endpoints from earthworm reproduction laboratory studies in tier 1. For the active ingredient Boscalid no risk to earthworms has been identified based on the chronic laboratory studies provided by BASF to EU registration authorities. However, for one of the formulated products containing Boscalid the tier 1 assessment did not allow to exclude a potential
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set using "holistic" analysis operations putting representativeness/comparability of examined earthworm communities, site- and soil properties of the different locations as criteria in the analysis. Based on these criteria a statistical assessments of representative and comparable earthworm communities in relation to the field exposure were conducted. The assessment revealed that – using data from representative and comparable study sites - there was no concentration related effect of a five-year use of the product regarding diversity and abundance of different earthworm communities.

EUCOTOX Knowledgebase: New tools for data visualization and database interoperability

C. Elonen, U.S. EPA/ORID/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. Fay, CSRA, Inc. The EUCOTOX Knowledgebase (EUCOTOX) is a comprehensive, curated database and analysis tool for retrieving data from single chemical exposure studies to terrestrial and aquatic organisms. This EUCOTOX Knowledgebase provides risk assessors and researchers consistent information on toxics effects of chemical substances for use in deriving benchmarks and establishing criteria. EUCOTOX 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+ fields. Study details such as species, taxonomic 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, EUCOTOX 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 EUCOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases has been employed to assist in efficiently accessing necessary data. The EUCOTOX Knowledgebase will be available in EUCOTOX 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 database

H. Hausen, RWTH Aachen University; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research A steadily increasing number of databases in ecotoxicology and ecology combine and merge 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. Automation of data 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 organs, environmental parameters, and vegetation. The data in the warehouse are coming from various sources, like museum collections, field data, literature and unpublished results. Edaphostat performs several steps of data cleaning, formatting, and transformation to make datasets comparable. Preprocessed data are analyzed and the results are visualized as interactive plots and dashboards. The tool depicts species distribution alongside environmental gradients (for example pH and C/N) and habitat parameters (such as soil classes) and species settlement in ecological niches. Edaphostat makes use of the full power of the EdaphoWarehouse (https://portal.edaphoWarehouse.org/) and the OWL-based database of land selected by e.g. area, time period or study design. It performs automated analysis of environmental data to assess species-specific aetiological preferences and ecological niches.

TU006 Deriving USEtox aquatic freshwater toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program

E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; P. KARAMERTZANIS, ECHA; European Chemicals Agency; J. Provoost, European Chemicals Agency; J. Provoost, European Chemicals Agency; S. Proenca, EU Commission Joint Research; D. Versteeg, EcoStewardship LLC Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEFO) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” [2013/179/EU]. The potential impact of the use of the REACH dataset for deriving toxicity effect factors for USEtox multimedia fate model [3]. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer effects. For PEF/LCA, 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 chemical agency (ECHA) for more than eight thousand chemicals all the physico-chemical properties (166'926 test results), ecotoxicity (242'729 test results) and human toxicity data (41'381 test results) available in the IUCLID 5.5 database (as of March 2017). The database has been used to calculate unique value for chemical properties

TU004

Contextualising statistically significant differences observed in mesocosm studies utilising 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 rigorously is beyond the capability 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 thus the appropriateness of how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and thus the appropriateness of

TU003 Enhancing the utility of the EUCOTOX knowledgebase via ontology-based semantic mapping

K.A. Fay, CSRA, Inc.; C. Elonen, U.S. EPA/ORID/NHEERL; D.J. Hoff, U.S. EPA ORD / Mid Continent Ecology Division; C. LaLone, U.S. EPA / Mid Continent Ecology Division; A. Pilli, M. Skopinski, CSRA, INC; R. Wang, U.S. EPA / Exposure Methods and Measurements Division The US Environmental Protection Agency’s Ecological Toxicology (EUCOTOX) 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 EUCOTOX. 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 EUCOTOX 2) mapping species to NCBI taxids and 3) mapping all relevant EUCOTOX 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) to REST API to conduct batch 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 EUCOTOX term would be returned and specific ontologies recommended. Using this approach, the majority of the 2000+ EUCOTOX codes were mapped to ontological class identifiers; some terms required multiple identifiers to properly describe them. Further, manual curation was necessary for the results of a single code mapping. The results of the automated code mapping approach were evaluated against a set of manually annotated prototypes as induced by exposures to ten well studied chemicals (atrazine, bisphenol A, cadmium chloride, chlorpyrifos, copper sulfate, cypermethrin, dioxin, EE2, malathion, or Tris(1,3-dichloroisopropyl) phosphate) in six vertebrate species ( carp, zebrafish, fathead minnow, mouse, rat, trout). The consistent of this presentation neither constitute nor necessarily reflect US EPA policy.

TU002
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 taxonomic group, was established, as well 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 each chemical. Correlation between Acute and Chronic geometric means with standard deviation - Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TU007
Deriving physico-chemical input data for the USEtox model from the REACH database for thousands of chemicals using R-Studio program
M. Oliviero, F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Proenca, EU Commission Joint Research; A. Gissi, European Chemicals Agency; F. Saouter, EU Commission JRC / Sustainable Assessment Unit
Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEFF) was a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). The potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life, soil and air. The toxicity information is used for cancer and non-cancer effects. For PEPEF/LCA, these data are required for thousands of chemicals using the most up-to-date information. The EU commission Joint Research Centre has obtained from the chemical agency (ECHA) for more than eight thousand chemicals data regarding physico-chemical properties (166/926 test results, as of March 2017) available in the IUCLID 5.5 database. These data have been processed to automatically derive accurate values for six of the physico-chemical properties required by UseTox for fate modelling: Kow, Koc, vapour pressure, water solubility, Henry law constant and biodegradability; in addition, adsorption partition coefficient (Kd) to suspended matter, sediments and 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 Klimisch 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. Oliviero, University Parthenope; s. schiavo, ENEA CR; s. manzo, ENEA / SSPT-PROTER-BES
Nanotechnology is a rapidly expanding field of research continuously producing novel materials with nanoscale properties (nanomaterials, NMs), as result, it is inevitable that NMs will enter the aquatic environment. Usually the ecotoxicological approach is generally based on a battery of bioassays with organisms belonging to trophic levels, such as algae and phytoplankton acting as the exposure 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 applied 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 physic-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 physic-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009
Historical analysis of the use of plant protection products in apple orchards (1970-2014): Combining handwritten farmers records with electronic data
L. de Baan, Agroscope / Institute for Plant Production Sciences IPS; M. Mathis, J. Steger, Agroscope; O. Daniel, Agroscope / Institute for Plant Production Sciences IPS
Plant protection products (PPPs) are used to protect crops against pests and diseases and ensure yields and quality of crops. Because they are biologically active, they can cause negative side effects on the environment or humans. Data-sets on the use of PPP for specific crops over a long time would allow to get a better knowledge on their potential environmental impact, with the aim to develop sustainable approaches. However, 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’s, to evaluate farm economics. Up to the 1990’s, data were only available in handwritten paper format, since 1997 they were collected electronically. In this study, we digitised the handwritten records and combined it with the electronic data. We first developed a concept, how the handwritten records can be entered into a database, which contains similar information as the electronic data. We collected data on farms (productivity), apple plantations (year of plantation, size, type, variety), and plant protection measures per plantation (product, dosage, date of application). In We also developed procedures to handle missing data and to detect errors in the indicated dosage or field size. Finally, a dataset of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-es 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 first digitise handwritten data and then use the digital data for future analysis.

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. 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, and 3) establish whether the potential risk for birds (direct) was able to explain differences between the impact of NNs on individual species population growth. A total of 54 bird species were modelled, for which the estimated effect of NNs on population growth were highly varied. Relationships between the estimated effects and species traits, including hypothesised risk to exposure will be reported.

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. Hjernman, 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
**TU012**

**Application of a ‘weight-of-evidence’ model for assessing sediment quality and associated hazard with offshore gas platforms discharging produced water**

A. Troncunhy, ISPRA / National Center for Laboratory Networking, Ecotoxicology Area; L. Manfra, R. Di Mento, G. Moltedo, B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; C. Sibbio, G. Chiarotti, O. Faraponova, M. Amici, C. Maggi, G. Romanelli, G. Sesta, G. Granato, F. Venti, P. Lanera, S. Merli, F. Orusino, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area. The study focused on assessing sediment quality and associated hazard in the area of the offshore gas platforms discharging produced water. The approach utilized the weight-of-evidence (WOE) model, which integrates different lines of evidence (LOEs) to develop a comprehensive assessment of sediment quality. The WOE elaboration allowed to better synthesize and evaluate complex datasets, providing a more realistic evaluation of the potential hazard associated with the platforms. The study concluded that offshore gas platforms can be considered as potential sources of contamination, and further monitoring is recommended to assess the impact of discharges on sediment quality.

**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. This study aimed to identify bacterial indicator taxa that can better characterize the impact of stressors and especially pollution on microbial community structure in stream ecosystems. The research used high-throughput sequencing to analyze bacterial communities across an urbanization gradient in streams. The results demonstrated that bacterial communities were significantly impacted by urbanization, with certain taxa being more sensitive indicators of stress than others. The study highlighted the potential of using bacterial indicator taxa to assess the impact of urbanization on stream ecosystems and provided a framework for future research in this area.

**TU015**

**Diarzon sorption in freshwater biofilms: determination of isotherms**

B. DiMare, I. Rech; A. Sali, D. Goerlitz, M. Munch, H. W. W. Schröder, I. Rech, B. DiMare. In 2000, the EU Water Framework Directive (directive 2000/06/EC) was implemented with the objective of reaching the good ecological status of rivers. Since then, various methods have been developed to assess biotic and abiotic stressors in aquatic ecosystems. This study investigated the sorption of diuron in freshwater biofilms to determine the potential impact of this common herbicide on aquatic biota. The research involved the use of artificial biofilms and the determination of diuron sorption isotherms. The results showed that diuron sorption is complex and influenced by factors such as biofilm composition and environmental conditions. The study provided valuable insights into the behavior of diuron in aquatic ecosystems and highlighted the importance of considering sorption processes in risk assessments.
during one month was exposed in channels at 6 increasing concentrations of diuron: 0, 1, 5, 10, 25 and 50 µg.L⁻¹ for two hours, with a flow velocity of 2 cm.s⁻¹. Then, Langmuir isotherm equation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µg.L⁻¹ of diuron in the water. This suggested that all absorption sites were saturated, and then diuron concentration in the biofilm became independent of diuron concentration in the water. The fitting of a Langmuir isotherm allowed to estimate a maximum diuron concentration in biofilm of 80 µg.L⁻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 concentration of the maximal capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about behaviour and impact in periphytic microorganisms.

TU016  
New insights into the biotransformation of sulfurlamid: 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 perfluorooalkyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and humans. N-ethyl perfluoroctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide. Sulfurlamid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have involved the biotransformation of biotransformed sulfurlamid and conjugated sludge, marine sediments and soil, heavy metal, nifant antibiotic resistance and endocrine disruption in aquatic ecosystems (Aydinalp and Porca 2004). The aim of this study is to determine the role of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protothelamya 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), can not be synthesized de novo or in insufficient proportions by animals and instead must be brought by algal diets 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; Burnes et al. 2011; Finnera 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 (Aydinalp 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-metolachlor, 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) polyunsaturated fatty acids (PUFA) decreased with S-metolachlor contamination (C2); 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 aminocids.
was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiogeoEco platform approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TI/020 Environmental factors-regulated disease dynamics of tilapia lake virus (TLV) transmission in farmed tilapia ponds
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BACKGROUND: Outbreaks of tilapia lake virus (TLV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TLV 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 TLV disease dynamics by constructing an epidemiological model to implicate aquaculture management among farmed tilapia ponds.

RESULTS: The mortality of Nile tilapia infected by intraperitoneal (I.P.) injection with different TLV dosage were fitted by two parameter Hill model to estimate median lethal dose (LD50). To explain the TLV highly artificial environmental conditions, sacrificing some of the experimental susceptible-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 TLV under treatment of cohabitation.

CONCLUSIONS: TLV transmission could be affected by environmental factors such as temperature and aqcuaculture pond. Results of toxicity assessment and disease epidemics could provide insights into aquaculture management of TLV disease by controlling potential factors in tilapia ponds.

Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

TI/021 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 in highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoupled CuO (Cu2O, as ion 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 (Cyanobacteria) and diatoms (Diatomaceae and Chrysophyceae) 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 throughout. TiO2, significantly inhibited biomass production of both green algae in the standard medium (EC50=14.3 mg/L), but only R. subcapitata was inhibited in ANW (EC50=31 mg/L). TiO2 NPs did not significantly inhibit Fv/Fm of any species in either medium up to 100 mg/L, indicating a lack of toxic effect on the photosynthetic apparatus. The sensitivity to CuO remained at a similar level in the standard OECD medium (biomass based EC50=0.2-0.9 mg/L) for all species, but differed over orders of magnitude in ANW (EC50=0.3-16 mg/L). The cyanobacterium, that has the smallest cell of the four tested species, was consistently most susceptible to Cu toxicity. While shedding of Cu ions from particles explained Cu toxicity, TiO2 effects were at least in part due to observed cell detachment. These differences could be observed under different environmental conditions.

Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

Chlorinated solvent contaminated groundwater: a glimpse into the environmental microbial communities and their potential for bioremediation
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Chloroethenes are among the most frequent pollutants affecting groundwater in Northern Italy due primarily to the extensive use of industrial solvents. As many contaminants released in the environment because of inadequate disposal, they accumulate and persist in the ecosystem posing a threat for human and environmental health. Degradation of such harmful xenobiotics can occur thanks to the activity of autochthonous microbial communities able to break down the more chlorinated compound to lesser chlorinated ethenes which need to be detoxified as well. Bacteria able to metabolize such toxic substances are indeed well known as well as many of their metabolic pathways, but still an efficient and complete detoxification process is hard to achieve. The understanding of the microbial activity underpinning the whole process is crucial especially during a bioremediation process where microbes are stimulated through the amendment of nutrients in order to obtain the complete detoxification. The huge impact of metagenomics, and other molecular biology techniques for the comprehension of microbial composition and activities in different environments, is helping to shed light for the comprehension of the critical apparatus behind the detoxification process but we are still at the beginning. During the present work, two microbial populations inhabiting a chlorinated solvent polluted groundwater, with and without nutrient amendment, have been analyzed after whole genomic DNA extraction and sequenced. The microbial communities derived from such analysis, will help to enlight the differences between the two populations in terms of genes expression and potential of biochemical pathways for pollutants’ biodegradation in relation to the chemical and geochemical parameter characterizing the specific site. Metagenomics of polluted sites is a powerful tool that could help in the future to define the best strategy to employ in order to obtain a complete environmental detoxification. This approach will be useful both for companies operating in soil and water recovery and for policy makers.

TI/023 Impact of the antihistamine fexofenadine on structure and functioning of less-associated microbial communities
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Effects of pharmaceuticals and pesticides designed to control microorganisms (e.g., antibiotics and fungicides) on aquatic microbial decomposers and the functions they provide are rather well-documented, while knowledge about effects of other micropollutants is scarce. In a recent study the antihistamine fexofenadine was shown to impact the microbial decomposition of plant detritus, however, the mechanistic basis for this remains unexplored. We therefore conducted 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 including fungal biomass, sporation of aquatic fungi, bacterial abundance, fungal and bacterial DNA, and enzyme activities. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to analyze total organic carbon. After 15 days of exposure, there was a tendency towards reduced decomposition of black alder leaves (~40%) in both fexofenadine treatments, while after 30 days, decomposition in the 200-μg/L treatment was increased by ~45% (but both not significantly different from the control). On the contrary, the decomposition of hay tended to be increased by fexofenadine exposure after 15 days. After 30 days no differences could be observed among fexofenadine treatments for hay, while generally more hay was decomposed than black alder. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure led to minor changes to an increased proportion of microbially-derived DOC. These observations suggest that the microbial communities’ structure and/or functional composition differ between the two tested substrates as well as among the antihistamine treatments. Moreover, potential implications in carbon and nutrient fluxes in exposed systems are indicated as the detected alterations in DOC quality may affect planktonic decomposer communities that are involved in DOC’s mineralization in surface water. To gain in-depth mechanistic understanding of the observed effects, we are currently analyzing variables related to microbial community structure and functioning.

TI/024 Innovative tools and metagenomics for the monitoring of rivers and lakes: The European project INTCATCH
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The project INTCATCH (Innovative tools and metagenomics for the monitoring of rivers and lakes) was funded by the European Commission under the 7th Framework Programme (FP7). The project was aimed at developing innovative tools for monitoring water quality, and to use them to test the potential of metagenomics for monitoring environmental trends. The project was divided into two main activities: (i) development of innovative tools and methods for monitoring water quality and (ii) use of metagenomics to identify and quantify the microbial communities in water samples. The project was conducted in collaboration with 15 partners from 10 countries, and involved the collection of water samples from 20 sites in Europe. The project was started in 2010 and was completed in 2014.
Environmental Health; L. Mancini, Italian Institute of Health ISS; C. Mancini, AECC / Environmental 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 Gardensa Servizi S.P.A. Peschiera del Garda; P. Varotto, Azienda Gardensa S.P.A. Peschiera del Garda; A. Tittonel, Technical S.P.A. Milano; D. Calisi, Algorithmica S.r.l. Roma; F. Giannone, Algorithmica S.r.l.; R. Allabahi, Boku University; A. Parsons, L. Parsons, Divisionstelle. Ltd.; T. Runnalls, Brunel University / IFE; G.C. Brighty, Environmental Sustainability Associates limited; T. Licha, Göttingen University; S. Malamis, Athens Technical University; T. Knutz, Go-Sys; A. Merkoci, ICREA - The European Project Horizon 2020 INTCATCH (Development and application of Novel, Integrated Tools for monitoring and managing Catchments) has the main goal to recommend and develop new methods and tools for the monitoring of surface waterbodies in Europe. The tools foreseen by INTCATCH 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 Intcatch 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 tools developed for the monitoring of water quality, allowing the detection of potential changes in bacterial community composition. Moreover, the metagenomics data, linked to the informations of the other tools, can be also used for the identification of pollution sources because the proportions of the bacterial 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, Irsee Lyon; A. Dabin, Irsee Lyon-Villeurbanne / UR MALY; E. Lyautey, Universite Savoie Mont Blanc; B. Ferrari, Centre Ecotax EAWAGEPFL; S. Pesce, Irsee Lyon-Villeurbanne / Microbial Ecology; M. Suchanek, University of Geneva. 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 risk for benthic microorganisms, with potential negative effects on the functioning of the whole ecosystem. Therefore, the goal of this field survey was to examine the impact of copper on bacterial communities in sediments, also with the aim to understand the mechanisms by which changes of the bacterial community 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, such 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. Since, metal tolerance levels are linked to the informations of the other tools, can be also used for the identification of pollution sources because the proportions of the bacterial groups vary in relation to several stressors (agricultural, urban, living stock, etc.).

TU026 Current challenges and perspectives in aquatic and soil microbial community ecotoxicology
K.K. Brandt, University of Copenhagen / Department of Plant and Environmental Sciences; M. Schmidt-Jørgensen, UFZ - Helmholtz Cire Environment; Research / Department of Biocatalytic 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. Then, 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.H. Polst, Helmholtz Centre 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. Schmitt-Janesko, UFZ - Helmholtz Cire 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 changes in hydraulic conditions. Even the type of biofilm can change in response to decreases in size due to reduced water flow and turbulence, and the cell-to-EPS ratio increases. As the EPS content of a biofilm may influence the bioavailability of toxicants, differences in community tolerance towards herbicides are expected for biofilms grown under variable flow conditions. Still, the interactive effects of hydrodynamic growth conditions and herbicide tolerance are lacking. Using an artificial flow-through channel and water from the River Selke (Elbe catchment, Germany), we created heterogeneous flow regimes and related biofilm community structure and function to different mean flow velocities and values of turbulent kinetic energy. Taking the biofilms grown under such controlled hydraulic conditions, herbicide tolerance towards prometryn was tested according to the PCR method. Focusing on the protist aquatic phycomycete biofilm communities, we 1) investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photosynthesis) and 2) assessed the role of EPS in stressor interactions. The relevance of EPS content in combined stressor interactions was confirmed by using artificial EPS and algal cultures.

TU028 Does fungicide exposure alter interspecies relationships of aquatic fungi during leaf decomposition? - A case study using species-specific qPCR assays
N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; M. Kemnah, Universität Koblenz-Landau / Institute for Environmental Sciences; C. Baschen, 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 analyzed using spore morphology, which does not allow assessing direct inferences on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the structural model of a fungal community to hyphomycete species composition under different models of toxic action (four sum concentrations from 5 to 2500 μg/L and a fungicide-free control: n=5, N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 μg/L resulting in significantly reduced abundances. Interestingly, two of the two tolerant species (i.e., N. lugdunensis and T. marxianum) 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 hyphomycete communities. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring.

TU029 Cyanobacterial Bloom in the Lake Varese: Characterisation of Microbial Communities by Metagenomics analysis
D. Conduto Antonio, European Commission Joint Research Centre / Directorate Space, Security and Migration; R. Loos, I. Sanseverino, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; A. Beghi, F. Pandolfi, ARPA Agenzia Regionale per la Protezione dell’Ambiente della Lombardia; P. Genoni, Lombardy Regional Environmental Protection Agency; D. Napieroka, T. Lertzig, 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 focus 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 deep region of the lake (0.5 m from surface depth), 13 cm (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCHI). 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 2x250bp paired reads, the corresponding shotgun samples as 100bp paired reads. Shotgun analysis was performed for sample collected from 31/8/2016 until 5/10/2016 and only for EPI and 2.5x SECCHI. 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 SECCHI (S) samples. The spatial distribution of the cyanobacterial community 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 SECCHI 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 185 Eucaryotic species, other work has suggested in order to discard a possible contribution of phototrophic eukaryotes.

TU030 Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope
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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 was performed in the presence of copper. Composition of biofilm was followed by bioaccumulation of two Cu isotopes in different biofilm fractions throughout biofilm growth and maturation. During the early stages of its development (0 to 20 days), biofilm was grown on glass slides in water spiked with natural dissolved copper. Then, biofilm was transferred to a mono-isotopic (65Cu) copper-enriched medium for 20 additional days. During these two successive exposure periods, dissolved Cu concentrations and the corresponding 65Cu/63Cu isotopic ratios were monitored every two days. At the end of each of the 2 exposure periods, biofilm was sampled from the slides and freeze-dried. A sequential extraction was then applied to recover Cu from the colloidal and capsular EPS fractions. The resulting pellet was mineralized to determine Cu concentrations in the intracellular fraction. Copper concentrations and isotopic ratios were determined by ICP-MS in water collected at various times of the experiment and after 20 and 40 days in the different fractions of the biofilm. The results showed constant dissolved Cu concentrations during the two exposure periods (~7 µg/L); while isotopic ratios 65Cu/63Cu widely differed between the first (2.23) and the second phase (0.25) of exposure.

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, although results 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.

TU031 Zirconium impact on freshwater periphytic communities
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 increases metallic element mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of tetravalent metals are very scarce. Zirconium (Zr) is a tetravalent non-radioactive element for which the global demand has been increasing in the last decades. Benthic microorganisms (community) 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 nM (C0), 0.5 ± 0.3 nM (C1) or 2.9 ± 0.3 nM (C2) of Zr (n=3). One slide per section was sampled after 1, 2 and 4 weeks of exposure. Biofilm production was measured via chl a fluorescence, photosynthetic activity, microscopic microorganism identification, polysaccharides 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 at12 and 14. 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 12 and 14. Principal response curve (PRC) analysis showed significant changes over time of microecofauna composition but was not able to refer to Zr and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganisms play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganisms composition which could disturb periphyton key functions. A better understanding of effects of metals on microecofauna would improve risk assessment of metal exposure in aquatic ecosystems.

TU032 DNA metabarcoding demonstrates effects of copper at environmental concentrations on microbial diversity in marine periphyton biofilms
N. Corcelli, University of Gothenburg, Sweden / Biological and Environmental Sciences; I. Yang, Nanjing University, State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; H. Kronenberger, T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; M. Eriksson, Chalmers University of Technology / Department of Shipping and Marine Technology

Copper pollution is common in coastal areas. In particular, the use of copper-based antifouling paints on ships hulls elevates copper concentrations in these environments. This study assesses the effects of dissolved copper on community structure and function of marine periphyton biofilms. Microbial diversity and community function were determined by 16S and 18S rRNA gene sequencing, targeting prokaryotic and eukaryotic organisms, respectively. Community function was studied as impacts on algal biomass, photosynthetic pigment profiles and primary production. Additionally, we studied Pollution-Induced Community Tolerance (PITC) using photosynthesis as the endpoint. Periphyton was exposed for 18 days to five copper concentrations, between 0.01 and 10 µM, in a semi-static test. The copper exposure sequencing yielded 7.1 and 5.7 million high quality 16S and 18S reads, and the average numbers of 16S and 18S Operational Taxonomic Units among the samples were 9405 and 1242, respectively. Analysis of Unifrac distances showed that copper significantly changed the eukaryothic community structure at concentrations as low as 0.01 µM. The prokaryotic community structure had been changed at slightly higher concentrations (0.06 µM). A total of 23 taxa, including species within the Proteobacteria_Bacteroidetes, Strunomycetes and Hacrobia classes, were identified as particularly sensitive to copper. Algal biomass, photosynthetic pigment profiles and primary production, were reduced at Cu concentrations of 0.06 µM and higher. PITC measurements confirmed that copper
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU/033  
A Time-series Study of Soil Microbial Community 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, biodiesel which contains diesel is more microbial friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolog EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesel 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. Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment? (P)

TU/035  
Can post mortem data be used to monitor population health in response in the barn owl?  
L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Shaw, Centre for Ecology & Hydrology (NERC)

The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) is national long-term project that monitors contaminant residues in a range of avian predator species. Each bird that is submitted to the scheme is given a post-mortem examination during which approximately 60 macroscopic observations and measurements are made. The information gathered during this examination could potentially be used to monitor health status of the birds at the time of their death or at a particular stage of their development. Previously we have focused on examining health indicators for the sparrowhawk, Accipiter nisus. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by fluctuating asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was outside these limits would be indicative of sex-ratio distortion. For the remaining health indicators, adult 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 deposits were 23-65% and 28-75% for females and males, respectively. The level of kurtosis within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.

TU/036  
Identifying suitable marine biomonitors in South Africa: Mussels vs Whelks  
C. Sparks, Cape Peninsula University of Technology / 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. We 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 bioconcentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Ni, Mg, 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 biomonitors 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 that only occurs on the west and south east of the country, the proposal is made that B. lagenaria could be considered as alternative bioindicators of ecotoxicants in contaminants in the region.

Recent developments in environmental risk assessment for pollinators (P)

TU/038  
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (Bombus terrestris)  
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinson, University of Oslo / Department of Physics; K. Borgia, 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 sub-lethal effects of neonicotinoids on honeybees (Apis mellifera) and other bee species. Neonicotinoids in field-realistic doses. However, ecological and physiological traits vary among bee species and studies on honeybees may not provide satisfactory predictions for negative effects on other bee species. Using bumblebees, Bombus terrestris, the present study developed a new experimental method to quantify how chronic dietary exposure to the neonicotinoid imidacloprid affects learning, locomotor activity and consequently the ability to forage and thus pollinate in a non-Apis species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (sugar water), ranging from field realistic.
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (rewarding) and yellow water-filled (non-rewarding) artificial flowers were tested systematically in a flying arena. The bumblebees were tracked by cameras, allowing for analysis of the flowers choices, locomotor activity and all the flowers visited during numerous, simultaneous foraging bouts. This study shows the successful application of a new method to track bumblebee behaviour. Further, the study shows that learning and locomotor activity are negatively affected, in a dose-dependent manner, when bumblebees are exposed to imidacloprid. Moreover, we show that field-realistic doses of imidacloprid have negative effects on bumblebees.

TU039
Sensitivity of honeybee larvae to PPPs and impact analysis based on EFSA Bee GD *
R. Becker, BASF SE Agrarzentrum Limburgerhof; J. Lueckmann, Rifcon GmbH * on behalf of the ECPA NTA & Bee Working Group Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae or honeybee brood. In July 2013 the European Food Safety Authority (EFSA) published a guidance document on the risk assessment of plant protection products on bees (EFSA 2013). This document is intended to provide guidance for 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 main objective of this poster is to summarize the available industry data, for active substances and formulated products on honey bee larvae 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 (TRQs) for honey bee larvae. This considers exposure routes for the IPPS for a set of on-field and off-field (PPPs) active ingredients and a seed treatment (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 margins and adjacent flowering crops. The second objective of this poster is to evaluate the impact of the proposed screening and tier I risk assessments on the pass/fail rate of currently available active substances and formulated products which is an ability of the scheme to correctly identify compounds of potential concern and consequently screen out those of low concern. The aforementioned analysis follows the principles described in the ECPA impact analysis (Miles and Alix 2013) and compared the first approach with the outcome based on laboratory data. In

TU040
Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference of the brood termination rate under semi-field and field conditions*
J. Oomen, Rifcon GmbH; R. Becker, BASF SE Agrarzentrum Limburgerhof; S. Schmitzer, IBACON GmbH; B. Szcześniak, Eurofins Agroscience Services Ecotox GmbH *on behalf of the ICPF PR Bee Brood Working Group and the Bee Brood Working Group of the German Ag Bienenschutz Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae and adults. According to the OECD guidance on the risk assessment of plant protection products on bees (Apis mellifera, Bombus spp. and solitary bees) (EFSA 2014), both, the Oomen bee brood feeding test (Oomen et al., 1992) as well as the OECD Guidance Document 75 (2007; OECD GD 75) are given as the two higher tier options to refine the risk on honeybee if concern is raised in tier 1. Both methods focus on the brood termination rate (hereafter BTR) as the key endpoint. While the Oomen bee brood test investigates an artificial and worst case acute or chronic oral exposure scenario with a test item spiked feeding solution administered inside the hive (Lückmann & Schmitzer 2015) brood studies according to OECD GD 75 under semi-field conditions rely on a realistic contact and oral exposure scenario to bees comprising contaminated nectar and pollen after oviposition of a bee attractive crop. As the evaluation of historical data from semi-field studies according to OECD GD 75 showed a strong variability of the control BTRs (Becker et al., 2015), the performance of OECD GD 75 bee brood studies under field conditions was regarded as an option to get more reliable BTR data (Becker et. al. 2015, Giffard & Huart 2015). The present poster compares control BTRs from Oomen feeding studies with BTRs obtained from OECD 75 semi-field and field trials and considers explanations for observed variances. Moreover, the possibilities and limitations of the three methods will be discussed.

TU041
Does assessing of all brood cells of a hive reduce uncertainty and increase reliabililty of Semi-field honeybee brood studies (OECD GD 75)*
J. Oomen, Rifcon GmbH; G. Gonisier, M. Kleinhenz, B. Szcześniak, Eurofins Agroscience Services Ecotox GmbH; S. Knaebe, EAS Ecotox GmbH / Ecotox Field The OECD guidance document 75 (2007) introduced a semi-field test method to assess the effects of PPPs on honeybee brood. The assessment of bee brood development over one brood cycle is conducted by mapping cells. It starts from the egg stage and the fate of individual cells is followed until hatch. For this purpose, pictures are taken at defined stages of the development cycle and compared to the development in separate control hives. Three parameters in regards to brood development are assessed and evaluated: brood termination rate (BTR) (number of the marked cells where a termination of the bee brood development was recorded, expressed as a percentage). This constitutes an indication of the compensation of bee brood losses and brood index (an indicator of the bee brood development, facilitates a comparison between different treatments). Due to the high variability of BTRs within treatments and high control mortality in several studies no definite conclusions regarding effects on brood were possible (Pistorius et al. 2012). To address this variance, effort was taken by the ICPPR working group to provide an indication of the potential of brood variability. In order to address this, the ICPPR working group has been provided with historical data and give recommendations for future testing (Pistorius et al. 2012, Becker et al. 2014). Despite fulfilling all recommendations, high variability in brood termination and high control mortality is still evident in some of the conducted studies. For those studies data interpretation and conclusions are questionable. According to Wang and Görlich (2017) one reason for the variability of brood termination rates is that the evaluation of brood development is based on a limited, defined number of cells containing eggs. According to their opinion results might be different if all cells would have been chosen. They suggested that it would reduce the uncertainty to a minimum. In this poster the recommendation of Wang and Görlich (2017) is used to find out if uncertainty can be reduced by evaluation of all cells. The brood data used were collected according to OECD 75 during a 15 day period. In case of a strong BTR, the brood development of a whole colony (3 replicates, untreated) are compared to the results were 200 cells per hive were used. The parameters compared are: BTR, brood and compensation indices.

TU042
Ecotoxicological studies with bumble bees - latest developments and method improvement
L. Franke, Eurofins Agrosciences Ecotox GmbH / Ecotoxicology Field; O. Klein, Eurofins Agrosciences Ecotox GmbH / Ecotoxicology Field; J. Fricke, Eurofins Agrosciences Ecotox GmbH / Ecotoxicology Field; J. Sorli, TRIALCAMP SLU; T. Vollmer, Eurofins Agrosciences EcoChem GmbH / Field Ecotoxicology; S. Knaebe, EAS Ecotox GmbH / Ecotoxicology Field The publication of the proposed EFSA risk assessment for pollinators resulted in an increasing demand for experiments with non-Api pollinators. As bumble bees (Bombus terrestris L., Hymenoptera, Apidae) are commercially available and their biology is well-known, they can be used for ecotoxicological semi-field and field studies due to their high selectivity. In addition, they are able to provide high quality data on the performance of pesticides on honey bees (Apis mellifera, Bombus spp. and solitary bees) (EFSA 2014), both, the Oomen bee brood feeding test (Oomen et al., 1992) as well as the OECD Guidance Document 75 (2007; OECD GD 75) are given as the two higher tier options to refine the risk on honeybee if concern is raised in tier 1. Both methods focus on the brood termination rate (hereafter BTR) as the key endpoint. While the Oomen bee brood test investigates an artificial and worst case acute or chronic oral exposure scenario with a test item spiked feeding solution administered inside the hive (Lückmann & Schmitzer 2015) brood studies according to OECD GD 75 under semi-field conditions rely on a realistic contact and oral exposure scenario to bees comprising contaminated nectar and pollen after oviposition of a bee attractive crop. As the evaluation of historical data from semi-field studies according to OECD GD 75 showed a strong variability of the control BTRs (Becker et al., 2015), the performance of OECD GD 75 bee brood studies under field conditions was regarded as an option to get more reliable BTR data (Becker et. al. 2015, Giffard & Huart 2015). The present poster compares control BTRs from Oomen feeding studies with BTRs obtained from OECD 75 semi-field and field trials and considers explanations for observed variances. Moreover, the possibilities and limitations of the three methods will be discussed.

TU043
Higher-tier risk refinement of solitary bee species 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. bicornis as test organisms for the risk assessment, and higher-tier semi-field testing with Osmia as proposed by the ICPPR working group has been under development. However, experiences from current field studies on Osmia show that exposure of adults and larvae is not necessarily given as these solitary bee species have a pronounced polylectic feeding behaviour that can result into a low exposure to a test substance (i.e. not being a real worst-case). In order to address this problem, the refinement of worst-case solitary bee risk assessments under realistic field conditions may be achieved by using a 'focal species' concept, where most appropriate focal solitary bee species can be identified to represent a worst-case choice per crop, application time and country/zone. Whereas this approach is well-known for bird and mammal risk assessment it has not been yet applied for.
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 sensitivity - Preliminary results of ECPCA company data evaluation A. Dinter, C. Hofmann, D. Ingwers, A. Jäger, O. Krüger, G. Melchior, S. Meintz, A. Metz, G. Pfeiffer, J. Schmitz, S. Seelbach, S. Alix, Dow AgroSciences / Risk Management; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; P. Campbell, Syngenta / Environmental Safety; M. Miles, Bayer CropScience UK / Environmental Safety; E. Pilling, Dow AgroSciences / Regulatory Sciences; N. Ruddule, Syngenta Ltd / Product Safety; A. Sharples, FMC Agricultural Solutions; G. Weyman, ADAMA; L. Will, EAG Laboratories; F. Zerbe, EAG Laboratories; J. Zoll, EAG Laboratories; S. Seelbach, Dow AgroSciences

A preliminary data evaluation was conducted by ECPCA companies to compare the sensitivity of bumblebees (Bombus terrestris) with the sensitivity of honeybees (Apis mellifera). For the evaluation about 70 data sets were available for contact exposure and about 50 data sets for oral exposure. The data sets comprised 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 a 10 tier ECPCA company data evaluation indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

TU045 Bumblebee (Bombus spp.) 10 day feeding laboratory test design: First results from an ICP-PR field ring testing N. Exeler, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, Environ, H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; A. Molitor, Eurofins AgroScience Services GmbH; S. Vinall, Mambo-Tox Ltd; K. Amsel, BioChemagrar GmbH; S. Haupt, IBACON GmbH; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology A decline in some pollinator species has led to an increasing pressure on political decision makers and regulatory bodies and resulted in a change 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 ringtest 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 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 (Perfekthion) was evaluated with these laboratory experiments. The test protocol was provided as a laboratory test design: First results from an ICP-PR field ring testing procedure 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 as a dominant) and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant) and needs to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant) and needs to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant) and needs to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant). Bumblebees do not share food via trophallaxis and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant) and needs to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen as a dominant).

TU046 Standardization of method to test toxicity on stingless bees The ICP-PR Working Group - UNESP University of the State of São Paulo, Júlio de Mesquita Filho / Brazil; R. Nocelli, USB/Cnr / Departamento de Ciências da Natureza Matemática e Educação; O. Malasina, UNESP University of the State of São Paulo, 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, with 37 subfamilies: Xylocopinae, Nomadinae, and Apinae. The subfamily Apinae comprises 19 tribes, among them the Meliponini, commonly known as ‘stingless bees’. However, several species have been included in the list of endangered animals and there are many reports indicating a decrease in the abundance of all native species. To ensure protection of this huge diversity and continued growth of agriculture, it is important for Brazil to have a system to evaluate which compounds are safe for bees and efficient in agriculture. Current toxicity studies in bees are carried out with the Apis mellifera, but stingless bees present a very different behaviour and biology. The oviposition process, the internal care of the hive, the feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to European honeybee (Apis mellifera L.) for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we used a new test system: The standard OECD acute oral test with honeybees were kept in 250 mL cages (ten bees were placed per cage, such that each treatment contained thirty bees from three colonies), fed in groups through microtubes (1.5 mL) punched in extremities, and kept in a chamber of biochemical oxygen demand (BOD) at 29 ± 2 °C, relative humidity of 70 ± 10% and in constant darkness. The diet used was composed of 50% (w/v) aqueous sugar solution. Our observations showed that to perform the Acute Contact Toxicity Test for stingless bees some adaptations in OECD (214) are necessary, like to adjust the temperature of the incubator (29 ± 2 °C instead of 25 ± 2 °C), anesthesia should be done by cooling and the time should be adequate for each species. The development of these tests will allow the development of safer strategies for the protection of biodiversity and, at the same time, support the expansion of agriculture, which is an important socio-economic activity in the region.


The recently updated EFSA draft honey bee Guidance document also specifies other hymenopteran pollinators, like solitary bees and bumblebees, as groups to take into consideration when assessing the risk of plant protection products to pollinators. However no validated test protocol and consequently no extensive data set is available to compare sensitivities of other relevant pollinators to those of honey bees. Within the current project of the ICP-PR Non-Apis working group a study was made to develop a first-tier acute oral test for Osmia spp. bees. Based on the honey- and bumble bee guidelines OECD 213 and OECD 247 an acute oral test was designed using dimethoate as reference substance. Osmia bicornis and Osmia cornuta were housed individually and fed a known amount of test volume per dosage. First results indicate that with this method reproducible results were obtained. In these tests, control mortality never exceeded 12 percent. Furthermore, sensitivities of O. cornuta and O. bicornis appeared to be rather similar, although O. cornuta showed a slightly less sensitive response, (which might be) due to its larger body weight. Hence, the LD50 values after 96 hours ranging from 2.6 – 7.1 ug a.i./bee indicate that a validated and workable methodology has been set up and a test guideline is within reach.

TU048 2 Years of Solitary Bee Semi-field Ring Testing and Final Conclusions (ICPPR Non-Apis Working Group) S. Knabbe, EAS Ecotox GmbH / Ecotoxic Field; N. Exeler, Bayer AG, Crop Science Division; L. Franke, J. Fricke, Eurofins AgroScience Services Ecotox GmbH / Ecotoxicology Field; M. Frommberger, Julius Kuehn Institut; T. Jütte, Julius Kuehn Institute; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology; O. Klein, Eurofins AgroScience Services Ecotox GmbH / Ecotoxic Field; J. Lueckmann, Rifcon GmbH; H. Giffard, Testap; A. Rossbach, Tier3 Solutions GmbH / Field team; C. W. Schneider, BASF SE; A. Schnurr, BioChemagrar GmbH

The publication of the proposed EFSA risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set-up. The ringtest design was based on the EFSA guidance document, OEP/EPPO Guidance No. 170 and results of discussions regarding testing solitary bees during the meetings of the ICPPR Non-Apis working group in 2015, 2016 and 2017 followed by a workshop in 2017 to harmonise methodology. Ringtests were conducted with two representatives of a solitary bee species (Osmia bicornis L. and Osmia cornuta Latr.; Hymenoptera, Megachilidae). These species are polylectic and can forage on a diverse spectrum of flowering crops. They are nesting in cavities. Both are common species in Europe commercially available and are widely used for pollination services. Several laboratories participated in the higher-tier ring tests. 8 semi-field tests were done in 2016and 9 in 2017. Two treatment groups were always included in the ringtest: an untreated control and dimethoate as a toxic reference item (optional other i.e. brood affecting substances (fenoxycarb)). In the study design adult bees were exposed in the tunnels during their reproductive period. Adult bees, as well as their offspring, were exposed to the treated pollen and nectar during development. Relevant endpoints for this study design are observations of the flight material in front of the nesting units, nest occupation (i.e. number of nesting females), the production of complete cells and cocoons per female, the brood
termination rate during the larval development as well as the success of emergence of their progeny (F1-generation) in the following year. Based on the results of the ringtests over 2 years a draft protocol is available together with recommendations for the methodology needed. This includes how the cocoon incubation and hatching of bees can be synchronised with the onset of flowering, how fit solitary bees are out of season and which substance at what rate can be used as reference item for brood studies.

TU049 Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach
T. Pamminger, BASF SE, Agrarzentrum Limburgerhof / Ecotoxicology; N. Hinrichs, 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. Aphis mellifera) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In current risk assessment the A. mellifera is treated irrespective with information on bee bodyweight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to AChE inhibitors and confirms that A. mellifera is particular sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

TU050 New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experience
M. Persiatahl, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH
With the growing concern for insect populations and an increased awareness of the importance of pollinators in the public opinion as well as in the regulatory context related to pesticides, new methods have been developed to measure exposure of pollinators in pollen and nectar. The methods used need to adequately reflect the properties of the tested substance and the circumstances of the application as well as potential influences of behavioural aspects such as foraging behaviour. Also, residue kinetics of a given substance have to be considered and must be reflected in the time points used for sampling. Here, we present recently employed approaches for studies which measure exposure and in which methods the determination of residues as part of (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.

TU052 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. Rebelo, IBAMA / CCONP
 Globally 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 challenges is the establishment of a matrix to determine the risk assessment procedures to protect pollinator insects against pesticides effects. In this context, it was published in February 2017 the Normative Instruction 02 (NI 02/2017) that establishes procedures to risk assessment of pesticides to pollinators. This is the first Brazilian specific regulation based on a risk approach, and in July 2017 IBAMA published a Manual of Environmental Risk Assessment of Pesticides to Bees which exists in an accessible way how the normative should be applied. NI 02/2017 is widely based on US/Canada’s approach, which means that it focuses on Aphis mellifera data; the models used for screening are Bee-Rex and AgDrift; tests required for tier 1 are the same and there is one scheme for foliar applications and other for soil/seed/trunk treatments. But there are few modifications: 4 tiers, the last one being post-registration monitoring; use of a safety factor of 10 for non-Apis bees; residue trials must be performed in Brazil and for tier 2 a crop grouping is considered. With this normative IBAMA expects that pesticides be used efficiently without incurring unacceptable risks to bees. Although IBAMA has a full framework for risk assessment established for honeybees there are still gaps in knowledge and research needs for ensuring that procedures to protect bees can be improved, especially regarding native bees. Hence, a matrix of selection for Brazilian bee species was proposed for selecting native species for use in pesticide risk assessment. This matrix provided the basis for electing meliponines (stingless bees) as a priority group. In the near future IBAMA intends to assess the need of changes in the risk assessment procedure, eventually including a stingless bee as a representative species.

TU053 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 Environmental and Natural Resources Institute (IBAMA) and comprises two aspects: 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 substance, we will show how the Brazilian approach (“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

TU054 An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan
Y. Kamezu, Chiba Institute of Technology / Creative Engineering; E. Fujita, K. Takahira, Chiba Institute of Technology / Environmental Safety
Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothianidin, Dinotefuran, Thiamethoxam and Nitepyrin 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. However, their potential application to honey bee colony is increasing 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 Japan. Information about condition of colonies was also collected from beekeepers. Wild honeycomb was 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 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 sacrood 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.

TU055 Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation
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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
for comparison with residue concentrations detected in pollen and nectar from treated and untreated crops. In 2016, a honey bee colony feeding study was conducted with thiamethoxam with the aim of providing a robust colony-level endpoint for comparison with residues in pollen and nectar. Analyses of the colony data indicate there were clear significant effects at the highest concentration of 100 µg/Kg for many colony parameters and overwintering survival. At 50 µg/Kg, despite a few treatment differences for pollen stores, overall colony strength and overwintering survival were lower in the control, confirming the NOEL of 50 µg/Kg. The NOEL was determined to be 37.5 µg/Kg. To assess the potential risk to honey bees from exposure to thiamethoxam and metabolite CGA322704 (clothianidin) residues in pollen and nectar, the NOEL and NOAEL can be compared to measured residues in treated or untreated crops. In a treated oilseed rape-exposure study (Pilling et al., 2013) the maximum thiamethoxam residues found in pollen and nectar were 1.0 µg/Kg and 3.0 µg/Kg, respectively. The residues of CGA322704 were below the 1.0 µg/Kg LOQ. In an 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 lower than the 1.0 µg/Kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of colonies to levels of thiamethoxam in pollen and nectar of seed treated crops 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 genes as a tool to test pesticides toxicity

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Recently, alternative splicing has been identified in honeybee brains and it has been hypothesized that alternative splicing might be an important regulatory mechanism for genes involved in neuronal processes. We compared the effects of different pesticides (imidacloprid, thiamethoxam, dimethoate) on the alternative splicing pattern of the Elav (embryonic lethal abnormal visual system) and Dscam (Down syndrome cell adhesion molecule) genes, which have an important role in the formation of nervous system. Elav encodes proteins commonly used as neuronal markers in metazoans, which has action on post-transcriptional regulation and is required for differentiation and maintenance of the nervous system. Whereas that, Dscam gene can suffer alternative splicing from a high variability region and be able to generate more than 18,000 isoforms and it is important for growth and connection of mushroom bodies, a center of learning and memory, for the expansion of dendritic fields. Based on this, we injected 2 µL of each of the pesticides (0.01 mM Thiamethoxam, 2 mM Carbendazim, 47 mM Glyphosate) to the abdomen of forager bees. After 24 hours, the brains were dissected for RNA extraction. We analyzed alternative splicing of Elav and Dscam genes by reverse transcription of polyadenylated cDNAs and then separated these fragments on denaturing polyacrylamide gels. It was not possible to observe a differentiated pattern of splicing for Elav neither for Dscam, comparing the control groups with the bees exposed to pesticides. The doses used and the exposure time in our study was not sufficient to indicate these genes as biomarkers inApis mellifera. However, further studies are needed, exploring different doses, contamination routes, and increasing the exposure time to verify if these pesticides are capable of altering the alternative splicing pattern of genes directly related to the nervous system. (Fapses: 201522368-S).

TU057

Non-uniform distribution of treated sucrose solution via trophalaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates

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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 (Brodsk Schneider, R. et al. 2017) it seems that food sharing via trophalaxis might lead to a non - uniform distribution of the tested sucrose solution between caged bees. This can cause high variability on measured parameters among group members, replicates and treatments. For homing success rate and gene expression endpoints, bees were orally exposed to different sub-lethal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bees, based on the homing flight ring-test protocol. For mortality, bees were exposed orally to dimethoate at 0.033, 0.07, 0.1, 0.13, and 0.35 µg/bees, based on the acute oral toxicity test guideline OECD 213. For both methods, the treatment-feeding regime, was conducted with ten bees/cage and two bees/cage. Homing flight success rate, at 1ng TMX/bees, was significantly lower with ten bees compared to the two bees approach. A large variability of success rates and gene expression among 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 groups of honeybees should be discussed and considered to minimize the trophalaxis dependency regarding food distribution in group dosed honeybees. Moreover, to compare endpoints of toxicological studies with single dosed wild bees for regulatory purposes. <br clear="all" /> [1]Brodsk Schneider, R., Libor, A., Kupelwieser, V., Crailsheim, K., 2017. Food consumption and food exchange of caged honey bees using a radioactive labelled sugar solution - PLOS ONE | https://doi.org/10.1371/journal.pone.0174684

TU058

Modelling and validation of honeybee foraging behaviour for the pesticide risk assessment

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In recent years a number of publication models have been developed for honeybees and they 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 a 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. Kleimann, A. Görlich, WSC Scientific GmbH

In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 99th percentile exposure percent 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. Kleiman, A. Görlich, WSC Scientific GmbH

For honeybee semi-field and field studies EFSA defined SPGs (specific protection goals) in its latest guidance document on the risk assessment of plant protection products (PPP) on bees. Detrimental effects on colony size as a result of PPPs should not exceed a 7% threshold to not endanger the fulfillment of the ecosystem 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 forager treatments, 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

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Microbial pesticides are unlikely to cause disease in non-target insects due to a lack of specific pathogenicity. However, simply exposing the insect to a microbe has the potential to activate subclinical responses that can lead to colony level effects. For example, injection with a non-pathogenic, microbial immune elicitor induces a massive antimicrobial peptide response in bumblebees and honey bees. This immune response lasts several days and is costly to maintain. These costs are demonstrable through trade-offs between immunity and other life-history traits such as learning and longevity. In addition, immune activation alters many aspects of normal colony functioning, such as changes in foraging activity, decreased queen attendance, modified feeding behaviour, increased production of sexuals and forced ejection. Crucially, many of these effects only become apparent in the colony, and show specificity between bumblebees and honey bees. The established paradigm uses laboratory trials as a ‘worst-case’ scenario before progression to higher tier field trials, which may mask the downstream immunological impacts on endpoints such as longevity. Evidence exists for immune activation in insects via oral exposure with non-pathogenic bacteria. We therefore propose the need to establish whether oral and cuticular contact with microbial pesticides can induce the immune system in bees. Should immune activation be confirmed in the laboratory in the absence of lethal effects, 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

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The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso 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 Chemistry. The 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 in the various parts of cattle and cows in the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both the meat and cow. There was a major reduction in the results obtained for cooked 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 antioxidant system (catalase [CAT] and superoxide dismutase [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 0 to 28 days, whereas effects on other enzymatic markers were low and temporally inconsistent. NRRT also was significantly decreased after 28 days. The toxic response was highly correlated to the organic content and to Fe and Ni content of the soils. Cation exchange capacity was the only soil parameter that was significantly correlated to the acute toxicity (LC50=416 mg Bi/kg) and bioaccessibility of Bi, and describes bioavailability and chronic effects of byssum on the earthworm Eisenia andrei. In reproduction tests, adult earthworms were exposed to natural sandy soil spiked with Bi citrate. Results indicate that Bi fraction of unheated treated white suckers collected in a rice field at 0.01 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?

N. Urien, INRS-EIE / Centre Eau Terre Environnement; S. Jacob, P.-C. Campbell, P. Couture, Université du Québec à Rimouski / Centre Eau Terre Environnement

Metal exposure may lead to accumulation and toxicity in aquatic species. Once metals enter living organisms, they can penetrate into their cells and cause deleterious effects. Alternately, metals can be detoxified by binding to molecules designed to sequester them and prevent them from exerting their toxic effects, such as metallothionein (MT) and metallothionein-like peptides (MTLP). MT and MTLP are known to be able to bind a body weight loss of the worms (30-42 %) as well as a complete impairment in reproduction at 56 days. These results are revealing early sub-lethal biological alterations in connection to contaminant toxicity and bioavailability. Bioaccessible 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 biaccceasibility 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 fraction of unheated treated white suckers collected in a rice field at 0.01 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.
chronatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb=Hg>Cd>Cr>Ni. The HPL and MI values were far above the critical values. Results also showed EDGs obtained to include PHA, phthalates, PDCDs, PCFDs, BPDEs, 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. We 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 in highly metal contaminated soil supplemented with sewage sludge M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A.O. Murtas, Czestochowa University of Technology / Department of Infrastructure and Environment; A. Grobelak, M. Kacprzak, Czestochowa University of Technology / Institute of Environmental Engineering

Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Contamination of soil and water with HM not only decreases the growth of plants but since metals can be accumulated in plant tissues they cause a severe threat to animals and humans to 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. Many studies were devoted 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 level of MT was observed in plants grown under metal stress. The results showed that sewage sludge added to the growing media significantly increased the metallothioneins expression in plants. The level of metallothioneins is an excellent biomarker for metals, which means that presented assay can be used as a sensitive stress marker for phytoremediation process.


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 originally on the basis of metal concentrations (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 daphnid 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 elements in corals from South Africa and the Mascarene Basin V. van der Schyff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwet Yive, University of Mauritius / Chemistry; H. Bouwman, North-West University / Unit for Environmental Science and Management

Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in skeletal and tissues of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WIO). Fragments of four soft- and five hard coral genera were collected from five sites in the WIO. Sodwana and Alibw Shoul constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Mascarene basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected 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 Mascarene Island samples. Corals without symbiotic algae could only be collected from the South African reefs, and contained the highest concentration of metalloids. Soft corals exhibited a different relative composition pattern of metals than hard corals. They been used to analyse contaminants from different organisms in 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. Polypilopora from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WIO than in certain regions of the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in Sinularia (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

TU069 Cytochrome P450, fat and ageing: new insights into metal toxicityology N. Rai, Orebro University / The Life Science Centre, School of Science and Technology; P. Olsson, Orebro University / The Life Science Centre-Biology; L. Jargren, Orebro University / The Life Science Centre-Biology

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 individuals to hematological and developmental disorders. Several genetic markers including metallothioneins, heat shock proteins and oxidative stress related genes have been used to characterize the effects of metals in different organisms. 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 elucidated. C. elegans is a well characterized 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 interconnection 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. However, but the upregulation was above 15 fold in the metal mix-ONC 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 fas-1, post-2, acc-2 and fat-5 were also altered on exposure to both the metal mixture and environmental sample. Our results show that metals alter the CYPs and fatty acid metabolism and can have further 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 / Geochemy; M. Soto, University of the Basque Country / Zoology and Animal
study the effects of culture medium on metal toxicity. Based on these results, our second purpose was to propose a new approach for the evaluation of metal toxicity on microalgae avoiding the interference of culture medium. In this study, we evaluated the toxicity of copper (Cu), lead (Pb) and zinc (Zn) on the microalgae *Pseudokirchneriella subcapitata*, since they are considered to be more sensitive to chemicals compared with other aquatic organisms such as fish. Cu and Zn were chosen for study metal species because they play an important activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microcosm (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 modified OECD medium (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalgae was exposed in a simplified test medium (distilled 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 for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 µg/L, respectively and in BBM, they were >300 µg/L in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg/L for Cu, Pb and Zn, respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.

TU073

Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico.

M. Maniez-Najera, G. Barrera Escrigue, Universidad Autonoma Metropolitana Inzapalapa / Hydrobiologia; P. Ramirez Romero, V.A.M. Inzapalapa / Hydrobiologica 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 population growth, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites where that over time were declared protected natural areas. Population's settlements on their 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, Mexico, which is used for fishing, irrigation, recreation and electric power generation, among other purposes. Therefore, the objective of this study was to evaluate the water chemical quality and tilapia quality. Five field trips were made in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, nitrites, phosphorus; also metals: cadmium, chromium, copper and lead were determined in both water and tilapia. Results indicated that the physicochemical parameters are within Mexican admissible ranges. Nitrite and phosphorus exceeded the acceptable limit for urban use and protection of aquatic life. Lead and chromium in water exceeded the limits in four collections, and tilapia, only in two of them. Cadmium and copper registered in water behaved similarly exceeding in two seasons the levels allowed by Mexican law, while in tilapia, cadmium only exceeded the acceptable limits/ for consumption in two seasons. Based on the concentrations of nutrients and metals, it is concluded that water of the Tenango dam is not suitable for urban use, nor for the protection of aquatic life and tilapia should not be consumed. These levels of contaminants could represent a risk to the life/ associated with this artificial water body. The diverse uses and the absence of a management strategy have deteriorated the dam's water quality and also the tilapia as a resource associated with it; finally, this situation compromises the integrity of an aquatic body included in a site declared as a protected/ natural area.

TU074

Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipstick Products in Nigeria.

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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 lipid matrix of lipsticks contains heavy metals. The presence of heavy metals in most lipsticks may help to predict the possible risk associated with the use of these products. The main objective of this paper is to evaluate the hazard quotients of heavy metals due to daily ingestion or use of 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 metals 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;
Arsenic concentration range between (0.55–1.53 ± 0.26) mg/kg and chromium was 0.04-0.16 ±0.02) mg/kg. Cadmium and arsenic concentrations were below detectable limit of 0.001 mg/kg while mercury concentration ranges between 0.04-0.61 ± 0.01) mg/kg. Calculated target hazard quotient (THQ) was highest in mercury with the value of 0.60.59 and the lowest value was obtained in Arsenic with 1.43×10^-2. However, target cancer risk (TR) was highest for Lead with the value of 2.4×10^-10 and the lowest value for cadmium was 2.5×10^-10. This shows that some lipsticks products popularly used in Nigeria contain high concentration of heavy metals such as Lead, Arsenic, Chromium, Cadmium and Mercury and they have high cancer risk. Therefore, public health awareness on the risk associated with the use of these cosmetic should be carried out.

TU075
Fatty acid profile of Cerastoderma edule and Scrobicularia plana affected by copper sulphate exposure
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At the past 30 years were recorded an intensive practice in the use of fertilizers and pesticides, mainly in the European Mediterranean region, that, in particular cases, exceeded the limits of regular legislations established by the European Union. The widespread use of these chemicals compounds and the pressure over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper can affect biochemical processes, such lipid metabolism of shellfish. Many changes due to copper exposure are still unknown. Nowadays, bivalve species are used in ecotoxicological bioassays due some particular characteristics, such as the wide distribution, ecological relevance, the capacity to filter and ingest large volumes of sediment particles and water and ease handling in the field and in the laboratory. Therefore, this work aims to determine toxic effects and changes in fatty acids profile composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes. In a first phase organisms were exposed under laboratorial conditions to copper sulphate to determine lethal concentration; at a second phase, it was conducted four different feeding regimes in partitioning, speciation and resuspension. The two marine bivalve species is the most affected by the contaminant.

TU076
Heavy metals in soil and vegetables of allotment gardens in the Cape Town, South Africa
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Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are persistent environmental contaminants which ultimately accumulates in soil with possible translocation into the tissue of vegetables, thereby posing a potential risk to human health. While most research focus on major agricultural areas, less attention has been paid to the accumulation of heavy metals in home gardens, schools and rural areas where subsistence farming is increasingly used in South Africa as a means of poverty alleviation and increasing food security. This study was conducted to investigate the concentration of selected heavy metals in soil, water and vegetables in the Cape Peninsula in formal and informal gardens of the Cape Town, South Africa. Thereby assessing the health risk associated with the consumption of vegetables grown in the informal agricultural sector. Soil, water and vegetables were sampled during winter and summer seasons from the study areas and were analyzed for heavy metals (Pb, Cd, Mn, Zn, Cu, Ni, Fe and Co) using Inductively Coupled Plasma (ICP). Results showed that there are no significant seasonal and spatial variations in the physico-chemical properties of soil and water samples. The soil and water pH are slightly acidic, ranging from 6.30 to 6.90, and 5.60 to 7.00, respectively. Soil organic matter ranges from 1.7 to 13.5%. Results for water indicated that there was concentration fluctuation during winter and summer, with summer concentrations ranging from 0.062 to 0.947 mg/L while in winter the range was 0.002 to 2.347 mg/L. Soil heavy metal concentrations ranged from (0.59-1209.95 mg/kg) in winter and (0.52-1127.41 mg/kg) in summer. For both seasons the metal concentration in soil increases in the order; Cd < Co < Ni < Cr < Pb < Mn < Zn < Fe. The concentrations of all the elements in soil and water samples were within the permissible limits set by WHO and FAO. The concentration of heavy metals in vegetables were generally higher in summer (ranging from (nd–116.26 mk/kg) than in winter (ranging from nd–144.28 mg/kg), with the general trend being in the order; Cd < Ni < Pb < Co < Cu < Cr < Zn < Mn < Fe. In general, the below-ground vegetables such as brinjals and green peppers exhibited lower accumulation tendencies than above-ground and leafy vegetables such as cabbage and spinach.

TU077
High selenium lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh
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Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are widespread use of these chemicals compounds and the pressure over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper can affect biochemical processes, such lipid metabolism of shellfish. Many changes due to copper exposure are still unknown. Nowadays, bivalve species are used in ecotoxicological bioassays due some particular characteristics, such as the wide distribution, ecological relevance, the capacity to filter and ingest large volumes of sediment particles and water and ease handling in the field and in the laboratory. Therefore, this work aims to determine toxic effects and changes in fatty acids profile composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes. In a first phase organisms were exposed under laboratorial conditions to copper sulphate to determine lethal concentration; at a second phase, it was conducted four different feeding regimes in partitioning, speciation and resuspension. The two marine bivalve species is the most affected by the contaminant.

TU078
Metals removal from water for hazard classification
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Metals usually enter aquatic ecosystems in an oxic environment and associated with particulate matter. It is important to classify the strategies available for metals removal. How do various test method conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case 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 loading rates included dissolved Cu, Ni, and Fe, dissolved oxygen (DO), pH and AVS-SEM of sediments. Multiple dried vs. non-dried sediments were tested in batch reactors for both 96 h and 28 days tests. Dry Buffalo River sediment, a sediment with reasonable worst-case properties for metal binding, typically removed 70% Cu and Ni from the water column at 1 mg/L loading. Incubated sediments removed metals significantly faster than non-incubated sediments (p < 0.03). Higher sediment loading rates removed metals faster as expected. Sediment type and loading rates affected pH, which started at 6.0. Cu removal (96 h) and resuspension (1 h post 96 h) resulted in no significant increase in Cu, but did elevate Fe concentrations. The results show that 70% of Ni and Cu is removed from the water.
TU079
Modelling the chronic toxicity of copper to fish at low pH
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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 were extended 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
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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 six reproduced sediment 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 AquaBloq, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Limnocorals (LC) to isolate water columns above various capping treatments, simulating lake-mesocosms. Simultaneous in-situ and ex-situ toxicity tests were conducted using Daphnia magna, Hyalella azteca and Chironomus dilutus. Test organisms were protected from temperature shock by pre-acclimating 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
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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 pollution sources of which little is known, and no regulatory environmental framework for immissions exists so far. In addition, a review by Herrmann et al. (2016) demonstrated the considerable lack of reliable data for La toxicity in the aquatic environment. Considering their future use, release, and environmental fate, an evaluation of environmental risk from lanthanum and gadolinium will have to be based on information on exposure pathways, exposure and effect concentrations. The project REEChange addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxicological responses obtained for Aliivibrio fisheri and Rhaphiodocells subsilicata so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are of the same magnitude as for cadmium. (2) by substance flow analysis (SFA) for La and Gd, exemplarily performed for Germany. Information has been collected from published work for a variety of potential sources for La and Gd in rivers and lakes. Additionally, water and sediment samples have been analysed at specific locations. Current data point to wastewater and specialised industries as prominent sources of emission. (3) by investigating the impact of changing environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests was applied to monitor the toxicity responses in overlying water and sediment. This includes tests with Aliivibrio 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 preliminary 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 and conductivity and pH. The origin of metals in sediments may originate from anthropogenic activities including mining, industries, agriculture as well as aeral deposition. Limited attention is however given to the contribution that natural occurring phenomena play in the concentration of metals in the sediment.

TU083
The effect of copper sulphate on the antagonists enzymes activity of two size classes of Cerasoderma edule
A.D. Mesquita, Department of Biology / CESAM - University of Aveiro / Department of Biology and CESAM; S.M. Marques, University of Aveiro; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; A.M. Goncalves, MARE, Dep. of Life Sciences, Coimbra University; G. Gonçalves, University of Aveiro / Department of Biology and CESAM; C. Wolmarans, University of the West of Scotland / School of Science; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; A.M. Goncalves, MARE, Dep. of Life Sciences, Coimbra University / School of Biomedical Sciences and Environmental Health; S. Heise, Hamburg University of Applied Sciences / Life Sciences
The project REEchangE addresses these topics in the following ways: (1) by investigating the impact of changing environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests was applied to monitor the toxicity responses in overlying water and sediment. This includes tests with Aliivibrio 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 preliminary results of the microcosm experiments along with the information on bioavailability based on biotests and speciation data.
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.

**TU086**

**Toxicity evaluation of soils sampled in the vicinity of an Aluminium smelter in Montenegro using the Ames, Bioluminescence and DR-LUC biosays**

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This study conducted as a part of the national project ECOTOXI that main topic was testing applicability of several bioassays in assessment of cause-effect relation between levels of organic environmental pollutants in soils and its toxic and mutagenic response on samples organic extracts. Samples was collected in vicinity of Aluminum Plant Podgorica and pools of red sludge in Zeta plain. The area with intense industrial activity is also reach with agriculture and is just in 5km distant from Podgorica (Capital of Montenegro). Waters of several rivers in this area, which are significantly influenced by municipal wastewater of cities, are abundantly used for watering crops in area. We tested mutagenic potential of samples organic extracts in the Ames test, on bacterial strain *Salmonella typhimurium* TA98, acute toxicity on bioluminescence of bacteria *Vibrio fischeri* and concentrations of possible dioxins present in the samples by DR-Luc test on rat H4IE hepatoma cell line. The obtained results indicate a strong mutagenic effect of organic pollutants mixture in tree samples collected near the Aluminum Plant and pools of red sludge, what was significantly in correlation with the recorded concentrations of dioxins in the DR-Luc test and with measured concentrations of polycyclic aromatic hydrocarbons, which extracted with the maximum allowable prescribed concentrations. Two of tree samples, with high response, were in agricultural area. Even if it is a clear trend of decrease of mutagenic effects as well as reduction of the concentration of dioxins and PAHs with increasing distance of sampling sites from the Aluminum Plant and pools of red sludge, almost all samples showed a certain elevated level of mutagenic activity, which may be a consequence of the impact of multiple sources.

**Safe by Design: responsible and innovative research for safe and sustainable chemistry (P)**

**TU087**

**In silico approaches to screen and design safer chemicals**

**E. Papa, A. Sangion, P. Gramatica, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)**

The prohibitive economic and social cost of testing, necessary to provide extensive information on fate and effects of existing chemicals to humans and the environment, highlights the need to focus on rational and safe design of chemicals before synthesis (i.e. Safe by Design – SBD approach). This approach applies the principle of green chemistry “Design safer chemicals and products,” and is useful to prevent hazardous substances from being developed and entering the environment, as well as to build safer alternatives to existing hazardous chemicals. While in the last decades computational chemistry and in silico models have been widely and successfully applied in the design of drugs with desirable pharmacological activity, these strategies have not yet been applied extensively in the design of sustainable, “safe by design” industrial chemicals as well as no real guidelines exist at the regulatory level. Modelling bases on Quantitative Structure-Activity Relationships (QSARs) rely on the assumption that biological activities/properties of chemicals are intrinsically dependent on the molecular structure. Endpoints like for instance toxicities, physico-chemical properties as well as biotic and abiotic degradations can be predicted starting from models based on molecular descriptors of the chemical structure, which serve as basis to develop the SBD approach. Therefore, in silico strategies such as the aforementioned QSAR (and QSAR-like) models and multivariate analysis (MVA) can be successfully applied to screen undesired 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 QARINS and available in the freely distributed QARINS-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 and Pharmaceuticals (PPCPs) and nanoparticles. All the presented strategies support the identification of safer alternatives to chemicals that are screened by QSAR as undesirable from their molecular structure. The QSAR approach, applied for SBD before the chemical synthesis, provides concrete opportunities to increase the sustainable use of chemicals and to reduce the need for a posteriori remedial actions.

**TU088**

**Application of chemometric methods and QSAR models to support pesticide risk assessment starting form ecotoxicological datasets**

**E. Galimberti, ICPs International Centre for Pesticides and Health Risk Assessment; D. 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 Prevention (ICPs) of Milan-IT, together with the Wageningen University and Research Centre of Wageningen-NL, worked on a data collection project commissioned by the European Food 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 (PPP). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC_{50} or EC_{20} as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC values are considered more appropriate endpoints since they take into account concentration-response curve. Ecotoxicological data gathered from 70 active substances’ approval dossiers were collected and stored into a database, and then analyzed to derive NOEC. Adequate statistical models were selected and used to calculate EC_{50}, EC_{20}, and EC_{10} with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSAR) 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

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In the framework of the 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 uncoted and coated with citrate or polyethylene glycol phosphoric acid ester (PEG). OECD Test Guideline (TG) 305 (diet administration) has been followed. Fish (±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hepatosomatic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO2 NPs. A difference was observed for the uncoated NP 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 the uncoated NP for which Ti levels in the fish were higher than for the other coated NPs. A difference was observed for the coated NPs with the metals in the fish being the highest for the CeO2 NP coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO2 NPs uncoted 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.

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TU090

Colloidal characterization of nano-enabled products for the restorations works of art: environmental fate of nano-ingredients

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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 techniques are still little known and requires an adequate assessment and management of potential risks [2,3]. ENM formulations are increasingly preferred for conservation interventions compared to the corresponding bulk materials formulations because of their small size and enormous specific surface area that favour their interaction with the material to be conserved/restored. But the small size, coupled with their capacity to adsorb biomolecules, make them particularly effective at reaching sub-cellular locations by potentially being able to 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 complicated the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In this context, in the frame of the EU FP7 2010 NANOMAT project, the aim was to develop 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 ENMs and the biological medium, in the frame 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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Safe-by-design in chemistry may positively contribute to a circular economy by avoiding the introduction of hazardous substances. Specifically in nanotechnology the terms “Safe innovation” and “Safe(r)-by-design” are used popularly referring to the goal of considering safety aspects already at an early stage in the innovation process of (nano)materials and nanoenabled 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 is needed in order to identify potential for exposure. After this the standardized 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 (undeclared) product can be obtained by collecting information on a limited number of physicochemical properties of the intended graphene product: 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.

TU092

Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine

M. Schmutz, C. Soni, EMPA 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 of nanomedicine, which is complex, and combines knowledge from different fields. It is at the junction among pharmacy, medtech, biotech, nanotech and chemical companies which are important economic and social player in Europe. In this context, the GoNanoBioMat project aims to facilitate SMEs in Europe in the decision making for developing and producing safer and sustainable polymeric nanobiomaterials for drug delivery. To do so, the consortium designed a “Safe-by-Design” framework based on the nano-enabled technology and the biointerface and to find out which are the critical quality attributes (link between physico-chemical properties and toxicity, product safety, quality and purity). Furthermore, there are difficulties in reproducing environmental and human health experiments for assessing the related
risks and having batch-to-batch uniformity. Finally, notifying bodies are behind development because of the uncertainties arising from this field. Therefore, it seemed important to include in the framework the following aspects: safe material’s design, human 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 name-specific guidance on innovation. 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 toxicology and environmental assessments
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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 are pointed to the right hotspots concerning energy and climate change, which is promising for application during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have 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 production in general. Within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

TU094
Liquid organic hydrogen carriers (LOHC) - comparative hazard assessment
M. Markiewicz, Technical University of Dresden / Sustainable Chemistry Group; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry.

Renewable energy stored in LOHC systems could replace fossil fuels yet their environmental impacts are largely unknown. This technology is still relatively new, and requires R&D efforts to optimise its performance to commercially attractive levels. This opens the possibility to proactively design the carriers for increased operational and environmental safety. A preliminary, comparative hazard assessment was performed using automotive diesel oil as a reference. The biodegradability and acute/subchronic (eco)toxicity using: enzymes (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-2- and intermediate forms of alkylcarbazoles, with the order of gL.2 Butanone is more toxic than 2-Octanol and Daphnia magna is a suitable test organism to evaluate the toxicity of a synthetic fuel. The over results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development.

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 biochemical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of "Green Toxicology" which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Microinucleus 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-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanol did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster "Down to Earth - Turning biomass to fuels from biomass" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TU096
Investigation of the toxic effects of new mixtures of deuterium rich ethers and esters on aquatic and terrestrial life and health
G. Mengotti, Heriot Watt University; A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; E. Tagliavini, Heriot-Watt University; C. Samorì, University of Bologna; H. Johnston, D. Brown, Heriot-Watt University; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences.

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 biochemical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of "Green Toxicology" which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Microinucleus 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-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanol did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster "Down to Earth - Turning biomass to fuels from biomass" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

New frontiers in Life Cycle Inventory data collection and modelling (P)

TI097 Predicting environmentally beneficial production pathways for chemicals with neural networks
J. Kleinjans, 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.

TI098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
S. Choy, 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 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.) - sod4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - has 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.

TI100 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, OxkowX; 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.) - sod4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - has 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.

TI105 Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCIs in the perspective of the applicability of the Improved LCA method and the Environmental Footprint (EF) method
M. Bartz, 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-profile procedures, where use and consumption were sometimes considered as the same. The current study has focused on 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 infrastructure 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 contain some format, syntax and conceptual errors which were inherited from several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors well as goals, problems or possible solutions during 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/EA website. Among the above mentioned at once the overall changes occurred in the ILCD/EF transition phase can be resumed as following: - 1242 obsolete or wrong elementary flows have been deleted /mapped - 560 new elementary flows have been created - Around 55.000 characterisation factors are different (this is mainly due to the introduction of new methods, and regionalization of some of them) - 37 duplicated flows have been eliminated - 275 wrongly categorized flows have been assigned to the proper category - 218 wrong, 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.
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 wherever the LCA practitioner is. This will be the basis for the calculation of the consumptive water output (owing minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operational flows of water in a chemical plant and the link to the life cycle inventory (LCI) and ILCD flow names. This is based on the International 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 get LCA. The presentation aims to attack LCA“IA 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
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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 our carbon footprint. 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 calulating time dependent environmental interventions and the related impacts of toxicity and climate change. The aim of this study is to investigate the environmental performances over a large time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions were distributed in time, then was 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 clogging on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic approach provides new opportunities but also some drawbacks. 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, Stockholm Environmental Institute
That location matters when it comes to quantifying environmental impacts of agricultural commodities. The current efforts to include spatial information 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 framework to consider the geographical 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-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 relevant contribution of soybean to the further life cycle 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 is because the recipes might be 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 performances are higher than those of the competitors. 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 performances are higher than those of the competitors. 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.
TU106
Developing guidelines for elementary flow nomenclature
A. Edelen, ORISE; W. Ingwersen, US EPA

In general, a flow in life cycle inventory data refers to an input or output to a process. Flows may be of two broad types: elementary flows or intermediate (known as “technosphere”) flows according to ISO 14044 (ISO 14044 2006). Elementary flows are those which transfer energy, space or that are used directly from the environment or released directly back to the environment.

Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An active early 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-Langevel and 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 implement the KOS standard.

TU107
Building a Life Cycle Inventory of stormwater pollutant fluxes: model evaluation for a separate residential urban catchment
E. Risch, IRSTEA Montpellier / UMR ITAP; P. Roux, Istrea / ITAP ELSA-PACT; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istrea / UMR ITAP; C. Sinfort, ITAPA, Istrea, Montpellier SupAgro, Univ Montpellier / ELSA Research group and ELSA-PACT International Organization for Standardization, Switzerland

Current life cycle assessment studies of urban wastewater systems (UWS) substantially underestimate impacts of these systems to receiving waters by not including stormwater pollution generated from the impervious surfaces of urbanized catchments. To this date, UWS are typically modelled with average discharges of treated effluents in dry conditions. In recent work, untreated stormwater discharges were shown to be significant and comparable to the freshwater ecotoxicology impact at year and event scales. Stormwater pollution typically shows a high spatio-temporal variability owing to (i) a variety of anthropogenic activities/sources within the urban catchment and (ii) rainfall specificities of local climates. The links between urban land uses, associated activities and stormwater pollution are missing in existing LCA methodology and warrant further developments. In order to address this issue, we propose a new approach for stormwater pollutant emissions from relevant urban sources within the life cycle inventory (LCI) of an urban catchment. The main objective of the proposed framework is to provide site-dependent LCI of stormwater pollutant fluxes for residential urban catchments with separate sewer networks. Major urban sources contributing significantly to stormwater pollution are defined and linked to the urban structure. The model hierarchy is built on four levels from micro scale (elementary urban surfaces) to meso-scale (city). Urban sources within the catchment contribute to stormwater pollution by emitting pollutants following either (i) a direct deposition route to urban surfaces (e.g. brake wear, metal roof corrosion) or (ii) an atmospheric emission followed by a partial deposition (e.g. diesel exhaust gases from vehicles). The model first builds up of pollutants on elementary urban surfaces was modelled for each primary source. During storm events the wash-off and transport of available pollutants via runoff were calculated for different urban surfaces. Stormwater fluxes were aggregated at wider scales (block, neighborhood and city) using a semi-distributed dynamic rainfall-runoff model SWMM. The proposed framework was evaluated on a virtual urban catchment under two contrasted climates with different rainfall distribution. Pollutant fluxes from urban surfaces were analysed and compared for each climate over a one year period. Stormwater LCI results showed a site-dependency under a given climate, and a minor sensitivity to rainfall distribution.

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

TU108
Tissue specific 32P accumulation and consequent biological effects in bivalve molluscs
E. Vernooij, The University of Plymouth / School of Biological & Marine Sciences; J.T. Smith, University of Portsmouth / School of Earth and Environmental Sciences; A.N. Jha, Plymouth University / Biological Sciences

1. Introduction

The aquatic environment is the natural recipient of anthropogenic contaminants, 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 mCi/dl) taking into account a current no-effect screening value of 0.24 mCi/dl (European Commission). The first set of studies determined 32P accumulation in specific mussel tissues (i.e. adductor muscle, digestive gland, mantle, gills and ‘other’), internal mussel water (water inside the mantle cavity), shell and faecal matter using scintillation techniques. From this bioaccumulation study, we were able to highlight key tissues of interest; the digestive gland for example, received the greatest proportion of 32P independent of mussel species. In the next set of studies, a suite of biological responses of choice 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 0.1 mCi/dl in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to fresh water (DP), marine bivalve (MG) displayed lower DNA damage (both tissues) across all 32P 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 potential effect of contaminants in the aquatic environment.

TU109
Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a vitellogenin inducer?
L. Fernández González, P. Sanchez Marin, University of Vigo / Ecology and Animal Biology; G. Grueiro Noche, S. Muniategui Lorenzo, University of Coruña / Analytical Chemistry Department; A. P Diz, University of Vigo / Biochemistry Genetics and Immunology; r. beiras, University of Vigo / Toralla marine sciences station (ecimar)

Vitellogenins (Vtg), the egg-yolk precursor in female oviparous animals, is a common biomarker of estrogenicity widely used as an indicator of endocrine disruption in aquatic environments. Nevertheless, in the case of mollusks, it is still unclear if the synthesis of Vtg is regulated by steroid hormones as in the case of vertebrates. In the case of the synthetic hormone ethinylestradiol (EE2) the results of the studies are inconclusive. The aim of this work is to verify whether the estrogen, 17α-ethinylestradiol (EE2) induces the production of Vtg in Mytilus galloprovincialis at two exposure times and different nutritional regimes.

For that, we used a shotgun label-free proteomics approach by high resolution LC-MS/MS to identify and quantify Vtg in mussels gonads. In this way, we can verify if the energetic balance is a key confusing factor in Vtg production. The relationship between the maturity state of mussels and their Vtg levels was studied as another possible confusing factor. Mussels from uncontaminated area in Galicia (Spain) were collected in autumn/winter, corresponding with early gametogenesis stage. Mussels were exposed during 4 and 24 days to 100 ng L-1 of EE2 to assess whether Vtg synthesis was induced by EE2. During exposure, mussels were fed three times per week with two different regimes: a low regime (equivalent to 0.29 % of mussel dry weight per day) or with a high regime (equivalent to 5.55 % of mussel dry weight per day), representing negative and positive energy balance respectively. For the low feeding regime, shotgun proteomics identified an detected Vtg only in female gonads. The results showed an increase in Vtg levels in mussels exposed for 4 days to 100 ng L-1 of EE2 compared to the solvent control, although this increase was not statistically significant. In mussels exposed for 24 days to 100 ng L-1 EE2, Vtg levels were more than 2.5 times higher than in mussels exposed to a solvent control. These results suggest that EE2 does not induce Vtg in M. galloprovincialis. However, it is possible that Vtg synthesis was impaired by the fact that organisms were in negative energy balance. The results of the experiments done at a higher feeding regime (currently being analysed) will confirm this result. A significant correlation was found between Vtg levels and the maturation state of female mussels, indicating that maturation state is a confounding factor for the application of Vtg levels in disruption studies.

TU110

262

SETAC Europe 28th Annual Meeting Abstract Book
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 deposits. 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 both in-vivo and in-vitro experimental approaches to study the toxic effects of oil sands material collected from different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded negatively to the presence of oil sands material through different aquatic toxic responses (i.e. mortality, toxicity, and 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. Syrja, Helmholtz Centre for Environmental Research Gmbh / Effect-Directed Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

Many aquatic organisms are sensitive to man-made chemicals in the water. However, some species tolerate the occurrence of toxic chemicals and at the same time benefit from the nutrients that are often abundant in polluted waters. Such is also the case of the 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 Holtemme (Germany). The species was 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 mouthing 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 mouthing 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. TU144 Antenna Regeneration of the Marine Amphipod Paralyhehawaiensis as a Possible Endpoint in Ecotoxicology - Preliminary Data O. Diehl, P. Assano, G. Umbuzeiro, School of Technology, UNICAMP / LAEG Paralyhehawaiensis is a marine amphipod of worldwide circumtropical distribution. An ecotoxicological tests for. Hawaaiensis 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. hawaeiensis has local progenitor cell in each part of body. It was already been demonstrated that P. hawaeiensis has a fast regeneration of thoracic limbs, within a week, but no information on antenna’s regeneration was found. Thus, the aim of this study was to obtain data on regeneration of antennae of P. hawaeiensis to determine the viability this endpoint on toxicity tests. On day one left 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 an stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were feed three times a week, the necessary conditions of salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertook full regeneration. At the end of the last test, another picture taken to determine the difference between the length (mm) before and after full regeneration. Average regeneration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently. Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxics to assess their ability to undertake the regeneration process in the regenerated 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
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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 are just as important to assess as the water bodies. Marine and Estuaries are highly relevant conditions. Furthermore in community studies like aquatic mesocosms, terrestrial model ecosystems (TME) or field studies, a variety of non-standard species interacting with each other and their abiotic environment are included and can be evaluated. Aquatic mesocosm studies have been used as higher tier tool in risk assessment of plant protection products in the EU since the 1990ies. In the last decades, they have been able to be able to be adapted to non-standard species that cannot be covered by the current lower tier studies. However, community tests were often criticised for their high variability and low statistical power. In the last decade, sampling methods have been optimized and a pragmatic approach for MDD categorization has been developed to evaluate effects with regard to their statistical power. Furthermore, in the last years there is an increasing concern that current risk assessment is related to a single product while in the environment the populations are exposed to a multitude of different plant protection products. In principle, in those community test systems also multiple mixtures or typical sequences of products can be tested. Due to the characteristic of the cur-rent risk assessment procedure sequences of different products are not yet considered. In conclusion, community studies are often noticed only as tools to defend single plant protection products without recognizing their outstanding ecological value. These studies are still the most realistic approach to assess effects on population and community level under realistic environmental conditions. The position and the order of these highly informative studies in risk assessment should be rethought. We suggest further options to integrate community approaches in risk assessment, for instance as a screening test addressed to lower tier testing to get a broader idea about the relevant effects on ecosystem structure and function; 2) as monitoring tool for products which passed risk assessment to check up on community level effects; 3) as monitoring tool for typical sequence scenarios of different products which will be used together in one crop. Here exemplary results of community studies and a screening study will be presented.

TU116 Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa
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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 (WCBS Cost Assessment Project, 2011). Pollution has various effects on 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 showing the relationship between water quality and biodiversity in freshwater ecosystems. 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 low 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
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 developing the relationships between water quality and invertebrate communities, the next step was the establishment of a method for testing of mayfly species Epeorus sp. In the developed test system, contrary to usual indoor stream systems, not the water body itself, but test vessels inside test containers are circulated, thereby creating a target flow. The test containers are filled with medium and contains ten replicates each. Each replicate is a small cage, which serves as individual compartment for individual testing of one test organism. The surroundings are adapted to the natural habitat of the test organisms. As endpoints growth, emergence and mortality are observed during a 21 day exposure period. For the studies we use field collected larvae which are adapted to laboratory conditions.
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 Stonfly 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 Tetratin®, which was used in Stonfly testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. After that additional 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 Imidaclopid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and Stonfly larvae to Imidaclopid will be compared. The new testing method can provide toxicity data of a chemical versus the 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 Stonfly species will be presented.

TU119

Toxic effects of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation


Carbamate insecticides are commonly used in agriculture for crop protection extending their toxicity through the inhibition of the enzyme ethylcholinesterase. In Argentina, the maximum concentration of carbaryl (CAR) detected in surface and subsurface drainages was 45.7 μg L⁻¹. In this study, we evaluated the subchronic toxicity of environmental concentrations of the active compound and a commercial formulation of CAR on biochemical and reproductive parameters in Biomphalaria straminea, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 126.8 μg L⁻¹, and the equivalent to 126.8 μg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were so as to have the same molarity as azmophos-methyl, an insecticide previously used in our laboratory. In bioassay 1, eight glass vessels per treatment were used with six snails each. After 14 days of exposure, homogenates were made with the organisms’ soft tissues (pool of five snails per vessel). In the supernatant fraction, the following parameters were measured: cholinesterases (ChEs), carboxylesterases (CEs) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassay 2, ten 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 recorded and track the swimming speed of different marine invertebrates, including cnidarians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR systems have 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 alteration of marine invertebrates as 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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The application of lantihanes (Ln) in different sectors of the world economy has significantly increased during the last two decades. This process has been accompanied by the need for new environmental regulations. The anthropogenic anomalies of Ln in soil, surface water, groundwater and even in tap water have already been registered. The disruption of the natural biogeochemical cycle of Ln increases the risk of biota being exposed to elevated concentrations of Ln. However, the ecotoxicological effects of these elements and their fate in the environment are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, noticeably vary presumably due to different test conditions. For this study, acute ecotoxicity testing of Lu, Ce, Pr, Nd and Gd nitrates to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water. Also, long-term (21 days) exposure of D. magna (OECD 211) in lake water was included. It was shown that the Ln fractionation between two main phases (precipitated or settled or remained in the water column) changed during the tests depending on (i) water composition, (ii) nominal concentration, (iii) exposure time, and (iv) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigated Ln to both crustaceans was similar. The EC₅₀ values for 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 highest tested concentration (50 mg L⁻¹). In contrast to acute assay, the 21 day chronic test performed in the lake showed high Ln toxicity to D. magna (0.2 to 0.5 mg L⁻¹). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between EC₅₀ of individual Ln were not statistically significant. Thus, our results support the hypothesis that different lantihanes 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

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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 very sensitive 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 alteration of marine invertebrates as 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.

265

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As human population increases, the presence of emergent chemical contaminants (ECCs) in freshwaters increases. ECCs have shown to be persistent and bioactive, reaching the freshwater aquatic systems mostly untreated, where their fate and behavior is little understood. Anti-cancer drugs are among the ECCs of concern due to their high cytotoxicity and increasing usage. The administration of drugs in coral reefs, instead of single drug treatment, make the assessment of the environmental risk of these compounds a difficult task with much information lacking on sub-lethal effects on aquatic species. We used two cytotoxic drugs aiming at linking their effects on the reproduction inhibition of the rotifer Brachionus calyciflorus with processes of oxidative stress. The rotifer was exposed to four different concentrations of an antimetabolite (5-Fluorouracil; 5FU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Fluorouracil had a stronger effect (EC₅₀ =0.074 mg L⁻¹ on the population growth rate than Doxorubicin (EC₅₀=13 mg L⁻¹) and toxicity effects were detected at environmentally relevant concentrations. Two concentrations of each drug were chosen for binary mixtures and two concentrations per drug were used to assess reactive oxygen species (ROS) accumulation and plasma membrane damage with epifluorescence microscopy. In the presence of low concentrations of SFU, there was a reduction of the toxicity induced by DOX indicating possible antagonistic effects between both drugs. At concentrations, as low as EC₁₀, we found accumulation of ROS in a dose dependent manner showing a clear connection between ROS accumulation and the toxicity of these compounds. Furthermore, this indicates that biomagnification (contaminants obtained from food) and biomagnification (contaminants obtained from food) and bioconcentration (accumulation in the water body) may play a role in the toxicity of the metals and pollutants in corals. Corals can also include other elements into their skeleton lattice by substitution of Ca²⁺ 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 of uptake and different elemental compositions in the calcium carbonate matrix may lead to differences in the bioaccumulation of trace metals in the skeleton, particularly hard corals, where it may become part of the eventual skeleton by overgrowth. This pathway might conceivably be considered as “particulate bioconcentration”. Zooxanthellate algae are known to accumulate metals differently from their hosts. We surmise that the intricacy of the symbiosis between algal cells and coral tissue will make it difficult to ascribe relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

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 other esterase activities are important in terms of assessing the toxic mechanism of organophosphate and carbamate insecticides. There are several techniques for measuring AChE and general esterases (GE) activity involving spectrophotometric or fluorescence detection of transformation products. In this study, we tested four methods to detect AChE and GE activity in vitro and in vivo in the two aquatic invertebrate species: Daphnia magna and Chironomus riparius. Four different species were chosen for this control (differences in activity) 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 acetylcysteine (ACh) as substrate, measuring acetyl production; 3) GE-assay using 1-naphthyl acetate (1-NA) as the substrate, measuring 1-naphthol production and 4) GE-assay using 4-methylbenzylidene butyrate (4-MUB) as the substrate, measuring 4-methylbenzylidene formation. Michaelis-Menten curves were created for all substrates, where it was possible. The results showed that the GE-assay using 4-MUB measured general esterase activities well both in vitro and in vivo. The AChE-assay using ATCI and ACh as substrates showed comparable activity in vitro and in vivo, which indicates a possible metabolic reactions to long-term exposure. The maximal GE-activities in D.magna and C. riparius were 345±44 and 151±51 nmol min⁻¹ and 17.4±1.7 nmol min⁻¹ mg⁻¹ protein for D.magna and C. riparius, respectively, making C. riparius the species with the highest activity.

Turning to in vivo measurements, the GE-activities were 49.1 and 17.4 nmol min⁻¹ mg⁻¹ protein for D.magna and C. riparius. The results of GE-assays using 1-NA and 4-MUB are similar. The AChE-assay could not be conducted in vivo. The GE-assay using 4-MUB, however, could be conducted in vitro as well as in vivo. The GE-activity in D.magna was higher while the AChE-activity in D.magna was lower compared to C. riparius.

TU125

Factors influencing bioaccumulation of metals and pollutants in corals

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Tetrationhroethylene (TCE) is a contaminant frequently found in groundwater of industrialized areas worldwide. The degradation of this chlorinated aliphatic hydrocarbon (CAH) is often incomplete in groundwater and takes several decades. Contamination from TCE is considered persistent and difficult to remediate, due to its high density that favors a gravity-driven vertical infiltration into groundwater bodies. Through means of the Water Framework Directive the European Union has demanded Member States to provide TCE threshold values (TV) for assessing groundwater body quality. In Italy, TCE TV is 1.1 μg/L in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in both algal cells and coral tissue will make it difficult to ascribe relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

TU126

Survival, metabolic rates and locomotory activities of a groundwater-obligate copepod species under long-term exposures to tetrachloroethylene

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Polycyclic aromatic hydrocarbons (PAHs) constitute a class of widely distributed environmental contaminants of the water of a particular area. This occurrence. The crystalline structure of the CaCO₃ coral skeleton differs between hard and soft corals, being either aragonite or calcite. Different mechanisms of uptake and different elemental compositions in the calcium carbonate matrix may lead to differences in the bioaccumulation of trace metals in the skeleton, particularly hard corals, where it may become part of the eventual skeleton by overgrowth. This pathway might conceivably be considered as “particulate bioconcentration”. Zooxanthellate algae are known to accumulate metals differently from their hosts. We surmise that the intricacy of the symbiosis between algal cells and coral tissue will make it difficult to ascribe relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

Molecular and biochemical biotransformation responses in oysters Crassostrea brasiliana ( Lamarck, 1819) exposed to pyrene and fluorene

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Polycyclic aromatic hydrocarbons (PAHs) constitute a class of widely distributed organic pollutants in aquatic environments. PAHs affect organisms due to its carcinogenic, mutagenic and/or teratogenic characteristics. Once the PAHs enter...
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster *Crassostrea brasiliana* exposed to pyrene (50 mg.L\(^{-1}\) and 100 mg.L\(^{-1}\)) and fluorene (100 mg.L\(^{-1}\) and 200 mg.L\(^{-1}\)), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcription of phase I (CYP1-like, CYP2-like, CYP2AUI and CYP156A1-like) and phase II (GST-like, GSTm-like and SULT-like) biotransformation genes, EROD, GST and GSTm activity, were evaluated in gills. The half-life time of pyrene (100 mg.L\(^{-1}\) = 2 h and 12 min) in water was lower than fluorene (100 mg.L\(^{-1}\) = 5 h and 54 min). These results might be related to the higher lipophilicity of pyrene, facilitating its influx through the plasma membrane into the intracellular compartment and ensuing metabolic activation. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Also evidences a possible participation of these genes and enzymes in pyrene biotransformation metabolism. In addition, it suggests the participation of CYP2AUI gene 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 Impact on Marine Protected Area: cross-border co-operative actions), which has the purpose to deploy 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 adjacent protection area and an adjacent MPA. This study was carried out during the 2018 summer season, in the Livorno harbour, where we intended to explore the eventual adverse effects of point 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 the control and the exposed area. GST and GPX 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 metabolism. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Further studies could be performed to validate the usefulness of these biomarkers for monitoring marine polluted areas.

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 (Haro et al., 2007). The invasive species are being used extensively in laboratory tests for their usefulness for seeking mechanistic links between effects occurring at the individual level and consequences for higher levels of biological organization. In addition, compared to vertebrates they are easy to maintain under laboratory conditions, widely distributed and ecologically relevant. Although Cnidarian jellyfish (*Scyphozoa*) are known to play an important role in marine food chains as predators, grazers and decomposers of other species, they are not yet employed in routine ecotoxicology. The aim of this current investigation is to suggest the use of two new invertebrate species of the jellyfish * Aurelia sp.* and *Sanderia malayensis* as model organisms in ecotoxicological bioassays. A series of experiments were carried out in laboratory controlled conditions, in order to characterize some experimental parameters that can influence the frequency of development and survival endpoints. Finally, the results of a sub-lethal response test for this innovative invertebrate model for ecotoxicological testing. After these preliminary tests, ephyrae were exposed to a wide range of potentially toxic compounds (metals, surfactants, pesticides, nano-materials and harmful algae, emerging compounds), in order to evaluate the potential of ephyrae jellyfish in ecotoxicology. The experiments allowed to identify two end-points (sub-lethal, frequency of pulsed and acute, immobilization) with different levels of sensitivity and to optimize the use of an automatic recording system of swimming marine invertebrates (Swimming Behavioural Recorded e SBR), already employed with other biological models. In addition, the comparison of the EC50
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  
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In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental indication of chemical analyses. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount.  
Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in eco-toxicology 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 substitute and orthogonal endpoint. In detail, we optimized and improved an automated recording system, namely Swimming Behavioral Recorder system (SBR), by developing i) a new swimming speed alteration test used 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 sea urchin embryos cannot sustain 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 fractionated using a sequential LC-UV fractionation methodology based on two different columns: a Nucleodur C18 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), REF final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-target analysis was performed by means of UHPLC-Qactive Plus MS in positive and negative modes with a C18 column. Toxic compounds were identified using MS2 spectra, Metfrag and Compound Discoverer (Thermo) interfaced to mzmine. Among the collected C18 fractions, only fraction 113 (F13) showed a clear toxicity and, therefore, it was tested separately to establish the concentration-response model. The curve-dose response of the raw sample (EC$_{50}$=10 REF and EC$_{50}$=19 REF) could be explained by the contribution of active F13 (EC$_{50}$=14 REF and EC$_{50}$=9 REF). Regarding the chemical analysis, among the final candidate list (206 compounds), mendezanolone (an antihelmintic agent) was confirmed chromatographically with standards. Nevertheless, a sequential fractionation of F13 was also carried out with an aminopropyl column, which showed a different orthogonality compared to C18 column, and the resulting 15 fractions were also submitted for further bioassays and data-dependent analysis. Overall, the results of this work suggest the possibility of addressing a kind of specific toxicity in sea-urchin embryos owing to the determination of only one toxic fraction and the contaminants identified in that fraction. Acknowledgement. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. L. Mijangos is grateful to the Basque Government and H. Ziarrusta to the Spanish Ministry for their predoctoral fellowships.

**TU134**

Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity  
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Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxygenase pathway. As signaling molecules, they are important for diverse physiological systems such as inflammation, allergy, pregnancy, pain perception and blood pressure control. Therefore, they could be the important target for toxicant 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 transcriptional 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 transcriptomes. To ensure accuracy, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under different dietary exposures (regular and restricted) and, regarding chemical mixtures of natural environments, pulse exposures (on Pb acclimated daphnids) to the fungicide mancozeb were also accomplished. Organisms from Pb were changed to a clean media for recovery for three generations. To monitor acclimation, standard acute immobilization tests to K$_{3}$CO$_{3}$O$_{4}$ (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, except D. similis from recovery period under food restriction. However, Pb tolerance increase is seen on both species. Regarding mancozeb exposure (Pb acclimated), no difference between treatments is seen under regular food. However, opposite outcomes are shown under food restriction, such as D. magna increasing and D. similis decreasing tolerance to mancozeb. Adverse outcomes regarding recovery was shown, D. magna relied on genetic adaptation, since it kept a higher tolerance to Pb, even after three generations under recovery, and D. similis relied on physiological acclimation, being similar to organisms from control treatment. Food restriction also decreased reproduction and increased neonates’ body length (both species). The opposite outcomes under food restriction is crucial regarding natural environments and the natural fluctuating amount of nutrients. Therefore, results indicate that daphnids are capable of acquiring resistance to Pb under a long-term exposure, being an essential data on chemical mixtures contaminated habitats, since their tolerance to other chemicals can vary (as shown for D. similis). And also, opposite outcomes regarding monoeciatric species indicates that it is not accurate to use species from different climates to estimate toxicity.

**TU135**

Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach  
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Plano human activities can be related to environmental contamination (e.g. industries, agriculture). Those contaminants may have continuous or pulse sources that do not necessarily cause mortality; therefore, behavioral endpoints are less invasive than traditional acute tests, but still sensitive and more ecological relevant. In different latitudes even phylogenetically close related species may present divergent chemical tolerance. Therefore, it was used in this study the model species from temperate areas Daphnia magna and the tropical species Daphnia similis. Most studies rely on short term acute and chronic tests. To enhance accuracy, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under different dietary exposures (regular and restricted) and, regarding chemical mixtures of natural environments, pulse exposures (on Pb acclimated daphnids) to the fungicide mancozeb were also accomplished. Organisms from Pb were changed to a clean media for recovery for three generations. To monitor acclimation, standard acute immobilization tests to K$_{3}$CO$_{3}$O$_{4}$ (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, except D. similis from recovery period under food restriction. However, Pb tolerance increase is seen on both species. Regarding mancozeb exposure (Pb acclimated), no difference between treatments is seen under regular food. However, opposite outcomes are shown under food restriction, such as D. magna increasing and D. similis decreasing tolerance to mancozeb. Adverse outcomes regarding recovery was shown, D. magna relied on genetic adaptation, since it kept a higher tolerance to Pb, even after three generations under recovery, and D. similis relied on physiological acclimation, being similar to organisms from control treatment. Food restriction also decreased reproduction and increased neonates’ body length (both species). The opposite outcomes under food restriction is crucial regarding natural environments and the natural fluctuating amount of nutrients. Therefore, results indicate that daphnids are capable of acquiring resistance to Pb under a long-term exposure, being an essential data on chemical mixtures contaminated habitats, since their tolerance to other chemicals can vary (as shown for D. similis). And also, opposite outcomes regarding monoeciatric species indicates that it is not accurate to use species from different climates to estimate toxicity.
4-hydroxyphenyl 4-isopropoxyphenylsulfone (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appeared to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU137 Oxidative effects of mono(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level

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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 (EC) 2004/2008 on the placement of MEHP as act as environment disrupting chemical in aquatic organism such as Daphnia Magna. The aim of this study was to elucidate the linkages between toxicity test result and oxidative stress of MEHP. We studied the effects of oxidative stress as molecular initiating events on Daphnia magna. We observed the changes in different levels of the lipid peroxidation, glutathione S-transferases (GSTs), catalase (CAT) and superoxide dismutase (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU138 Are Daphnia magna and Chironomus riparius acute responses comparable?

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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 toxics. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data requirement in EU Regulation 2004/2008 on the placement of MEHP as act as environment disrupting chemical in aquatic organism such as Daphnia Magna. In recent years even the use of first larval stage of Chironomus riparius (Insecta, Diptera) has been proposed (OECD test guideline n. 235, 2011) to be used to complement existing Test Guidelines for chromosomal 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 surface waters as it is the first larval stage 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 conditions/sensitivity of the breeding organisms in the lab Therefore it can be of interest to understand its relevance when compared with the answers of other organisms, belonging to other taxa and with different life cycles. In order 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, commonly used to test sensitivity of C. riparius and D. magna respectively) and an unknown toxicant (a fatty acid C14-C20). Preliminary results indicate possible discriminatory potential between test organisms; if confirmed by definitive testing these observations may represent a warning when carrying out acute testing toxicity on water medium, confirming the importance to test different trophic levels and showing the need to further investigate the use of the acute test on Chironomus riparius according to OECD 235 to assess the acute toxicity on aquatic organisms.

TU139 Analysis of mixtures of bisphenol A and UV filters Octocrylene and OD-PABA on Chironomus riparius using a specific RT-PCR array

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Ana-Belén Muñiz-González, José-Luis Martínez-Guitarte, l祖父Groupo de Biología y Toxicología Ambiental. Facultad de Ciencias. UNED. Madrid (Spain)Keywords: UV filters, BPA, RT-PCR array. The ultraviolet (UV) filters are main components of many personal care products (PCPs) that are extensively used. They are organic compounds defined as emergent contaminants, which are increasing their presence in the environment because their use in recreational and industrial activities. Described as endocrine disruptors in vertebrates, their effects on invertebrates have been poorly studied, especially in mixtures. On the other hand, Bisphenol A (BPA) is as plasticizer used in packaging and other industrial products with confirmed endocrine disruption activity. In this study we have used two common UV filters, octocrylene (OC) and 2-ethylhexyl 4-dimethylaminobenzozate (OD-PABA), and BPA to mimic the mutative mixtures resulting from PCP and interactions with plastic of PCP containers. These mixtures allow reach the biopsy 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. The potential of mixtures was analyzed by retrotranscription and Real-Time PCR using a specific array covering a multiple relevant metabolic pathways like endocrine system, immune response, stress response, detoxification mechanisms and apoptosis among others. Using an array could improve the toxicological evaluation of the cellular effects of the compounds favoring the identification of new molecular biomarkers useful for ecological risk assessment and toxicity tests. The methodology used to design the array can be used with other species improving also our knowledge about the mode of action of these compounds. In this work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), C2TM2015-64913-R/aN/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 population resistance to environmental changes and is considered a useful tool to underpin adaptation 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, to assess how genotypic sensitivity varies with the environment and study of toxicity mechanism asexual reproduction under different genotypes and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A. C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbical 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 fungous disease and cotton pests. The use of this pesticide declines at high rates, there is an increased 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 mg L–1) resulted in impairment of C. riparius emergence and developmental rates (reduced larval growth and delayed emergence), with male development time being
the most sensible endpoint (LOEC of 40 µg L⁻¹). Short-term exposures (48 h; 0, 10, 40, and 160 µg L⁻¹) to amitraz induced glutathione peroxidase activity and a decrease in catalase activity. Additionally, amitraz exposure caused a decrease in lactate dehydrogenase activity and a significant increase in electron transport system activity, both energy metabolism associated biomarkers. Regarding oxidative damage biomarkers, lipid peroxidation increased in C. riparius larvae exposed to amitraz. Whether there was a significant decrease in DNA damage levels at 10 and 40 µg L⁻¹ treatments. The study 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/1302/2014), 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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Department of Biology, University of Aveiro / Biology; A.R. Silva, University of Aveiro / Dept.of Biology & CESAM; D. Nunes Cardoso, CESAM; U. Kervran, INRA, Université de L'Île-de-France; T. Neves, University of Aveiro / department of Biology & CESAM; P. Silva, Universidade de Aveiro; J. Uclar, University of Ljubljana / Department of Biology; F.J. Wrona, University of Calgary / Department of Biological Sciences; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology Agricultural practices include the use of agrochemicals for crop maintenance and enhanced productivity. Although soil contamination may result in organo-agrochemicals, copper pesticides, have been used in a range of agricultural applications, which may result in environmental problems. More recently, nanopesticides were introduced in the market with the intent to improve efficacy and decrease environmental negative effects. However, the chronic ecotoxicological effects of nanopesticide exposure on soil biota are not well known since related environmental hazards are most often assessed using only the active ingredients. Moreover, the multigenerational effects of long-term, chronic exposure of soil organisms to agrochemical applications are unknown. The objective of this study was to evaluate the impact of long-term, multigenerational exposure of the soil collembola Folsomia candida to conventional and nanoparticle formulations of copper pesticides. Two formulations were assessed: Kocide® 3000 (nano form) and Champion® WP (conventional), as well as the pure active ingredient Cu(OH)₂ in spiked LUFa 2.2 soil. The effects of multigeneration exposure to the Cu pesticides were assessed using two soil treatments: 1) Cu spiking performed only at the beginning of the experiment and collembolan responses (survivorship, reproduction) measured for three generations (i.e., aging soil exposure); and, 2) Cu spiking performed at the start of each new cohort from generation to generation (i.e., renewal soil exposure). After three generations in both soil treatments, the surviving collembola were moved to uncontaminated soil for three generations to assess their recovery potential. Similar response patterns were observed in the two soil treatments for all three Cu formulations. Exposure to aging soils revealed an increasing tolerance across generations of F. candida. In contrast, in treatments with renewed Cu spiking, the collembolan populations showed ongoing sensitivity to Cu exposure. In both treatments, after being moved to clean soil, all treatment populations showed some recovery by displaying increased reproductive output. Copper forms presented different between them in the long term exposure. This study further emphasises the importance of using multigenerational approaches to obtain more ecological relevant evaluations of environmental risk associated with chronic exposure to soil agrochemicals.

TU143    Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behavioural of amoebocytes and eleocytes

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TU144    Toxicity of abamectin and difenoconazole, pure and formulated, to Folsomia candida

L.P. Figueiredo, University of São Paulo USP; G. Mainardi, Vrije Universiteit / Department of Ecological Science; C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; D. Rodolf, Vrije Universiteit / Department of Ecological Science. The progressive increase in the use of pesticides has been accompanied by effects at different levels of biological organization, implying losses of species and consequently of ecosystem services. Among the species utilized in terrestrial ecotoxicological tests, the springtail Folsomia candida (Collembola, Isotomiidae) is one of the species suitable for assessing side effects of agrochemicals. In Brazil, the acaricide abamectin and the insecticide difenoconazole are widely used in agriculture, but little data is available about their possible side effects on the soil community. The objective of this test work therefore was to evaluate the effect of abamectin, pure and in the formulation Kraft®, and of difenoconazole, pure and in the formulation Score®, on the reproduction of F. candida using a standard Lufa 2.2 soil. Juvenile F. candida, with age 10-12 d, were exposed following the standardized ISO and OECD test guidelines. The results were analyzed by analysis of variance (ANOVA) followed by Dunnett’s test at 5% significance level. Median lethal concentration (LC₅₀) was calculated using Trimmed Spearman Karber (TSK) and EC₅₀ and ECₐ₀ values for effects on reproduction were estimated using a logistic model. The results showed that both pesticides were more toxic in the formulation than when applied as pure active ingredient. For abamectin dosed as the formulation Kraft®, EC₅₀ was 1.0 (0.17-1.8) mg/kg dry soil, while it was 6.3 (1.8-11) mg/kg dry soil for the pure active ingredient. For difenoconazole applied as the formulation Score®, EC₅₀ was 53.5 (40.0-67.0) mg/kg dry soil while no effects on springtail reproduction were seen at concentrations of the pure active ingredient up to 333 mg/kg dry soil. The data indicated that it is essential to use the commercial formulation for tests with pure active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically understand increased toxicity levels caused by the tested formulations.

TU145    Terrestrial arthropods as indicators of environmental pollution

V. Lesch, North-West University; H. Bröwman, North-West University / Unit for Environmental Science and Management

In recent years, the use of and interest in terrestrial arthropods as indicators of environmental pollution has increased. Arthropods are an abundant group with more than 30,000 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 related environmental hazards are most often assessed using only the active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically understand increased toxicity levels caused by the tested formulations.
The ecological risk assessment of pesticides requires data regarding their effects to terrestrial non-target species. Commercial pesticides formulations, however, contain a significant proportion (> 90%) of so-called inert ingredients, which may greatly enhance or lessen the toxicity of a formulation. Chlorpyrifos is a broad-spectrum organophosphate insecticide that is used globally for crop protection and pest control and as many other active ingredients of pesticides is applied formulated into a suitable product. The objective of this study was to investigate the impact of the technical active ingredient (a.i.) chlorpyrifos and its four commercial formulations (Durban® 480 EC, Pirystex ® 480 EC, Pirystex ® 480 EC, Nurelle® D) on the acetylcholinesterase activity in snail Helix aspersa and earthworm Eisenia andrei. The difference in sensitivity of tested organisms towards above mentioned pesticides was assessed by the in vitro exposures at range of concentrations 5-300 μg/L. In the different fractions of organisms homogenate (head and haemolymph in snails; head and whole body in earthworms). The results from the in vitro study with the technical active ingredient and formulations showed AChE inhibition in a concentration dependent manner. The most sensitive responses to pesticides formulations exposures were found in H. aspersa haemolymph and E. andrei whole body homogenate. Among the tested pesticides, the inhibitory effect (based on the IC50s comparison) increased in the following order a.i. < Nurelle® Durban® < Pirystex ®< Pirystex ® (snail haemolymph). This study showed that the formulated pesticides caused significantly higher AChE inhibition compared to the technical a.i. in both model organisms. The data suggested that the in vitro exposure studies have predictive value for sensitivity to insecticides. Risk assessment based on the on active ingredient toxicity might be sufficient and toxicity testing of both a.i. and commercial formulation provide more realistic reports on the overall ecotoxicological impact of pesticides on sensitive non-target organisms. Keywords: chlorpyrifos, acetylcholinesterase, non-target organism, pesticide

Ariadna spider as a good candidate bioindicator of heavy metal contamination in the Namib Desert E. Conti, University of Catania / Department of Biological, Geological and Environmental Sciences; G. Liberatò, G. Liberatò, G. Protano, F. Nannoni, University of Siena / Department of Physical, Earth and Environmental Sciences; G. Costa, University of Catania / Department of Biological, Geological and Environmental Sciences; S. Corsi, University of Siena / Physical, Earth and Environmental Sciences. Human activities are strongly affecting natural ecosystems and native species have been proposed as bioindicators for pollution monitoring and assessment. The present study is the first attempt to use Ariadna spiders as indicators of trace metals contamination in the Central region of the Namib Desert. Mining activity is the biggest contributor to Namibia’s economy in terms of revenue and several trace elements as well as semi-precious gemstones and minerals are main products. Therefore, their released and potential contamination of specific Namib mining areas cannot be excluded. Various spider populations belonging to undescribed Ariadna species are widespread in gravel plains within the Central Namib Desert. Being sit-and-wait predators, Ariadna spiders spend their life in individual tunnels dug in the soil, so resembling the behaviour of ground-dwelling spiders known to be strong metal accumulators in terrestrial ecosystems. In the present study, we collected 60 specimens of three Ariadna populations (20 spiders from each site) in astral summer 2016, along a N/S and W/E transect at various distances from main mining areas of the Namib Desert. Depth and diameter of entrance burrow and body weight of each spider were recorded. Trace metals analysis were conducted in spider’s whole body as well as in soils samples collected around spider’s burrow. Oxidative stress parameters, CAT, GST and MDA were analysed in soft tissue of spiders and neurotoxicity assessed by measuring cholinesterase activity (ChE). Entrance diameter and depth of burrow seems to be affected by the distance from mining areas. Levels of Zn, Cd, As and Cu resulted higher in Ariadna body compared to levels found around their burrows. On the opposite levels of Pb, V, Cr, Co and Ni were 1 or 2 order of magnitude lower in spiders than in soils. Similar trends in such levels and biological responses as CAT, GST and ChE were observed among sites and based on various distance from the mining area. Such preliminary results support the recognition of Ariadna spider as a good candidate as bioindicator of trace metals contamination in Namib Desert.
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 laundering. Therefore, the fiber type and composition confirmed that these fibers still contained traces of the functional DWR treatment. Released into the environment these fibers might be exposed to long term degradation processes which would finally cause the formation of persistent environmental pollutants. In addition the results of this study suggest that similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

TU151

Microplastics in the environment: Evaluating the risks and identifying knowledge gaps
E.E. Burns, University of York / Chemistry; A. Boxall, University of York / Environment Department

The past ten years has seen increasing scientific and public concern over the harmful effects of microplastics (MPs) in the natural environment. In 2010, < 10 scientific publications contained the word ‘microplastic’ while this number had risen to around 170 in 2016. Alongside this, there have been significant policy and regulatory developments around the use and emissions of MPs. We present the results from a systematic review of the published literature to attempt to answer the question ‘what is the evidence that microplastics adversely impact freshwater and marine systems?’ In answering this question, we explore the evidence-base for a number of impacts on water quality, fish, birds and mammals. We have then undertaken the global coverage of microplastic occurrence studies in both aquatic and sediment compartments. We found that of the many of the occurrence studies employ unsuitable analytical confirmation methods which may lead to high error rates and limit data interpretation. In many ecotoxicology studies, effects were not seen at the highest concentrations investigated while others reported impacts at concentrations of 1-3 mg L^-1. The results confirm that calcium poly(styrene sulphonate) microplastics are of scientific and societal interest 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 structurally and physico-chemically stable, it may become a long-term source of organic and inorganic pollutants to aquatic environments.

TU153
A cost-effective methodology for separation of microplastics from freshwater systems
M. Rodrigues, Department of Biology & CESAM - University of Aveiro / Department of Biology; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; H. Nogueira, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University; N. Abrantes, University of Aveiro / CESAM

We have summarized the global coverage of microplastic occurrence studies. Only then will we be able to determine whether these materials are having real impacts or not.

TU154
Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems
S. Pehl, University of Bayreuth / Department of Animal Ecology 1; E.C. Atwood, RSS Remote Sensing Solutions GmbH; M. Boehm, Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences; N. Abrantes, Remote Sensing Solutions GmbH; S. Piehl, Lewis Maximilians University of Munich / Department of Biology; C. Laforsch, University of Bayreuth

Recently, there have been intensified research efforts to get reliable information about sources, sinks, and transportation pathways of microplastic in aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Environmental remote sensing provides the potential for the mapping of microplastics (< 5 mm) are of scientific and societal interest 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 structurally and physico-chemically stable, it may become a long-term source of organic and inorganic pollutants to aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Environmental remote sensing provides the potential for the mapping of microplastics (< 5 mm) are of scientific and societal interest 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 structurally and physico-chemically stable, it may become a long-term source of organic and inorganic pollutants to aquatic environments.
TU155 Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ samples and ocean current modelling
E.C. Atwood, RSS Remote Sensing Solutions GmbH; F.M. Falcieri, CNR - IFSAR; S. Pellet, University of Firenze; S. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; M. Matthies, University of Osnabrueck / Institute of Environmental Research; J. Franke, RSS Remote Sensing Solutions GmbH; S. Carmel, M. Scambio, CNR - ISMAR; C. Laforsch, University of Bayreuth; F. Siegert, RSS Remote Sensing Solutions GmbH.

Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, coral reefs, the fishing industry and shipping transport safety. Microplastics, defined as particles < 5 mm, form a considerable portion of this pollution and have recently received increased public attention following recent discoveries that not only can these particles be ingested by planktonic animals, but also outnumber natural food items in some ocean areas. Ingested particles can induce negative survival effects as well as serve as introduction vectors for accumulated persistent organic pollutants (POPs) or carcinogenic plastic additives into the base of the food chain, potentially leading to many seafood products consumed by humans. Research has mainly concentrated on marine systems, and while a growing number of studies focus on freshwater lakes, river systems have to date received little attention. In particular, riverine plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas remain largely unexplored. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from Landsat and Sentinel-2A. Model accumulation maps were validated against in situ samples 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 identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

TU157 Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK
R.M. Blair, S. Waldron, University of Glasgow; C. Gauchotte-Lindsay, University of Glasgow / Infrastructure and Environment; V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

Microplastics (MPs; < 0.5 mm) are classified as contaminants of emerging concern but currently are not regulated by water quality standards. Microplastics are highly diverse and their distribution in the environment is highly variable in space and time, making their quantification and risk assessment difficult. Further, their monitoring and regulation are hindered by limited empirical data, particularly of fresh- and wastewater systems as important pathways of land-based contaminants to oceans. Here, a study was conducted in a tertiary sewage treatment plant in the UK (Glasgow, Scotland) to assess the presence of MPs in the system and the effect of treatment stage in removing these contaminants before discharge into recipient estuaries. The MPs were extracted from 5 L samples at each treatment stage, using H2O2 digestion and vacuum filtration through 1.2 µm GF filter. Characterisation and quantification of MPs was carried out by light microscopy followed by detailed chemical analysis of representative subsamples via SEM-EDS and FTIR-ATR. Microplastics were present in wastewater samples collected at all treatment stages, and abundances generally decreased from inflow to outflow. Further, high variability in MP abundances was evident across sampling dates. Chemical characterisation by SEM-EDS revealed that 94% of analysed pieces were C-based materials, but only 25% were confirmed plastics based on FTIR-ATR results. In conclusion, the tertiary treatment process evaluated here efficiently removes MPs entering the system but small quantities may still be discharged into the environment. Further, visual characterisation with light microscopy may result in overestimation of MPs due to misidentification of cellulose and other non-plastic microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

TU158 Weathering-induced changes in the effects of microplastic particles and their leachates
J. Joehlen, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; C.D. Runnel, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Bioanalytical Ecotoxicology; D. Kühnel, Helmholtz-Centre for Environmental Research / Bioanalytical Ecotoxicology; M. Schmitt-Jansen, UFZ - Helmholtz CRe Environm. Research / Department of Bioanalytical Ecotoxicology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. MacLeod, University of Stockholm / Department of Environmental Science and Analytical Chemistry.

Studies on the potential effects of microplastic (MP) particles in the aquatic environment are numerous. However, many laboratory studies apply spherical, pristine particles, which may be of limited relevance given UV light irradiation, mechanical stress, salinity, biofilm growth and other factors that can influence the weathering of the particles. Due to the environmental impact of MP and their potential effects, a novel Oceans-funded project WEATHER-MIC is to assess the impacts that weathering has on the transport, fate and effects of MP particles and their leachates. We summarize recent results on potential effects. (1.) Influence of MP particles on organisms: We have exposed copepods, daphnia and algae to different fractions of virgin and weathered MP as well as particle-free leachates under controlled conditions. From the observation of apical endpoints in the acute toxicity assays, concentration-response relationships for the different fractions can be deduced. A critical evaluation of the suitability of the applied test protocols for the assessment of adverse effects of MP will be presented. (2.) Influence of ageing plastic and leachates on biofilm structure and function: Natural biofilms (containing bacteria, algae and fungi, embedded in extracellular polymeric substances) grown on microplastics on different types of aged and pristine polymeric substrates have been studied to observe the influence of weathering on the attachment and succession of biofilms. Sum parameters (biomass, pigment profiles, photosynthesis) and sequencing data were studied. (3.) Mixture effects of leachates from the most common polymers: Cell-based bioassays have been applied to study mixture effects of additives and degradation products of the polymers liberated during weathering of plastic material in artificial seawater in agitated UV chambers. The chemicals in the seawater leachates were enriched by solid-phase extraction or chemicals were directly extracted from pristine particles by ultrasonic-assisted solvent extraction. The concentrated leachates and solvent extracts were then dosed into cell-based bioassays, covering i) cytotoxicity; ii) activation of metabolic enzymes, e.g. via binding to the arylhydrocarbon receptor; iii) specific, receptor-mediated effects such as estrogenicity; and iv) adaptive stress responses such as oxidative stress. The results may help to understand effects caused by additives and parent compounds opposed to the degradation products liberated from the UV-weathered plastic.
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 water, wastes in aquatic environments and so on. This research shows occurrence and characteristics of MPs in surface waters. Sludge treatment 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 standardized microplastics (MPs) by FT-IR and microscopy. MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.

TU160 Detection of micro-plastic particles and microplastic in harbour soil samples using FPA-μFTIR-Imaging-FTIR
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, N. van Alst, F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering (52%), Aalborg University / Department of Civil and Environmental Engineering (48%). The particles size distribution showed the most abundant size range was 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-particle samples were successfully extracted and detected in a recreational harbor using the art analytical approach including multi-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. Horling, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hamey, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences
Wastewater is considered to be one of the major sources of microplastics (MPs) entering surface waters. Although a high retention potential of wastewater treatment plants (WWTPs) for MPs in raw wastewater has been reported, the composition and quantity of MPs collected from different treatment plants are divided into three fractions (0-5, 5-10, 10-15 cm). Separated plots receiving the same sludge treatments and soil conditions were assumed to be retained and accumulated in the sewage sludge. Runoff, after application of sewage sludge to agricultural soils, may consequently serve as an important source of MPs in the terrestrial environment through WWTP effluents, whereas the majority of MPs are assumed to be retained and accumulated in the sewage sludge. Runoff, after application of sewage sludge to agricultural fields, may consequently serve as an additional source of surface water contamination by MPs. Therefore, the aims of this study were: (i) to evaluate the occurrence of MPs in river waters; and (ii) to ascertain the contribution of WWTP effluents. The study was carried out in the Henares River watershed (Central Spain). Five WWTPs with differing dimensions (population equivalents between 10,000 and approx. 400,000), differ influence types (domestic, industrial, or both mixed), and differing treatment processes were selected. Wastewater inflow, outflow, and sludge (humid and dried) were sampled during two different seasons (spring and autumn). In addition, river water and sediment samples were taken in three different seasons (spring, 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 100 to 300 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 type and composition using FTIR (Bruker, Villus, Karlsruhe). This study aims to evaluate the occurrence of MPs in different matrices and to discuss the implications on human health. Despite of these studies point out the occurrence of micro plastics in freshwater systems including surface and groundwater basins, very little in known about its occurrence of micro plastics 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 other sources, such as sea salt, beer, and food and seafood. The research tasks of the present work were: Map published and available literature, develop and optimize a standardized fast, sensitive protocol for sampling and quantification of nano/microplastics particles in drinking water and finally. Analyze and possibly
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

V. Verney, CNRS - ICCF / Photochimie-CVP; G. BISSAGOU KOUMBA, UJAFICCF; F. Delor-Jestin, Sigia-ICCF; Z. Domnick, H. Askanian, CNRS-ICCF; J. Peiry, E. Rousset, O. Voldoire, CNRS-Geobal; A. Schaal, L. Durantou, Observatoire du Microplastique; M. Liboiron, Memorial University of Newfoundland

It is now known that the vast majority of microplastics found in the seas and oceans originate from lands. In such a process 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 (UV, rain, wind, mechanical erosion,...) which will continue and amplify its degradation, leading to its fragmentation. The work we have undertaken consists of: 1) Mapping the presence, the motility and the 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 Plasticcages 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 babyleg sampling net[3, 4], which makes it possible to multiply samples and analyses. 1 Occurrence of plastic litter in the Allier river in France, Vincent Verney, Gaëlle Bissagou Koomba, Alexandre Garreau, Florence Delor-Jestin, Erwan Roussell, Olivier Voldoire, Jean-Luc Peiry; To be published 2 https://www.researchgate.net/project/PLASTICCAGES 3 Compromise agency, the case of babylegs, Max Liboiron, Engaging Science, Technology and Society (3), 2017, 499-527 4 http://lapalagiessaussage.org/laboratoirerecyclen/
Occurrence and concentration of microplastics in an urban river C. Campanile, C. Massarelli, G. Baguñao, Italian National Research Council; V. Uricchio, Italian National Research Council / Water Research Institute

The term ‘microplastics’ was first used in 2004 to describe very small fragments of plastic (<50 μm) in the water column and in sediments. In 2006, E. Spildevand A/S. The treated wastewater was sampled before and after the disc filter was installed on the FPA. The filtered volume of effluent wastewater was determined using standard methods; the corresponding sample was stored in a mixture of organic matter, inorganic particles and microplastics. 

Environmental Science and Analytical Chemistry (ACES)

Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of polymers, sizes and shapes. However, risk assessment of MP exposure, in the lower size range (<100 μm), 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 separated from those due to background variability.

Environmental impacts could be, for example, the extensively documented dying of birds or fish or evading food, which contains microplastics. The resulting food web will accompany, if not outlast, mankind for a long time. PlasticBudget is a project and discussed in expert dialogues as well as other 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)

In this study, the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10–50 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 Spildevand A/S. The treated wastewater was sampled before and after the disc filter by filtering 1000 L through a stainless steel disc filter to remove large-scale water sampling devices. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The remaining water contained a mixture of organic matter, inorganic particles and microplastics that was subjected to a purification procedure including enzymatic digestion, chemical oxidation and flotation in order to eliminate the sample matrix and extract the plastic. Microplastics 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, microplastics 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 particles of the food chain. The long distance transport methods suggest that plastic waste will accompany, if not outlast, mankind for a long time. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps.

Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish confuse plastic with food) and human toxicity (for example by eating food, which contains microplastics). The resulting environmental impacts could be, for example, the extensively documented dying of marine organisms by microplastics, the danger of massive aggregation of tiny plastic particles in the food chain, or even the negative aesthetic impact associated with plastic in the environment. Corresponding midpoint and endpoint indicators and associated characterization methods, as well as standardization to a reference value (e.g. the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES)

These particles might act as sorbent and transporter for frequently occurring contaminants (pharmaceuticals, personal care products, pesticides) 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 show strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

The ubiquitous contamination of all environmental compartments with microplastics has extensively been 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 contaminants (pharmaceuticals, personal care products, pesticides) 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 show strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU170 Removal of 10-500 μm microplastics from wastewater effluent by disc filter M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department; K.B. Ølesen, Aalborg University / Department of Civil Engineering; F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department

In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10–50 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 Spildevand A/S. The treated wastewater was sampled before and after the disc filter by filtering 1000 L through a stainless steel disc filter to remove large-scale water sampling devices. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The remaining water contained a mixture of organic matter, inorganic particles and microplastics that was subjected to a purification procedure including enzymatic digestion, chemical oxidation and flotation in order to eliminate the sample matrix and extract the plastic. Microplastics 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, microplastics 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 particles of the food chain. The long distance transport methods suggest that plastic waste will accompany, if not outlast, mankind for a long time. 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.

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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 polymers, sizes and shapes. However, risk assessment of MP exposure, in the lower size range (<100 μm), 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 separated from those due to background variability.

Environmental impacts could be, for example, the extensively documented dying of birds or fish or evading food, which contains microplastics. The resulting food web will accompany, if not outlast, mankind for a long time. PlasticBudget is aiming to close some of the above-mentioned research gaps. 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.
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 polystyrene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Huffer, S. Slaweck, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The worldwide production and usage of mainly disposable plastic has increased from 1.7 million tons in 1950 to 299 million tons in 2013 [1]. Consequently, plastic wastes are deposited in the environment and persist due to long durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composites 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 polymer's properties [5]. Therefore, 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. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornì, M. Bijarimi, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson. Mar. Pollut. Bull. 2012, 64, 7828. [5] T. Huffer, T. Hofmann. Environ. Pollut. 2016, 214, 194.

TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses S. Krais, University of Tubingen / Animal Physiological Ecology; H. Schmiegl, Tubingen University / Animal Physiological Ecology; E.E. May, 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. Trieskorn, University of Tuebingen / Animal Physiological Ecology

Degradation of Building Plastics in the Environment and used as polystyrene products during the last decades, the quantity of globally produced synthetic polymers rises continuously 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 ecosystem deteriorating processes. Therefore, the objective of this study was to investigate the influence of polystyrene microplastics in combination with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10.000 polystyrene particles per liter (cycrogenically milled, < 100 µm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiacloprid. In order to quantify the effects of the pesticides cypermethrin, methiocarb and thiacloprid on the snails, five categories of behavior were defined, which are observable behavioral responses, five categories of behavior were defined, which are either 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, focusing 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 biota and chemicals interact with the plastics. In this study we continued the efforts 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 how microplastics in the environment can influence more complex pollution issue in the environment. This study could help to explore the issue 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. Biodiversity of this data will be used for recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU176 Effects of artificial weathering on polypropylene microplastics V. Fernández-González, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); G. Grieu-Noche, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); J.M. Andrade-Garda, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); P. López-Mahía, Universidad de Coruña / Analitical 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 between thousands of years and even millions of years following 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 BASEMAM 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-FTIR. This could be useful to identify real plastics and microplastics found in marine environment, and understand how aging affects the surface and chemical structure of this material. New 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 differ the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done to demonstrate the changes. Efforts are typically dose-dependent. SEM also included 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 biofouling microfouling chemicals interact with the plastics. In this study we continued the efforts 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 how microplastics in the environment can influence more complex pollution issue in the environment. This study could help to explore the issue 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. Biodiversity of this data will be used for recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.
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 other types of MP. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; bioplastics) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean Daphnia magna, a standard model species in ecotoxicology. To exclude particle effects caused by food dilution and thus identify microplastic-specific effects, kaolin clay was used as a reference treatment. In total, four treatments were included: PLA, PS, clay (reference), and control (food only). The exposure was conducted over 21 d using a plankton wheel to keep test particles and algae in suspension for comparable exposure concentrations. In the PS treatment, we observed high mortality, decreased feeding rate and reproductive output compared to all other treatments. These effects were not caused by toxic monomers of styrene or additives leaching out of the polymer, which was demonstrated in a follow-up test with the PS leachate. 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 differences between the polymer types 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)


The widespread use of plastic products in our daily life has led to a consistent increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for certain purposes and are, for example, contained in many cosmetic products. Abrasion and fragmentation of larger plastic items lead to the formation of secondary microplastics. Up to now, most studies investigating effects of microplastics in organisms concentrate on marine ecosystems, whereas knowledge on effects of microplastics in freshwater organisms is still scarce. The aim of our study is to investigate effects of polystyrene microplastics (cylindrically milled granules, fractioned to > 59 µm, up to 100,000 particles/L), distributed in combination with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the ferrous oxidative xylenol orange assay (FOX assay). In a follow-up experiment, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larva or juvenile brown trout. Further analyses are still in progress. The present study part is of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WRS1578).

TU180

Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocerans

G. Jakumar, CML Leiden University / MLI, N. Brun, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecological Monitoring and Assessment, UK; T. Secor, CML Leiden University / Conservation Biology; T. Bosker, CML Leiden University / Ceter for Environmental Sciences Microplastics (< 5mm) are ubiquitously distributed in the environment, causing increasing concern in recent years. The two predominant types of microplastic differ in shape and origin: primary microplastics (PMP) are intentionally produced as micro-particles for commercial applications, whereas secondary microplastics (SMP) are formed by the environmental breakdown of large plastics. Information regarding effects of microplastics on freshwater ecosystems is limited. In the present study, the acute and chronic effects of microplastics on three Cladoceran species, Daphnia magna, Daphnia pulex, and Ceriodaphnia dubia, to both PMP and SMP was assessed. The acute toxicity was assessed at 180, 220, and 260 C, to determine the influence of temperature as an additional stressor on toxicity. Acute sensitivity of D. magna and D. pulex to both PMP and SMP, increased sharply with temperature, whereas that of C. dubia was stable across temperatures. C. dubia was the most sensitive species at 180, followed by D. pulex and D. magna, which were of comparable sensitivity, however, the trend was reversed at 260 C. In addition, SMP had a similar toxic effect to PMP. D. magna was more toxic to C. dubia. Both PMP and SMP showed adverse effects on all three species during chronic exposure. Further, C. dubia was the most sensitive species followed by D. pulex and D. magna. All species were more affected by PMP than SMP during chronic exposure. The results of the current study indicate that exposure to microplastics has adverse effects on health and reproductive output of the species studied, although at relatively high levels of exposure, and that temperature as an environmentally relevant additional stressor has a major influence on species sensitivity to microplastics.

TU181

Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels

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The 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 affect 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 Dreissena polymorpha using a multi-biomarker approach. As MPs 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 (MIXs) of polystyrene MPs: MIX1, which contained 2 millions/L of 10 µm MPs and 2 millions/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 MIXs and to related controls; every 3 days we collected from each 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, cyto-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 it on a hydrocolloid soft tissue for cryostat 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 suggest that the toxicity of MPs could be lower than that of macroplastics, but also that MPs, through their bioavailability, or involved in metabolic pathways not detectable by our biomarkers. In addition, prolonging the exposure time the MP toxicity could be increased.

TU182

Polystyrene microplastic effects on the lipid peroxidation and antioxidant capacity in non- and temperature-stressed individuals of Dreissena polymorpha

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Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and thereby MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species is missing. Therefore, we analyzed the effects of irregular polystyrene MP (< 63 µm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve Dreissena polymorpha both in a single and multiple stressor exposure regime. We exposed D. polymorpha to polystyrene MP at concentrations between 6.4 and 100,000 p M L−1 over 6 weeks at 16 °C. After the exposure, the mglutid gland tissues were analyzed for malondialdehyde concentrations as an indicator for lipid peroxidation (TBARS assay, thiobarbituric acid reactive substances) as well as for the remaining abundance of hydrophilic, non-enzymatic antioxidant substances (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation
and antioxidant capacity did not indicate any increased stress levels in response to chronic MP exposure in *D. polymorpha*. In addition, the same experiment performed in a sub-chronic exposure (1, 3 and 7 d) did not reveal stress-induced effects either. Therefore, this study indicates that 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 sub-lethal or chronic stress response can be modulated by MP exposure. To explore such a scenario further, we will present results from ongoing multiple-stressor experiments in which we expose *D. polymorpha* to MP at 16, 24 and 28 °C.

TU183

**Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna?**

C. Schueg, Goethe University Frankfurt / Dpt. Aquatic Ecotoxicology; S. Rist, DTU (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 kind of challenges, some of which had already been faced by researchers in the realm of nanotoxicology. Our elucidation about 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 – it would be an example for a microplastic contamination of internal organs. 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 confocal-based clearing protocol followed by investigation through confocal laser scanning microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoplastics. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body of knowledge. Further research into the realm of nanotoxicology and biota-particle-interactions is still needed and clearly indicated by a lack of transparency in reporting methodology and results. We were able to adapt a fructose-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?**

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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 terrestrial environments, 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 ± 5.05 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 and in groups of 10 animals. The test container comprised two identical polypropylene vessels connected with a fixed polypropylene tunnel to enable animal migration between the two vessels and covered with a lid. In individual exposure the position of each animal was recorded 10 times within the 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were inspected only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was formed when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil and were not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behaviour of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.

TU185

**Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study**

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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. Beside their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported together into biota by the so-called ‘Trojan horse effect’. In this study, a higher CPF could only be detected in the wastewater phase. This was performed with the aim to discover the Trojan horse effect by means of a laboratory aquatic microcosm study. The insecticide chlorpyrifos (CPF) was used sorbed to 5 μm polyamide microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg MPL. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 1 mg/L (H). 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 confocal-based clearing protocol followed by investigation through confocal laser scanning microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoplastics. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body of knowledge. Further research into the realm of nanotoxicology and biota-particle-interactions is still needed and clearly indicated by a lack of transparency in reporting methodology and results. We were able to adapt a fructose-based clearing protocol to the use with high amounts of *Daphnia* samples.

**Microplastics exposures of fish: internalization and effects on behavior and growth**

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Awareness of the presence of microplastics, i.e. plastic particles ranging in size from 1 μm to 5 mm, in marine and freshwater systems has recently risen but detection and quantification is challenging. Furthermore, whether they pose a risk to aquatic organisms is not yet clear. Interpreting these results, MP might have led to higher reproduction rates as a stress response which were lowered when CPF was present. In this case, CPF must have become bioavailable to at least two different species, according to the lowered abundance levels in C, L and H compared to MPC. The reason why the presence of MP (without CPF) might have led to enhanced abundance levels 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. Morritt, Royal Holloway
This study compares the ingestion of microplastic by pelagic and benthic fish populations from two major UK watersheds: the Thames Estuary and the Firth of Clyde. A total of 760 fish from 20 species and 116 brown shrimp, Crangon crangon, were sampled. Individuals were examined under a dissection microscope and potential plastics were removed to be later identified by FTIR analysis. Out of 21 species, including both fish and shrimp, sixteen species from different trophic levels ingested plastics. Overall, between 33-47% of fish ingested plastic 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. De Feite, Università degli Studi di Milano; R. Bacchetta, University of Milan; P. Tremolada, University of Milano / Department of Biomolecular Sciences and Biotechnology; M. Parolini, University of Milan / Department of Environmental Science and Policy
Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in diverse aquatic ecosystems worldwide. In recent years, the attention has been attracted on microplastics (MPs), small plastic particles (dimensional rangeDaphnia magna)ffecting food intake, growth and reproduction. First, we performed a 24 hours uptake and 48 hours release test to assess the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release of MPs after 24 hours was not detectable. Microplastics 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. SUPLAN, University of Birmingham; I. Lynch, University of Birmingham / Geography Earth Environmental Science; J. Sadler, The University of Birmingham / Geography Earth 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 (Jemec, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.2-3.3 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 microplastic 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 Química Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Garda, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. Lorecz-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
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 micro and nanoplastics (diameter ≤75 mm). The presence and accumulation in the ocean is cause for concern for several reasons, one of the most important is that they can be ingested by marine biota [1]. Different studies have shown the effects on the biota, such as intestinal blockage, decreased mobility or death [2]. Microplastics can absorb persistent bioaccumulative and toxic compounds from seawater. Once ingested, the absorbed pollutants may be transferred to the respective organisms. A variety of methods has been developed to measure microplastics in biota. One important aspect of these analytical methods is the extraction of microplastics from interfering biomass. Many studies have employed one or more chemicals (KOH, H2O2) to dissolve the biomass, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for µ-spectroscopy-based analyses. 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 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 CTS-2015-170-C01-01 funded by FEDER BASEMAN (JPI Oceans) and, project CMT2016-77945-C3-3-R (ARPA-ACUA). References: [1] V. Hidalgo-Ruz, L. Gutov, R.C. Thompson and M. Thiel, Environmental Science & Technology 46, 3060 (2012); [2] M. Cole, H. Webb, P. K. Lindeque, E.S. Fleenman, C. Halsband and T. S. Galloway, Scientific Reports 4, 4528 (2014) [3] J. Wagner, Z-M. Wang, S. Ghosal, C. Rochman, M. Gassell and S. Wall, Anal. Methods, 9, 1479 (2017)

TU191 Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach
S. Moses, University of Bayreuth / Animal Ecology I; M. Loeder, J. Schrank, C. Lackorf, University of Bayreuth / Animal Ecology I
For the first time worldwide, in the joint project PLAWES the pollution with microplastics of a large European river basin will be investigated on the example of the model system Weser-National Park Wadden Sea. PLAWES, as a pioneer study, is going to conduct an interdisciplinary and ecosystem overarching analysis concerning the contamination with microplastics from the headstreams to the North Sea, thereby considering exemplarily major point (e.g. wastewater treatment plants, combined sewer systems) and diffuse (drainage, atmosphere) sources and entry routes. The new insights are going to be included in a new modeling concept for the identification of primary transport mechanisms and accumulation zones of microplastics. Effects of microplastics on ecosystems of the Weser-Wadden Sea system will be investigated on both, aquatic invertebrates and the interaction of pathogens with microplastics in biofilms. The insights on ecologically relevant aspects are going to be used to assess the environmental effects of microplastics on the model system Weser-National Park Wadden Sea and to transfer these to other systems. Furthermore, the results will be used to develop novel teaching materials to provide an education platform for teachers, pupils and parents across Europe. Hence, PLAWES will generate unique data on the impacts of microplastics on a large European river basin and on environmental health. This will not only be instrumental for decision makers and stakeholders but also serve as focal point to develop science-based solutions.

TU192 Photophotoluminescence of fresh and biodegraded microplastics containing 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 in irregular smaller sizes, and by a chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various 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 (the elemental composition and chemical characterization). 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 (PCPs) 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 CPCCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and thus have a high potential to contribute to the litter load. Knowledge in exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by 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; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus typically irregular in shape. The objective of this study was to compare the effects of spherical or irregular shapes of microplastics on the changes in organ function, thyroid hormone level, gene expression, and enzyme activities in sheepshead minnow (Cyprinodon variegatus). Both types of microplastics were accumulated in the digestive system, causing intestinal distention. However, irregular microplastics decreased swimming behaviors (total distance travelled and maximum velocity) of sheepshead minnow, when compared to spherical microplastics. Both microplastics generated cellular reactive oxygen species, while molecular changes (transcriptional and enzymatic characteristics) of key genes and enzymes, respectively were differed. This study provides insights into environmentally relevant (fragmented) microplastics will help to improve understanding of their environmental impacts. Keywords: Microplastics, Sheepshead minnow, Behaviors, Gene expression & Genes.

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast
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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 contaminated 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), polyvinyl 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 highly representative 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 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-term 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. Choqu, M. Milano, E. Reynard, 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 run-off/dissolution capacity 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 fact that no single benchmark meets 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-pressures, 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
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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 EQS for CPF based on the current data and the WFD method for EQS derivation published in 2012. 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 0.0004 mg/L is based on a NOEC for A. baiaus taken from the EESA authorisation dossier and set as 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 HCf from a species sensitivity distribution (SSD) for crustaceans and insects using
the lowest eligible AF of 5. The SSD reveals branchiopoda and amphipoda being the most sensitive taxonomic groups for CPY. A re-evaluation of old and new mesocosm data showed that using the available mesocosm data for EQS derivation is likely to be underprotective for amphipoda. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the QS referring to the pelagic community”. The data sets contained no data on chronic bioavailability for sediment organisms, with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data shows 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, measured as 0.324 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 in the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS,me,me of 0.016 µg/kg dw. Without this AF, the EQS,me,me would be in the same order of magnitude as the calculated EQS,me,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. For Pb, a concentration failing to meet 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 considered to account for differences in sites and samples assessed have a dissolved Pb concentration of greater than or equal to the EQS, and at tier 3, 1 site with a maximum RCR of 5.32. For the FOREGS dataset, 2% of the sites assessed had a concentration greater than or equal to the EQS,me,af. 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Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)

TJ/201 Modelling survival under chemical stress. A comprehensive guide to the GUTS framework

T. Jager, DEBBox Research / Dept of Theoretical Biology; R. Ashauer, University of York / Environment

Testing, analysing and predicting the lethal action of chemicals on organisms plays a central role in the fields of ecotoxicology and toxicology, both for scientific and regulatory purposes. The dominant approaches to deal with survival data are descriptive, focussing on standardised tests and simple summary statistics (such as the LC50). Such descriptive methods ignore the fact that lethal effects develop over time, thereby leading to biased assessments and precluding useful predictions to untested exposure scenarios. Making sense of toxic effects over time requires mechanistic models, and, more specifically, the explicit consideration of toxicokinetics and toxicodynamics (TKTD). For the endpoint survival, almost all existing TKTD models can now be viewed as special cases of a more general modelling framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field as it is explicitly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatment on this model framework. In a CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.

TU202 Dose response modelling in aquatic and terrestrial effect models

M. Wang, WSC Scientific GmbH / Dept E fate 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 linked to time variable exposure, which is more typical under field conditions. At present these models consider a threshold beyond...
which effects start to appear. Once this threshold is surpassed the amount of effect
is calculated using a linear regression, i.e. effects increase 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
important when the specific shape of a dose-response model affects the outcome of
an assessment and how the magnitude of predicted effects is affected.

TU203 Investigating toxicokinetics of emerging pollutants (PFASs) in the common sole (Solea solea) from in situ measurements and experimental data on PCBs within a DEB-based modelling approach.
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Environment and Agriculture - Istea / UR EAXB; V. Loizeau, IFREMER / UR Biogeochemistry and Ecotoxicology; L. Percequire, IFRD / UMR LEMAR; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; G. Munoz, Universite de Montreal / Chemistry; H. Budzinski, CNRS / UMR 5805 EPOC; J. Lobry, Istea / UR EAXB
In the context of global change, developing mechanistic tools integrating the influence of environmental factors on toxicants bioaccumulation dynamics is
required, as organisms will face unprecedented conditions. Mechanistic models
based on the Dynamic Energy Budget (DEB) theory are relevant to predict individual survival and development, determine the role of food, temperature and
availability, quality and quantity. Moreover, this modelling framework allows including adverse effects (DEB-tox), often based on internal concentration. However, for emerging compounds like PerfluorooAlkyl 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 aiming 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
proposed kinetics for sole calibration for a range of environmental diet, food
contamination and temperature scenarios. Comparing these predictions with in situ
measurements, we were able to highlight the major influence of diet composition.
The next step was to consider the other PCBs and PFASs with previously selected
environmental scenarios. Discrepancies between model predictions and
observations allowed us to formulate new modelling hypotheses taking into account
the physiology of sole metabolism and the multiple interactions between different
diet and food dependency on their properties (e.g. hydrophobicity, spatial conformation, functional
groups). This mechanistic 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 Notoptera 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. For example, a field experiment indicated that the crustacean
Notoptera spinipes used for modelling the copepod life history. That said, both models are promising tools for
study of 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 denaturated protein, and Cu accumulation in metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters of maximum Cu influx rate, total number of transport protein and affinity constant didn’t have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 ml g⁻¹ was

TU205 Grey seal physiology and environmental change
J. Desforges, Aarhus University (AU) / bioscience; G.M. Marques, University of
Lisbon; K. Kauhala, Natural Resources Institute Finland Luke; K. Harding,
University of Gothenburg Sweden
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 and incorporate long-term, field exposure (growth and
reproduction to parameterize and validate our model. Our model accurately
predicted grey seal ontology and lifehistory traits, providing one of the first
descriptions of mammalian development in DEB. Recent reports have indicated
that climate change effects on sea ice and fish web dynamics have impacted grey
seal condition (i.e. blubber thickness). We use our model to explore these
relationships and confirm if changes in seal body condition in the Baltic is
conducive to change in food quality/quantity and can lead to down-stream consequences
on reproductive success. The results offer new insights into physiology and ecology
of Baltic grey seals with the potential to lead to novel approaches for the study
of stress ecology and conservation of this species.

TU206 Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters
H. JM, J. Na, J. Jun, Korea University / Environmental Science and Ecological
Engineering
Present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history trait responses of Daphnia magna in short-term (5 days) and
long-term (21 days) exposures. D. magna exposed to 25 °C exhibited continuous
higher production of reactive oxygen species (ROS). In short term exposure,
glutathione peroxidase (GPx) activity was significantly suppressed in elevated
temperature. In contrast, daphnids showed significantly enhanced catalase (CAT)
activity indicating the possible increased metabolic energy investment. 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
indicates that D. magna may have more energy invested to cope with the thermal
stress. Moreover, a multi-generational study was performed to evaluate multi-generational effect of
elevated temperature on D. magna.

TU207 Transport-protein metal binding links uptake biodynamics for predicting copper in tilapia
Y. Chen, Kaohsiung Medical University / Biomedical Science and Environmental
Biology; W. Chen, Kaohsiung Medical University / Department of Biomedical
Science and Environmental Biology; C. Liao, National Taiwan University / Department of Biomedical Science
and Environmental Engineering
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 denaturated protein, and Cu accumulation in metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters of maximum Cu influx rate, total number of transport protein and affinity constant didn’t have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 ml g⁻¹ was
significant higher than that of MAP 0.269±0.018 ml μg⁻¹ (p < 0.001), and the uptake rate constant of MDP 0.128±0.001 ml g⁻¹ hr⁻¹ was also significantly greater than MAP 0.086±0.001 ml g⁻¹ hr⁻¹ (p < 0.001), it revealed that Cu was likely to bind on MDP in the low exposure concentration than that of MAP. This study concluded that Cu tend to accumulate in MDP, then may cause less toxicity to tilapia. Keywords: Copper; bioavailability; transport protein; subcellular partitioning

TU208

Relationships between subcellular metal partitioning and biomarkers of effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient
N. Urien, INRS-ETE / Centre Eau Terre Environnement; A. Urien, Université du Québec à Montréal / International Research Institute for the Environment; L. Ramilo, H. Sonnenberg, Ecological and Regulatory Solutions Inc.; P.G. Campbell, P. Couture, Université du Québec, INRS / Centre Eau Terre Environnement

Discharges from metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Nevertheless, metals can also be detoxified by binding to macromolecules 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 was investigated using metabolic pathways that result from AChE inhibition in zebrafish (Danio rerio) and identifying endocrine disrupting effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient. This study 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 in an embryotoxicity in vitro test specific to the aluminium addition. 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 upon 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.

TU209

Development of an adverse outcome pathway for acetylcholinesterase inhibition in zebrafish (Danio rerio)
K.H. Watanabe, A. Mikhail, Arizona State University / School of Mathematical and Natural Sciences; K. Conrow, Arizona State University; N. Vinas, Mississippi State University / Engineer Research and Development Center

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 upon 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 for the Middle Ground Fish Model for Lung Cancer
T. Hill, US EPA NHEERL/JST/D/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, streamlined risk-intent screens as well as the development of a quantitative approach that informs 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/nucleic acid adducts, diminished CC10 capacity and hyperplasia of CC10 deficient Club cells, and culminating in the adverse outcome of mixed-cell tumors. This model is in formation in the airway. The AOP is independent of route of exposure and grounded in overlapping mechanistic events for naphthalene, styrene, ethyl benzene, isoniazid and fluensulfone 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
M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; M. Freese, J. Pohlmann, Thünen-Institute for Fisheries Ecology; J. Doering, National Research Council at U.S. EPA, Environment Protection Agency, Duluth; M. Damerau, L. Marohn, R. Hanel, Thünen-Institute for Fisheries Ecology; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

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 macromolecules 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 was investigated using metabolic pathways that result from AChE inhibition in zebrafish (Danio rerio) and identifying endocrine disrupting effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient. This study 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 in an embryotoxicity in vitro test specific to the aluminium addition. 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 upon 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.

TU212

Salmonid pituitary cells as a test system for identifying endocrine disrupting compounds
L. Harding, University of Washington / Aquatic and Fishery Sciences; J. Doering, National Research Council at U.S. EPA, Environment Protection Agency, Duluth; M. Damerau, L. Marohn, R. Hanel, Thünen-Institute for Fisheries Ecology; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

The pituitary gland is a major endocrine organ producing anterior pituitary hormones and 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 17-α-ethinylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) transcriptome.
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-Ramirez, Z. Weng, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, Euromineral.

The current lack of a consensus on how to assess impacts from abiotic resource use in life cycle impact assessment (LCIA). Unlike other environmental impact categories, abiotic resource use does not just have one single, explicitly agreed-upon, international management goal. The SUPRIM project focuses on impacts which occur directly from the use of abiotic resources such as minerals, metals, and natural materials. It concerns impacts associated with their availability or accessibility, but excludes impacts covered by other impact categories, such as toxic emissions or adverse working conditions. The current state-of-the-art LCIA for abiotic resources has been criticized by representatives of the metals & mining industry. The LCA community is developing new methods, which all focus on different issues associated with resource use. This lack of a broadly accepted method, likely attributable to the lack of a common perspective on resource use and a common understanding of the potential problem(s) related to the use of resources, was the starting point of SUPRIM. The aim of the project is to obtain an understanding of different stakeholders’ views and concerns regarding potential issues associated with the use of resources. The gained insights are provided in the form of a structured overview of those views, and used as a basis for further method development. They are achieved by ‘taking a step back’ towards a structured discussion about potential problems with resource use, and different motivations behind resource management concepts. To guide the discussion towards a clear outcome, a framework was developed. It introduces distinctive criteria for the evaluation and/or formulation of perspectives and problems on resource use, which will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders from industry, policy and academia. The workshop outcome will be used to guide the further development of impact assessment from abiotic resource use in LCIA, such as a reduced future availability of the resources themselves, changes to their ability to provide functions, losses of certain desired properties in the environment or the technosphere, or an increased difficulty to access them. We aim to present both the framework developed for the formulation and evaluation of perspectives and the outcome of its first application during the stakeholder workshop.

TU215

The relevance of the end-of-life stage for the environmental impact of batteries J.P. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HIU; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis; C. Minke, Technische Universität Clausthal / Energy Research Center; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Numerous LCA studies exist in the field of energy storage, especially batteries. However, the majority of these studies focus on the production and use phase, while the battery disposal or recycling is usually evaluated in separate studies that focus explicitly on this part of the life cycle. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LiFePO4 battery (rain-mountable stand-alone system), a vanadium redox battery (VRFB), and a hybrid aqueous ion battery (AHIB) and a lithium-ion battery (LIB). The environmental comparison between batteries will enable a comparison of differences and overlaps between stakeholder views. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar

TU216

Battery recycling efficiencies and their influence on the life cycle impact of batteries
K. Boonen, A. Van der Linden, VITO

The EU Batteries Directive requires 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 disposables 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 change the environmental 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 WEEENmodels, 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 LCI (Life Cycle Impact) modelling were performed to determine the environmental impact that has been considered for each WEEE category, 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 WEEE, adopting attributional LCI modelling, showed that Scenario B presented a damage decrease for all WEEE categories. Moving on to 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 under the consideration of the avoided production of the EEE. 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 is 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

Y. NAKAMOTO

The LCA of the effect on efficiency measures in electric household appliances and the economic performance of the products has been conducted. In 2010, 44 energy-related products were classified according to the Ecodesign directive responsible for 53% of total EU-28 greenhouse gas emissions. The analysis of the LCA of scenarios of European consumption of household appliances in the residential sector is a basket of products (BoP) based on the average consumption of European citizens. 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, heating system, refrigerator, TV screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overall scenario covering the design options for products energy efficiency and expected trends in purchase and user behavior has been calculated and compared with the baseline. The baseline heat loss analysis (with ECID impact assessment method) 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 showed 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 improved energy efficiency of the products), IRP (due to the phasing out of nuclear power plants in Europe) and AP (in this case, the reduction of the amount of coal-based electricity leads to reduced releases to the atmosphere of those substances contributing to AP). Due to the expected increase of the number of devices per person in the future, some of the impact categories – namely HTP, 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. Nishijima, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies

In a case study analysis (with ECID impact assessment method) 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 showed 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 improved energy efficiency of the products), IRP (due to the phasing out of nuclear power plants in Europe) and AP (in this case, the reduction of the amount of coal-based electricity leads to reduced releases to the atmosphere of those substances contributing to AP). Due to the expected increase of the number of devices per person in the future, some of the impact categories – namely HTP, 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.

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]. By assessing and estimating the economic lifetime of vehicles based on consumer behavior that maximizes utility level over time, we were able not only to specify the replacement purchase rates on a dynamic discrete choice model but also to quantitatively analyze the environmental impact of changes in consumer behavior due to the adoption of policies because a motor vehicle inspection dummy, maintenance and repair costs, and new vehicle replacement purchase costs are explicitly included in the utility functions at the time of a vehicle’s lifetime and hence allow to understand the impact of some policy changes. We have developed 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 with a forward-looking perspective. In addition, it is clear that offering subsidies for car inspection costs can be expected to have a substantial effect on cutting CO2 emissions associated with the transport sector because it would dampen car replacement purchase behavior and thereby increase the average economic lifetime of cars. The results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in consumer assessment purchases. Furthermore, it is shown that car inspection systems have 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. 

ATISOL C2C - Life cycle assessment as a tool for the ecositing of a "vapour and air barrier membrane - insulator" system, in a cradle to cradle approach

B. Amante, Universitat Politècnica de Catalunya

The continuous and planned increase of the electrification in the transport sector is one of the main drivers of advances in energy storage for electric vehicle (EV) propulsion and present technological challenges to achieve the expected requirements. The implementation of the EVs on our roads remains a challenge and is below expectations foreseen. The elevated costs of the batteries and thus the EV cost, refrain the massive depletion of this technology. With the aim of reaching a full and efficient e-vehicle adoption as 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 associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at 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 possible use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.
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, pushing resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + renewable vapor barrier), with the potential to improve environmental impact on its whole life cycle. The solution can be used in both new construction and renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spunbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on different wall construction types and can be placed on existing surfaces. Due to the self-adhesive characteristics, the implementation is made easier in both common surfaces (walls, roofs and ceilings) and to the level of detail such as corners and junctions. In addition, the application of a clay finishing coating on the membrane completes the offer. The constructive system can be dismantled at the end-of-life of the building and the various elements are recovered and valued in a cradle-to-cradle perspective. A first step is already carried out: the Debieksin®. The preliminary life cycle assessment results support the technical partners along the whole development and evolution of the membrane by pointing out the hotspots of the system, from the choice of the components of the vegetal binder or the spunbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters and subsidized by the Walloon Region (BE).

TU224 Life Cycle Assessment of Recycled Asphalt and Biomaterials for Road Pavements
A. Jimenez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC Transport; M. Johnsson, the University of Nottingham / Centre for Transport Studies and the Road Transport Research Institute; G. Fischetti, Infrastructure Development Group Ltd; E. van Dijk, NuTec Concrete; I. Jarett, University of Nottingham / Centre for Transport Studies; D. P. McEwen, University of Nottingham / Centre for Transport Studies; P. C. Basset, University of Nottingham / Centre for Transport Studies; T. van den Brand, KWR Watercycle Research Institute

In this research two LCA studies are presented as starting points in studies on water treatment and reuse. S. Kools, Butkovskyi, Wageningen University WUR; B. Hofs, Evides Waterbedrijf; A. van Vliet, University of Freiburg / Chair of Societal Transition and Circular Economy

In this research two LCA studies are presented as starting points in studies on water treatment and reuse. One LCIA on climate change, to assess the carbon footprint of two ne

TU226 Pursuing the sustainable circular city - is environmental accounting supporting the transition?
A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

The transition from linear to circular economies is already in the international policy agenda and several actors are implementing this concept at different scales. In particular, cities are engaged in this process in pursuit of growing into 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 included life cycle assessment (LCA); carbon footprint, recycling, environmental assessment (RA) and tools that promote a circular economy.

TU227 Taking stock of a circular economy within planetary boundaries: A multi-scale analysis through consequential LCA
H. Helder, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

Current institutional agendas are embracing the concept of “circular economy” (CE) in order to improve the sustainability of products and services and reduce the resource dependence. CE is applied through a broad range of strategies at various scales. At the city level, case studies will examine different CE strategies such as eco-design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector. To interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.

TU228 Opportunities and threats in water treatment options as investigated by LCA
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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 for decision makers.
tool to direct future research. We performed the work using Simapro 8.0 software, method Recipe Endpoint (E) and the Ecoinvent 3.0 database. First, in drinking water production, flocculants are used to remove particles, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new flocculants. Our LCA study showed that flocculants obtained from iron sludge after HCl dosage have a significant lower environmental impact than commercial and laboratory grade flocculants. Recombining these flocculants into iron sludge for use in the drinking water purification or waste water treatment looks promising and this LCA study underlined that technical research into the quality of the flocculants is justified. A sensitivity analysis indicated that the iron content of the sludge is strongly determining the environmental impact; thus indicating that different types of iron sludge should be considered for further research. As second case study, we investigated water management in shale gas production, since hydraulic fracturing technologies require significant volumes of water for well development and produce 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 different air floating of solids, biodegradation, 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 including 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 water sector, evaluate possibilities for resource recovery and determine environmental impacts of processes.

TU229

Closing the loop in a territory: LCA approaches to boost resource recovery M. Calvet, CETAUQUA / MASE; M. Amores Barrero, CETauqa, Water Technology Centre; D. Marin, CETauqa, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETauqa Water Technology Centre / MASE; M. Termes, CETAUQUA; M. Ruiz Mateo, CETauqa Water Technology Centre

The concept of Circular Economy is widely extended in political and business agendas and so is the concept of “Closing the loops”. The idea that the value of materials and products should be maintained in the economy as long as possible and wastes minimised is understood and accepted. However, its implementation is bringing to the light questions as to which level to implement it (material, product, system, business and territory), which tools to use to decide on the most appropriate circular economy approach to develop etc. The idea of closing the loops, once municipalities and wider geographical areas, act as accumulators of resources that in the current linear model create negative externalities. However, these waste, water and energy flows if managed in a circular system could be valorised bringing massive opportunities to all territorial actors. This paper explores the application of the Circular Economy in two different case studies in Spain (San Felino de Llobregat in the “Territorial Circle”) and in Portugal (for which a methodology has been specifically created). The methodology is validated and its effectiveness demonstrated through the identification of more than 10 Circular Economy Opportunities in each case study. The role of LCA as a tool used in different stages of the Territorial Circular Model is explored i.e. at the data inventory gathering, resource flows analysis, assessment of the most appropriate circular economy strategies and the development of indicators to establish current levels of circularity and benchmarks. The need to develop a tool to assist in the data inventory gathering, data visualisation and material flows analysis to identify a greater number of circular economy opportunities is also highlighted. Conclusions of the research include the need to assess the identified opportunities from a technical, economic and social perspective. The importance of the development of an action plan to assist actors in the implementation of the preferred circular economy strategy is highlighted. Finally, the importance of monitoring of the assessed impacts of the strategy is emphasised.

TU230

Innovative method to optimize territorial organic waste resources G.C. Vega, The Technical University of Denmark (DTU) / Management Engineering; J. Sohn, The Technical University of Denmark DTU / DTU Management Engineering; M. Birkved, Technical University of Denmark / QSA Dept of Management Engg

A truly environmentally sustainable bioeconomy requires integrative approaches for system design and management of the industry to provide sustainable outcomes. A holistic approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of producer territories in order to provide site specific recommendations that take into consideration different geographical and feasibility constraints, the present and future energy grid, and production capabilities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burden shifting between environmental impacts while providing implementable decision support. Method: An LCA of various biotechnologies will be conducted with the aim to provide guidance for bioenergy ecodesign 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 when possible) scaled up to the territory level. A feedback loop is established between the modules of biotechnology assessment and the geographic assessment 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 governmental 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


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 severe constraints such as the availability of information on the specific composition of the waste, the availability in time and space of quality of waste as well as limited knowledge on the usability of such waste products. The goal of the SHAREBOX Horizon 2020 project is the development of a platform for the facilitation of synergies within the industry to enable a more circular flow of resources within the European processing industries. The SHAREBOX platform is a database of available waste and resources required by companies, enabling the transformation of waste to resources by matching supply and demand. The platform also serves as the first point of contact between different partners in a circular system. Furthermore, the platform enables the identification of new synergies overarching the different subsectors of the industries as well as optimal matching from the perspective of a circular economy. We analysed the implications of the transformation of different types of waste to resources when the industries are located in different geographic locations under consideration of the life cycle stage of transformation. Waste PET can be transported up to 10 000 km by lorry and still provide a net benefit regarding greenhouse gas emissions due to circular use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reuse of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232

Evaluation of nutrients and energy recovery technologies through Life Cycle approaches M. Ruiz Mateo, CETauqa Water Technology Centre; M. Calvet, CETAUQUA / MASE; S. Lopez, CETauqa Water Technology Centre / Santiation; M. Isasa, CETauqa Water Technology Centre / MASE; Y. Lorenzo-Toja, CETauqa, Water Technology Centre; D. Marin, CETauqa, Water Technology Centre / Environment and Socioeconomics

Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the recycling of nutrient resources, mostly nitrogen and phosphorus, from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE RECOVERY project aims at demonstrating, by means of a prototype, the feasibility of a new wastewater treatment approach, based on energy and nutrients recovery. The process tested in the project is based on an initial pre-concentration step that promotes the biosorption process maximizing the biogas production. The effluent of the pre-concentration unit is the influent of a nutrient recovery unit based on adsorption in zeolites. The LIFE ENRICH project (Enhanced Nitrogen and Phosphorus Recovery from wastewater and Integration in the value CHain) goes a step further and aims at demonstrating the whole value chain for nutrient recovery

288 SETAC Europe 28th Annual Meeting Abstract Book
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 selected the methodology to quantify the environmental burdens of these new valorisation activities. Sixteen innovative processes 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 and identify the most cost-effective alternative (CAPEX and civil works) and operation and maintenance phase (OPEX costs e.g. energy, chemicals, transport) and is aimed to identify the most economic-friendly scheme. 

TU23 Life Cycle Assessment of a novel process of polyhydroxyalkanoates production with waste and by-products from the wine industry value chain

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Current, the idea of a circular economy has an important role in the world political and business agendas about to decouple economic growth from resource constraints. Circular economy has not a single definition, nevertheless unlike the traditional linear make-consume-dispose approach, it seeks to maximize the added value at each point in a product’s life. In the Colombian context, palm cultivation is a major non-food agricultural commodity for the economy due to its abundance in the world market. The volume of production increases the sixth exporter of palm oil in the world. Furthermore, palm oil mills produce approximately 2 tons of concentrated solid wet biomass per ton of primary product commercialized (oil and kernel). Additionally, 0.7 cubic meters of liquid effluent per ton of fresh fruit bunches is also obtained. The aim of this research is to develop a circular economy approach in the Colombian palm oil industry, to account for the agriculture supplies and demands in a representative sample of the process chain. This study allows the characterization of the quantity of waste to be used in palm oil mill bio-refineries as a representative sample in order to identify potential risks. In addition, the work adds not only criteria for assessing the agricultural palm sector to establish indicators for a sustainable circular economy, but also methodologies based on Life Cycle Analysis to allow efficient management of resources, nutrients and agrochemicals in order to quantify the required amount to produce a given product. The knowledge of these parameters permits the identification of those elements that influence its magnitude, so that, different alternatives can be used to enable the sustainability of the oil palm industry. Finally, this research could contribute to develop knowledge and design tools to forecast the sustainability of resources and the optimization of processes carried out by palm-cultivation companies as part of their policy of environmental responsibility.

TU26 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILL EFFLUENT

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Exploring renewable energy sources is becoming increasingly important due to its low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be a suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle impacts of biogas production associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas plants stage. The life cycle assessment (LCA) was performed using ReCiPe 2016 environmental impact method and SimaPro 8.4 software. The present study demonstrates that the generation of electricity from biogas is advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.

TU27 Challenges and open issues in assessing new technologies for circular economy solutions

P. Masoni, Ecoinnovazione srl / Sustainability Department; A. Zamagni,
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 need to close 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, while the identification and management of the unavoidable trade-offs. In the case of innovative technologies developed to extract valuable substances from waste streams the complexities of the analysis are related to: scale-up from laboratory or pilot scale to full industrial scale; different possible industrial applications of the technology; a basket of diverse applications of the innovative semi-finished product/ingredient delivered by the new technology; diversity of the function of the technology; complex market of the substituted products, etc. This work presents and discusses how the above-mentioned challenges and open issues, with a focus on the diversity of the function of the technology, have been addressed in a specific case of an innovative technology to extract polyphenols from different waste streams. The presented example shows that the analysis can be rather complex due to the need of addressing different applications, identifying the benefits and drawbacks of 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 and data collection look like? 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 waste has an enormous negative impact on the global economy and food waste has been identified as a major environmental impact. EU’s theme “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 household waste 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 the amount of waste generated, a survey was done in one of the largest of the restaurant with 747 respondents. It was shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take away left food. 43% of those surveyed agree that food is wasted in too much quantity to take away. Most of respondents were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more information on solving problems like this is needed. Therefore, policies to encourage food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU239 Assessment of Carbon Footprint of a typical Spanish dietary pattern: The Atlantic diet X. Esteve Llorens, Universidade de Santiago de Compostela / Chemical Engineering; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; J. Garrido, Universidade de Santiago de Compostela; S. González-García, University of Santiago de Compostela CIF Q1518091A

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 global environmental agenda and sustainable food production and dietary patterns are considered of major interest. Consumption patterns vary significantly across Europe. In the southern countries, healthier diets richer in fruits and vegetables have been identified. In this sense, the traditional Atlantic diet is a common dietary pattern in Northern Portugal and Galicia (Northwest of Spain), culturally and climatic similar areas. The Atlantic diet is characterised by an abundant consumption of vegetables, fish and meat, mainly local and fresh products (seasonal food), cooked to maintain its characteristic flavour and taste. For this reason, it has become a worldwide reference for a healthy diet. The main objective of this 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 used as a first step to include dietary patterns of the traditional 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? N.A. Chaves, KU Leuven / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering; J. Eyeckmans, KU Leuven / Faculty of Economics and Business

The sharing economy, facilitated by digital platforms, is expanding in to more and more areas of the economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from providing wider access to goods and services, reducing the need for multiple 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 the lack of data on goods used in the sharing economy, the 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)


Although in 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 effectiveness of the resistance to the biogasification, the potential biogasification, and the potential biogasification of DDE in the case of DDE contamination. 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.


A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area a little more than one year after planting. In fact, the system of olive trees and poplar trees promotes a reduction of overall PCBs concentration under the Italian legal limit (D.Lgs. 152/2006) of 60 μg/g soil (Ancona et al., 2018). A further sampling was performed four year later in order to assess the PCB residual concentrations at different depths and distance from poplar tree trunks inside the planting area. At the same site, microbial analyses were carried out to investigate the total microbial abundance, cell viability and dehydrogenase activity. Moreover, nucelc acids were extracted from soil. The hypervariable regions V4-V5 of the 16S RNA gene were amplified and sequenced by MiSeq (Illumina). The structure of the microbial community in the planted and unplanted (control) soil was performed and compared and bacterial species involved in PCB degradation identified.

TU243 Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production V. Ancona, Water Research Institute - Italian National Research Council / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute; M. Cardoni, M. Di Lenola, National Research Council of Italy / Water Research Institute; D. Borello, Università La Sapienza / Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA); M. Falconi, ISPRA Institute for Environmental Protection and Research / Soil Protection Department - Geological Survey of Italy; A. Basile, Regione Puglia / Servizio Rifiuti e bonifica; A. Massacci, Italian National Research Council / IBAF; V. Uricchio, Italian National Research Council / VHA-REL Research Institute; L. Vergani, Univ of Insubria (Como) / Department of Science and High Technology

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 potential for poplar for syngas biogasification, 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. Genni, 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 transform and bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congeners found were similar between the two treatments. The anoxic treatment differed in terms of congeners detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone showed 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 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. Terzaghi, University of Insubria (Como) / Department of Science and High Technology; G. Caracciolo, University of Cono; E. Nogues, C. Morosini, University of Florence / Istituto per lo Studio delle DSAIT; G. Gaspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; S. Borin, University of Milan / DeFENS; F. Mapelli, University of Milan; L. Vergani, University of Milan / Department of Food, Environmental and Nutritional Sciences; A. Di Guardo, University of Insubria / Department of Science and High Technology

Phytoextraction and phytodegradation are techniques that have been used to remediate and contain PAHs and PCBs in contaminated soils. However, the effectiveness of these techniques has been limited by the lack of reliable data on the fate of PCBs in the rhizosphere. This study investigated the potential of poplar clones to remove PCBs from contaminated soil. The experimental setup consisted of a greenhouse experiment with two poplar clones (poplars and the Monviso clone) grown in soil contaminated with PCBs. The clones were chosen based on their ability to grow in different soil conditions and to produce biomass under flooding treatment. The results showed that the Monviso clone was effective in removing PCBs from the contaminated soil, while the poplar clone showed a lower capacity to remove PCBs. The study also highlighted several pitfalls in the experimental design, including the use of contaminated soil that was not representative of the site of interest, the lack of appropriate controls and replicates, and the use of inappropriate techniques for measuring PCB concentrations. The study also proposed guidelines for conducting future rhizoremediation experiments, including the use of appropriate controls and replicates, and the use of appropriate techniques for measuring PCB concentrations. The study also highlighted several pitfalls in the experimental design, including the use of contaminated soil that was not representative of the site of interest, the lack of appropriate controls and replicates, and the use of inappropriate techniques for measuring PCB concentrations. The study also proposed guidelines for conducting future rhizoremediation experiments, including the use of appropriate controls and replicates, and the use of appropriate techniques for measuring PCB concentrations.

TU246 Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil P. Ferdinand, U.E. Ezeji, Federal University of Technology Owerri / Biotechnology Technology Website

Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of the oil was
studied for a period of 4 weeks under laboratory conditions. Hydrocarbon-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0x10⁸ and 30x10⁶CFU/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.
F. Magelli, University of Milan; DeFENS / Department of Food, Environmental and Nutritional Sciences; L. Vergani, University of Milan; DeFENS; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology; Como; G. Raspas, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Zanardini, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milano / DeFENS; A. Franzetti, University of Milano / DeFENS; S. Borin, University of Milano / DeFENS; F. Diana, University of Milano / Bicocca; T. Stella, University of Milano-Bicocca / DISAT; M. Daghi, 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 hydrocarbons. This study focused on bioremediation of hydrocarbons contaminated soil. Bioremediation relies on the residing microbial communities and their activity but can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbiome selection are therefore pivotal to develop in-situ bioremediation techniques. In this perspective, the Pollution 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). 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 120 soil samples were collected in the SIN in faro 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 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 attenuation. This co-varied with the contaminated soil 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 bphC gene, codifying for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an indigenous bacterial potential, possible for future bioremediation 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. Daghi, 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. Biological remediation solutions are often compromised by both 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) or soil to improve the soil structure and addition of compost as amendment (CO). Thirty-six bioreactors were set up (6 sampling points for each condition in duplicate) and incubated for 180 days. Air pumps were used to insufflate air into bioreactors with the exception of NA ones. Laboratory analyses were performed on soil and soil gas samples at the beginning of the experiment and 6 samplings were carried out during the incubation period. Chemical analyses (GC-FID) of total petroleum hydrocarbons (TPH) were performed to evaluate the degradation rates and microbiological/molecular analyses (Total Bacterial Count, Most Probable Number-MPN, High-throughput sequencing of the 16S rRNA gene and quantitative PCR) to assess the growth of bacteria potentially involved in the degradation process. The highest degradation rate was observed in CO bioreactors (first-order rate constant K=0.180 d⁻¹) while lowest rates were observed in NA (K=0.004 d⁻¹) and SW (K=0.011 d⁻¹) in the first 60 days of incubation. However, a residual TPH concentration of >900 ppm was reached in all bioreactors after 180 days starting from an initial concentration of 2660 ppm. The microbiological characterization suggested a selection of the bacterial community according to the chemical results. In this respect, MNP results showed a significant increase in the number of oil-grown bacteria in CO bioreactors. These data will be confirmed by qPCR of the catalytic gene alkB encoding for an enzyme potentially involved in the biodegradation of hydrocarbons (on-going analysis).

TU249

Influence of Surfactants and Mycobacterium vanbaalenii PYR-1 Bioaugmentation on 14C-Pyrene Mineralization and Microbial Community Structure in PAH-Contaminated Soils
D.C. Wolf, University of California-Riverside / Environmental Toxicology; J. Gan, University of California, Riverside / Department of Environmental Sciences; Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that have potential mutagenic, carcinogenic, and teratogenic properties. Bioremediation has been recognized as a versatile approach to remediate PAH-contaminated soils. However, the biodegradability of PAHs is limited by their bioavailability to microorganisms in the soil porewater fraction. To expedite biodegradation, surfactants at the critical micelle concentration (CMC) has been added to enhance the bioavailability of PAHs. The aim of this work was to evaluate the effect of Brij-35, a non-ionic surfactant and rhamnolipid, a biosurfactant at three concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanbaalenii PYR-1 in PAH-contaminated soil using ¹³C-pyrene as a model compound. Additionally, the bacterial community structure after the 50 day incubation was analyzed using 16S rRNA gene high-throughput sequencing and PAH-degrading genes were predicted using phylogenetic investigation of communities by reconstruction of evolutionary trees (PI荣EST). The results demonstrated that they host an indigenous biodegradation potential in the sandy loam and clay soil compared to the unamended and rhamnolipid-amended soil treatments. The bioaugmentation of M. vanbaalenii PYR-1 had an immediate impact on PAH mineralization in both soils, resulting in 85% PAH mineralization after 50 days incubation by indigenous microbe populations in the sandy loam and clay soil compared to the uncontaminated soil and the addition of rhamnolipid mineralized PAHs. The addition of Brij-35 surfactant at all three concentrations resulted in increased PAH mineralization after 50 days incubation by indigenous microbe populations in the 30 days. The addition of rhamnolipid delayed PAH mineralization in both bioaugmented soil treatments in a dose-dependent manner. It appears that the rhamnolipid biosurfactant acted as a more favorable carbon source compared to ¹³C-pyrene and was preferentially degraded. Similar PAH-degrading genes increased in relative abundance after PAH addition, especially Bacillus and Sphingomonas. Species richness and Shannon diversity decreased following the addition of ¹³C-pyrene compared to the uncontaminated soil and the addition of rhamnolipid biosurfactant at 10X CMC in all soil treatments resulted in the lowest species richness and Shannon diversity. Using PICRUSt, PAH-degrading genes such as PAH dioxygenase subunits and aldehyde dehydrogenase were greatest in bioaugmented soil treatments compared to native soil treatments. Overall, the results of this study provide important insights towards the abiotic and biotic processes as well as their complex interactions in the bioremediation of PAH-contaminated soils.

TU250

Italian field results of Emulsified Lecithin-based Substrate used as ERD Treatment of Chlorinated Solvents in groundwater
A. Leombruni, M. Mueller, PeroxyChem LCC; F. Morlacchi, Centro Assistenza Ecologica; ELSMicroemulsion is a food-grade carbon that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is the acronym for Emulsified Lecithin Substrate, a technology designed to create reducing conditions and 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 produce hydrogen and electrons that are used to reduce organic compounds to their most reduced state (e.g., CO₂). ELSMicroemulsion acts as a reducing agent and produces reductant 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 hydrophobic and hydrophilic regions in their molecular structure. As a result, ELS tends to be stable emulsions, expectedly more stable than with only hydrophobic compounds. Further, phospholipids support remediation by providing essential nutrients (carbon, nitrogen, phosphorus) to bacteria. ELS Reagent was shown to effectively treat tetrachloroethylene (PCE) and its catecholates 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 consultation firm performed a field scale injection of ELS with a goal to reduce the PCE mass and its catecholates in the source area and the distributed plume and treat any residual
VOCs potentially migrating from beneath the former facility. A total of 4900 kg of ELS concentrate was emulsified and injected under pressure thought 51 fixed wells in the swallow contaminated aquifer. Subsequent field monitoring showed PCE and TCE below detection limits at all wells after 6 months. A 99.8% reduction of PCE and TCE was observed in the source and plume areas along with the reduction of the recognized catabolites, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethylene has also been observed in all the monitoring wells.

TU251
Cheese 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 Novy Bydzov (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 uncontrollable contamination of Quaternary aquifer which is about 4-5 meters thick, composed of sandy gravel and delimited by impermeable 400 meters thick Mesozoic strata. Application of different carbon sources (lactate, glucose, cheese whey and polyethylene glycol) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufacturers’ 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*, *Sulfurospirillium* and vinyl chloride (VC) reductases cvrA and bvcA. In addition denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsrA2 marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations. Moreover, higher bacterial abundance triggered efficient sequential 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 Various Organic Compounds (Modifiers) on Dehalorespiring Microflora

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Among all the groundwater contaminants chlorinated ethenones (CE) 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 carboxymethyl cellulose (CMC), molasses and detergent (anionic surfactant) on the specific dehalorespiring microflora was tested within this study. Groundwater contaminated with CE (1,2-cis-DCE and TCE) was collected from the chemical factory Spolchemie a.s. Batch tests with iron composite and various concentrations of CMC (0.25, 0.5 and 1 g/l), detergent (5, 10 and 20 g/l) and molasses (5, 10 and 20 g/l) were performed for periods ranging from 6 to 26 days. DNA was extracted after filtration of the tested water and used as a substrate for 16S rDNA amplification. 16S rDNA gene was used as a total bacterial community marker. Specific genes were used for detection of ongoing reductive dehalogenation (vcrA, bvcA, Dre DHC-RT and Dsb) and to monitor denitrifying and sulphate reducing bacteria (nirK and apsA). CMC bacteria protecting effect when nZVI is applied was observed. Positive effect was exerted in the presence of bacteria amount (106 CFU), denitrifying (nirK) and sulphate reducing bacteria (apsA). CMC as the substrate for dehalorespiring bacteria was not confirmed. Detergent enhances nZVI subsurface migration parameters. Direct positive effect on bacterial populations only in denitrifying bacteria was observed. Detergent had even inhibiting influence on dehalorespiring bacteria. Molasses as carbon and electron source had positive effect on all studied groups of bacteria. Interestingly, in combination with nZVI molasses enhanced growth of dehalorespiring but not denitrifying and sulphate reducing bacteria. Molasses is suggested to serve as the substrate for fermentation which produces electrons utilised by dehalorespiration. Molasses as the substrate and nZVI with its pH buffering capacity presented the best conditions for dehalorespiring bacteria. The authors acknowledge the assistance provided by the project No. TIP2000006 supported by TACR.

TU253
Mechanistic insight into microbial reductive dehalogenation

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Microbially mediated reductive dehalogenation provides a promising approach to remediate and detoxify halogenated aromatics. Despite extensive respective studies, the mechanistic understanding of the underlying chemical reactions is still limited. Interestingly, *Dehalococcoides mccartyi* strain CD1B1 and *Dehalobacter* strain 14DCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (atomically bound halogen vs. H) by the nucleophile cobalamin (vitamin B12). The latter was unravelled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational molecular orbital (MO) approach has been developed for a more detailed analysis of the molecular initiating event triggering the reductive dehalogenation.

Application to 93 ary halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-compatible e* orbital located at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CD1B1-active from non-active substrates for 92%. In this paper, we present efficient and cost-effective methods including applications of the MO approach for predicting dehalogenation pathways and regioselectivity. Overall, our approach supports the view that the reductive aromatic dehalogenation proceeds through an inner-sphere electron transfer. [1] Zhang, S.; Wondrousch, D.; Cooper, M.; Zinder, S. H., Schüürmann, G.; Adrian, L. 2017. Anaerobic Dehalogenation of Chloroanilines by *Dehalococcoides mccartyi* Strain CD1B1 and *Dehalobacter* Strain 14DCB1 via Different Pathways as Related to Molecular Electronic Structure. Environ. Sci. Technol. 51, (7), 3714–3724. [2] Zhang, S.; Adrian, L.; Schüürmann, G; submitted 2017.

TU254
Bacterial biosorption of PFOS from contaminated waters

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Per- and polyfluorinated alkyl substances (PFAS) have been extensively used for various commercial and industrial applications since the mid-1960s. Although they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009), Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contaminate the environment, animals and humans. The most frequently applied method for PFOS remediation of water is by passing it through activated granular carbon filters. Currently, there are increasing efforts to find new strategies for equally efficient and cost-effective methods for PFOS remediation of contaminated waters. This study investigated the possibility of removing PFOS by microbial binding. We tested the binding capacity of live and dead *Escherichia coli* OP50 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed by PFOS for by UPLC-MS/MS. The dead bacteria were found to have high adsorption (286-3324 g/g of bacterial pellet) whereas live cells had a low adsorption (7-95 g/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isomers as the linear compound; which defines the applicability of PFOS bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

TU255
Hexavalent chromium reduction in a biocathodic microbial electrolysis cell

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Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its cancerogenicity, Cr(VI) has to be removed, hopefully using environmental-friendly and economically sustainable remediation technologies. To overcome the limits of the currently applied bioremediation technologies, an alternative strategy is the use of BioElectrochemical Systems (BESs) to stimulate bioreduction of Cr(VI). BESs include a set of technologies based on biological reactors where an electrode (anode) can function as the final electron acceptor for the oxidation of organic compounds; then electrons flow through the circuit and reach the cathode that acts as the electron donor for the bioreduction of oxidized species. In the present study, we have assessed if Cr(VI) can act as an efficient terminal electron acceptor for an anaerobic biocathode in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a dual-chamber Microbial Fuel Cell, and inoculated with autotrophic cultre originate from anaerobic digester sludge. After 30 days of acclimation, the electrode was transferred into the cathodic chamber to work at -300 mV (vs. SHE) as the biocathode in a Cr(VI)-reducing MEC. An
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed at the initial, during the experiment and final time by spectrophotometric method, while the dissolved total chromium was analyzed by ICP-MS. During the whole test, the current intensity was monitored. At the end of the experiment, the microbial characterization of the communities enriched on the biocathode and in the cathodic area of 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 BES ensured higher removal efficiency than the pure chemical process. In addition, higher current densities were measured in the BES compared to the abiotic control, thanks to the biofilm interaction with the electrode. 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 years. 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 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 have a reducing ambient due to producing hydrogen which helps groundwater to reach an anaerobic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase1) to calibrate the injection for the site conditions. Based on the successful result of this phase, the full-scale 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 BPE bioremediation we have production of daughter products to pollution the accumulation of these by product 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, it has been possible to observe very good reduction rates with non-return valves corresponding to thirty years. Contamination has been treated. After a year (step 2), the injection took place in area C near to the site boundary. This allowed for accurate and tailored dosage application of the product without any risk of cross-contamination. Due to the rapid effect of injection, it has been possible to observe very good reduction rates within only few months from the application. PCE, has already shown reduction of three orders of magnitude and in some points, we reached the target, with daughter compounds appearing without accumulation.

TU257 Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments

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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 collected from a MCB contaminated area in South of Italy. 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 qRT-PCR techniques were used to investigate the EAM community. Moreover microbial α-diversity was calculated. The enrichment effect was evaluated both for the precultures and for the three components of MFCs (planktonic, biofilm and rod). Results showed that the MFC inoculated by Gen enrichment preculture had better performance than the FeC one (shorter start-up time, lower anode potential, higher current production and higher power density). The main source of variability resulted to be the kind of enrichment, both in the preculture 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 community enriched with FeC showed a lower Shannon diversity index, both in the preculture 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 removal of contaminants and to increase the performance of the MFCs. The present work indicates that Gen enrichment promoting the development of a self-balancing community seems to be a preferential approach to be implemented in in situ application.

TU259 Integration of molecular and isotopic analyses to investigate the potential of aerobic biodegradation at a site contaminated by Monochlorobenzene

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Bioremediation communities associated with artificially contaminated sites represent a great opportunity for environmental bioremediation considering that bacteria are able to use a wide number of chemical compounds as a source of carbon and energy. The use of an integrated approach based on different methodologies to gather more information about site-specific potential for bioremediation is gaining a wider acceptance from public authorities. The main objective of our work was to define quantitative indicators to assess the intrinsic degradation potential of a monochlorobenzene (MCB)-contaminated aquifer by the use of a “toolbox” based on isotopic and molecular biology analyses. Microcosms with groundwater collected from a MCB-contaminated site were set up under aerobic and anaerobic conditions. Three main endpoints were used to test the effectiveness of the treatments: TPH degradation, bacterial growth and δ13C substrate incorporation. The TPH degradation test revealed a concentration of 0.001 ppm TPH of the original sample after five days of incubation, which is in line with the expected degradation by aerobic biodegradation. The bacterial growth test showed the presence of viable bacteria in all the samples after five days of incubation, indicating the viability of the tested samples. The δ13C substrate incorporation test revealed that the samples were able to incorporate the 13C-labeled substrate, confirming the presence of active bacteria in the samples. Overall, the results of this study indicate that the site has the potential for aerobic biodegradation of MCB and that further investigations are needed to understand the factors affecting this process.
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 still in progress. However, during the biodegradation of MCB was completely depleted upon addition of nutrient and CSIA results confirmed negligible C isotope fractionation under oxidative conditions. The catalytic toedC gene, encoding for toluene dioxygenase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Recently, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MCB were also applied to another area contaminated by Mcb, and nearby the first site, to establish whether an aerobic approach for site reclamation from MCB would be successful in the extended area.

TU260 Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area
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The biodegradation and biodegradation of VC-containing 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 potential of 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 determine 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 Bacteroidetes and Bacteriodes enriched in 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PCEla, TCEa, VrCra, BvCa) and oxidative enzymes (ermC, emE) will be accomplished (on-going analysis) as well as isotopic analyses.

TU261 Microbial ecology and ecosystem services: a key role for biotechnological applications

Microorganisms are the invisible component of terrestrial biota, they contribute decisively to the ecosystem functionality, providing goods and services. Their play a crucial role in biogeochemical cycles function. They determinat for the water, air and soil quality. Despite microorganisms are of micrometric size (1µ – 1mm), their activities impact on a planetary scale. They are ubiquitous and show remarkable metabolic versatility. They are able to thrive even in extreme environments. Very often different strains of microorganisms perform their metabolic activities in close relationship and/or have co-evolved mutual dependence for performing complex processes where members of the food chain depend on the previous ones for their substrates. Human kind is largely relying on microorganism for its survival; they provide fundamental ecosystem services and perform complex biochemical activities to degrade residues and transform food. The scientific community is increasingly exploring the potentiality offered by functional microbial biodiversity to improve the human wellness and sustainability. Currently, a much interest is addressed towards biotechnological techniques that supply clean and affordable renewable energy sources exploiting the activities of microbial communities. This is the case of the anaerobic digestion (AD) process, through which, in the absence of oxygen, the complex organic matter is transformed into gaseous products, such as CH4, H2 and CO2. Although the engineering and technological aspects of the AD have been thoroughly studied, the microbial community is still managed as a ‘black box’, since most of the AD plants lack microbiological planning and monitoring. On the other hand, interactions between the microbial components have an invaluable combinable impact on the combined performance of the bioreactors as a whole. Disruptions in the AD process are often related to a poor understanding of the ecology of the microorganisms responsible for the associated biochemical reactions. In this work, insights about microbial community dynamics, investigated with innovative molecular techniques, are presented in order to improve the understanding of the linkages between natural and biotechnological ecosystems, and, by applying microbial ecology principles, improve the environmental engineering practices.

TU262 Evaluation of bioremediation potential in groundwater using newly-developed software
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Bioremediation 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 process of chlorinated ethenes, even to unprofessional users. The software enables an interpretation of input data, resulting in evaluation of the 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 Bydzov 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)

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 demand for phosphorus in metal workshops, 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 microcosm experiments were conducted in 5 L glass jars, that were filled with sediment and water from the reservoir. Among the 36 assembled microcosms, 18 were used as controls and 18 were used as treatment (with bags containing sawdust). The dissolved oxygen, iron, and orthophosphate were determined in interstitial water and water from the jar’s water column. Emerging contaminants and adsorbed phosphorus (P) were determined by mid-infrared spectrometry. Results: Dosed sawdust (0.1%) 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 interal flow of Fe. 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 mg P g-1 sawdust). The adsorption of carbamazepine, diclofenac, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estrone, 17-ethinylestradiol and 17-ethynylestradiol are lower than the limit of quantification (LOQ).

Conclusion: Sawdust is considered a biosorbent, of easy thorough studied, the microbial community is still managed as a ‘black box’, since most of the AD plants lack microbiological planning and monitoring. The management and the remediation of large 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 determine 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 Bacteroidetes and Bacteriodes enriched in 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PCEla, TCEa, VrCra, BvCa) and oxidative enzymes (ermC, emE) will be accomplished (on-going analysis) as well as isotopic analyses.

Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations (P)
TU264  
Formation potential of trifluoroacetate and its estimation by means of the TOP assay  
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Trifluoroacetate is the perfluorinated carboxylic acid with the shortest-possible  
chain length and thus a small, persistent molecule. Due to its high acidity (pKₐ < 0.23)  
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  
anthropicogenic 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 tandem mass spectrometry coupled to tandem mass spectrometric detection  
(KC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet,  
fluopicolide, fluopyram, flurtamone and tefbutricone; pharmaceuticals: fluoxetine  
and sitagliptin; industry chemicals: 4:2 FTSA and 6:2 FTSA) led to  
substance-specific molar yields between 7.1% (6:2 FTSA) and 96% (sitagliptin).  
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.

TU265  
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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protection products  
The substance 1,2,4-triazol is a known metabolite of several fungicidal active  
substances used in plant protection products. Modelled groundwater concentrations  
of peak triazol derivatives are expected to exceed 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 pesticides used as inactivation inhibitors 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  
uses cannot be ruled out, the presence of a pesticide is suspected. However, in  
many cases only its estimation by means of the TOP assay is possible.  
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.

TU267  
Implication of microbial adaptation for the persistence of emerging pollutants  
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and ecosystem dynamics; M. Braster, VU University Amsterdam; R. Helmus,  
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Amsterdam / IBED-ELI.  

Regulatory determination of the persistence of organic chemicals is mostly done using  
OECD ready biodegradability tests (RBTs). RBTs, however, suffer from several  
problems that lead to a high variability of the results and, hence, to  
difficulties in their interpretation. The origin and history of the inocula is one of the  
major causes of that variability. Nowadays, it is evident that results of RBTs change  
time as microbial populations apparently adapt within years to metabolise  
previously persistent chemicals. Several studies also show an improvement of the  
biodegradation rates even after a short period of pre-exposure to the tested  
chemical. As such, there is a need to assess the influence of this process on RBTs.  
We, therefore, used chemostat systems to expose activated sludge microbial  
communities to 3 different chemicals, 4-chloroaniline, 4-aminoantipyrine and  
methylpiperazine. Two of these chemicals are considered as emerging contaminants  
and are persistent according to RBTs. The biodegradation capacity of the  
activated sludge and of the exposed inocula was assessed in batch culture using the  
OECD 310 guideline for testing of chemicals. Different phases of biodegradation  
were measured following CO₂-production (OECD 310) and the compound and  
product concentration by LC-MS/MS. Community changes in the chemostats were  
determined by 16s RNA sequencing. The results of these experiments show  
enhanced biodegradation capacity for N-methylpiperazine after pre-exposure to  
this molecule. Moreover, microbial communities exposed to metformin were able to  
degrade this molecule and its known persistent transformation product,  
guanyleura, which is considered as persistent in fresh water. These preliminary  
results show that microbial communities can adapt to degrade a molecule that  
is initially persistent. These results are a first step to understand adaptation 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  
using adapted inocula.

TU268  
Prioritization of organic compounds based on their persistence in dissolved phase  
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Bordeaux  
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  
pesticide derivatives 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  
pesticide derivatives 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  
quotient is 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)  
while biotic degradation was shown to be the main attenuation process for 15  
molecules (e.g. diuron). Degradation was enhanced by increasing concentrations of  
suspended solids. Because half-lives of compounds presented important variations  
between all experimental conditions, valuable prioritization was complex to  
achieve in such conditions and consequently in transitional zones. A persistence

296

SETAC Europe 28th Annual Meeting Abstract Book
index and measured concentration in the Seine estuary were used together and allowed a categorized combination 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
OEC 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers
C. Coll Moro, Stockholm University / Environmental Sciences and Analytical Chemistry; Z. Li, Stockholm University / ACES; R. Bier, S. Langenheder, Uppsala University / Department of Ecology and Genetics/Limnology; A. Soheki, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES Persistent pharmaceuticals in aquatic ecosystems are of particular societal concern and the OECD 308 guideline is often used to obtain the biodegradation half-lives required for risk assessment. The environmental relevance of OECD 308 has been criticized in recent years 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-anoxic conditions and initial concentration levels). In this study, we have investigated the differences in biodegradation of a mixture of 9 pharmaceuticals (acetaminophen, caffeine, carbamazepine, diclofenac, fluconazole, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Gründlach, 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-stereile 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. 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 testing criteria. However, RBTs only assess the water compartment. The QSAR models are 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 (P\textsubscript{overall}).

TU271
Persistency assessment of pesticides in Denmark
A. Gimsing, The Danish Environmental Protection Agency / Pesticides and GeneTechnology; A. Aagaard, S. Marcher, The Danish Environmental Protection Agency / Pesticides and Biocides; V. Møller, The Danish Environmental Protection Agency Persistent active substances can affect the environment over long periods of time, as such substances can be distributed and accumulated within and outside the areas where they are used. Persistent substances constitute a long-term and difficult-to-quantify risk of spreading in the environment and affect organisms. Persistent substances can also cause effects on and lead to residues in subsequent crops. This also applies to the metabolites of an active substance. Therefore active substances with a DT50 above 180 days cannot be approved in Denmark. The persistency evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be 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 constitute the major part of data and if it is likely that DT50 for Danish soils is above 180 days under field conditions relevant to the intended use. The persistency evaluation should be performed for both the active substance and metabolites. However, metabolites which fulfill certain criteria are considered to be of no concern regarding persistency.

TU272
Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass
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Fungicides are routinely applied to golf course turfgrass prior to winter in temperate climates around the world to protect the plants against psychrophilic plant pathogens. The persistence of fungicides in winter conditions 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 influence the persistence of the fungicides propiconazole and chlorothalonil. Fungicides were applied once on 20 Nov 2015 and again on 5 Dec 2016. Weather conditions during winter varied with light snowfall, strong wind, and 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, corresponding increase in M. nivea-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, which 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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Grafted copolymers with microbial levan and polystyrene were produced from sucrose by S. market, a biodegradable, renewable and eco-friendly material. 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 $^{13}$C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O$_2$ consumption of samples mixed with soil was measured in period of 28 days. The $^{13}$C NMR spectrum of copolymer showed signals attributed to both monomers and to O$_2$ incorporated into 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 $^{13}$C NMR analysis. Results after 28 days in aerobic biodegradation in soil shows that obtained novel copolymer has biodegradation potential, however additional tests for biodegradation are needed.

**TU274**

**Aerobic degradation of styrenated phenol in soil: influence of the temperature and of the characteristics of the soils**

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The persistence of chemicals is assessed through their kinetic of degradation in the environment. Several simulation tests are available to evaluate the half-life of the chemicals in different environmental compartments. The half-life is then compared to the Annex XIII criteria of REACH to decide if the substance is be considered as Persistent (P) or very Persistent (vP). Nevertheless, the interpretation of those tests is complicated. Degradation rate ($k_1$) of 2,4- and 2,6-TDA was studied in different soils, 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 parent compound and formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

**TU275**

**Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests**

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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 rate ($k_1$) of 2,4- and 2,6-TDA was studied in different soils. The OECD Guideline Nos. 301B and 308, wherein their disappearance, formation of degradation products, and evolution of $^{14}$CO$_2$ were measured from initial doses of 0.5 mg/L. 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 TDA's in the RBT followed parent compound degradation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

**TU276**

**Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China**

B. Mai, Guangzhou Institute of Geochemistry; C. Huang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; Y. Zeng, Guangzhou Institute of Geochemistry

Biodegradation of polychlorinated biphenyls (PCBs) and polynonylated 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 and identified by high resolution LC/ESI-HRMS/MS for qualification. Two major biotransformation products of PCBs and PBDEs were identified. Among CSIA analysis, only the stable carbon ratios ($\delta^{13}$C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20 cm of the 3rd sediment cores were obtained. An increase in the $\delta^{13}$C values for BDE 28 and a slightly decrease in the $\delta^{13}$C 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 $\delta^{13}$C 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 debromination processes.

**TU277**

**Transformation and degradation mechanisms of flame retardant triphenyl phosphate in aquatic environment**

Y. Choi, Guangwu Institute of Science and Technology; S. Kim, Guangwu Institute of Science and Technology / School of Earth Science and Environmental Engineering

Organophosphate flame retardants (OPFRs) in aquatic environment are concerned because they are latest alternative chemicals of brominated flame retardants. Among OPFRs, triphenyl phosphate (TPHP) shows high consumption volumes, as well as high concentration in water. TPHP caused toxic effects especially in aquatic organisms but research of biotransformation products is insufficient. Kinetic studies of TPHP and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, Daphnia magna was used due to its sensitivity to aquatic environment. TPHP was exposed to Daphnia magna and each samples were separated by biota and remaining medium. *Daphnia magna* were homogenized and remaining medium were extracted with solid phase extraction. Samples were analyzed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray ionization 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 (DHPH), 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 (DHPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DHPH; as TPHP showed decreased, degradation product (DHPH) ratios increased. In conclusion, hydrolysis and sulfoxidation 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.

**TU278**

**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 novel silicone compounds. Siloxanes are important group of industrial chemicals, which are frequently produced in high amounts. They are widely used in industry, personal care products and agriculture. In general, siloxanes occur ubiquitous in the environment in different concentrations (e.g. in water from ng to mg per L). Since these polysiloxanes are exclusively cleavable by chemicals, potential substitutes, which are better degradable in the environment, are urgently needed. Therefore, a partially new synthesised homogenous group of silicon organic compounds ($p$-MeO<sub>H</sub>SiMe<sub>2</sub>, o-MeO<sub>H</sub>SiMe<sub>2</sub>, p-MeO<sub>C</sub>H<sub>3</sub>SiMe<sub>2</sub>, o-MeC<sub>H</sub>MeSiMe<sub>2</sub>, p-MeC<sub>H</sub>MeSiMe<sub>2</sub>, o-MeC<sub>H</sub>MeSiMe<sub>2</sub>) 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. Measuring the depletion of sunlight during a certain degree. After 6 hours, 99% of the substance p-MeNC9H4SiMe3 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 test confirm the data available in 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
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According to the United Nations (UN), a substance is the “chemical elements and their compounds in the natural state or obtained by any production process”. This definition has evolved according to different acts of regulation. Another category of substances is UVCB: Unknown or Variable composition, Complex reaction products or Biological materials” such as crude oils or vegetal extracts. In addition, there are “mixtures or solutions composed of two or more substances in which they do not react”. The assessment of complex mixture biodegradability can be limited by toxicological issues and/or difficulties in identifying the inherent biodegradability. This work is composed of three different studies to introduce and improve the “Ultimate Transformed Organic Carbon (UTOC) as a quantification tool for biodegradation. The UTOC approach includes the inorganic carbon resulting from respiration and the carbon assimilated by microorganisms. This measurement strategy was initially compared to a DOC D/E/WAY test (i.e. OECD 301A) and then successively tested and validated with non-soluble chemicals, pure and in an emulsion mixture (consisting in a virtual cosmetic formula). The UTOC approach highlighted the beneficial effects of an emulsion on the biodegradation of these substances. Prior to assess a natural complex mixture, pass levels to differentiate unequivocally ready and inherent biodegradability were determined. This latter step aims to reinforce safety in the assessment for substances of unknown category. Based on the principle of reducing the probability of persistent parent products or generation of toxic by-products during biodegradation, the UTOC approach was reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assayed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture. 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.

TU280 Development of a multi-sensors device to assess the biodegradation of chemicals
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Most of the methods used to evaluate biodegradation have been developed for almost 50 years. According to the fact that annually, hundreds of new chemicals require a biodegradability assessment; the development of new metrological solutions needs to be investigated. Indeed, few measurement systems, enabling an automated assessment are currently available from those based on manometric or oxygen consumption measurements, which present certain limitations to assess complex or volatile chemicals. To increase the reliability of the assessment, notably for volatile and complex chemicals, our objective was to develop a multiparametric platform disposing of its own measuring methodology. A research project was therefore conducted to develop this methodology while integrating automation of measurements to tackle another major challenge in biodegradation assessment. To reach this technological bottleneck, a validation of different technologies of sensors has been performed to assess their reliability and accuracy in operating conditions. This first step is crucial prior to establish a carbon balance analysis, using several
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.

TUI263 Investigations on key parameters of an innovative biodegradation test based on cell proliferation
S. Rey, Firmenich / Biotechnology; B. Özé Duygan, University of Lausanne / Fundamental microbiology; S. Leocata, L. Baroux, P. Merle, Firmenich; J. van der Meer, University of Lausanne / Department of Fundamental Microbiology; M. Seyfried, Firmenich

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 cytometry output. 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.

TUI284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances
T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tomiyama, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morta, 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 to resolve 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-methylhexadecane, is insoluble in water and tends to stay on the water surface. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface water. To overcome these challenges, 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 test results were accepted by the Japanese authority. An aroma chemical, 3,5,5-trimethylhexanenitrile, 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.

TUI285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants
B.A. Poursat, University of Amsterdam/IBED Institute / Institute for biodiversity and ecosystem dynamics; J. Dalmijn, University of Amsterdam / IBED; M. Braster, VU University Amsterdam; R. Helmus, University of Amsterdam / IBED; R.J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBED; P. van der Parson, University of Amsterdam / IBED

Assessment of microbial biodegradation is a key parameter for estimating the environmental risk of new organic chemicals. Commonly used tests for the assessment of ready biodegradability (RBTs) have been designed as simple and inexpensive methods to identify chemicals that are not expected to be environmentally persistent in most of the ecosystems. However, RBTs suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. These tests are low throughput, space consuming and poorly reproducible. Moreover, the origin of the inoculum is also a cause of variability in RBTs results. Pre-exposure of the inoculum to the tested chemical prior to any test has been proposed as a method to improve biodegradability testing. Pre-exposure could allow a better persistence prediction of chemicals present at low levels in wastewater or of newly produced chemicals by including the natural adaptation ability of microbial communities. Therefore, in order to assess the influence of the inoculum origin and of pre-exposure on RBTs, we compare the biodegradation capacity of activated sludge from different Dutch wastewater treatment plants before and after pre-exposure to five different chemicals. Carbamazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-methylpiperazine are industrial chemicals with erratic behaviour in RBTs. In this research, an effort is made to miniaturize the standard OECD 310 procedure. As this test requires large volume vessels, it is difficult to perform large scale tests with multiple inocula and compounds using this general setup, sealed batch reactors and 96 well plates. An approach 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.

TUI286 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 Tentative Guidance on RBTs and Chemical Safety Assessment Chapter R.7b: Endpoint specific guidance), adaptation has been explicitly excluded. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessment and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of these families was studied in detail regarding the future environmental fate of adaptation. 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.

TUI287 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 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. Chemicals manufacturers and 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 suspected from end of test degradation and different abiotic loss mechanisms. We present results from two marine BST tests (OECD 306 and BODIS) conducted on two synthetic hydrocarbon Gas-to-Liquid (GtL) products. In addition to measuring ultimate biodegradation (by oxygen uptake) in these tests, additional analytical techniques have been incorporated to enhance the interpretation of results. Extraction and analysis of test samples using gas chromatography has been conducted to (i) confirm substance dosing and (ii) understand the extent of abiotic losses in the test system. In addition, two-dimensional gas chromatography (GCxGC) was employed to characterise hydrocarbons present in test samples, which were compared back to the composition of the original test substances. An overview of the results and our recommendations on how marine 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
TU288
Organising an international ring test to improve the marine biodegradation screening test
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A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradation screening tests (BSTs) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, they have resulted in major enhancements also addressing the 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 protocol 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 also addressing the 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 protocol 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.

TU290
POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
s, katakam, I. Itet Hydrobat; A. Qureshi, I. Itet Hydrobat / Civil Engineering; P. Chakraborty, SRM University; A.K. Tiwari, NCAOR / Polar environment
We present preliminary results on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, and water] of Schirmacher Hills, Dronning Maud Land, Antarctica. α-HCH concentrations (4.48 ng/L and 30 ng/L for water and soil, respectively) were detected. In our study, we present the PCA of HCHs observed in moss, water, and soil samples from Schirmacher Hills. The observed concentrations are comparable to previous studies in this region. Moreover, this substance is classified as a pollutant of emerging relevance due to its persistence in the environment and its uncertain damages to both human and animal health.

TU291
Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD and GC-MS
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CCNH
Bisphenol A (BPA) is a compound widely used in plastics such as polycarbonates and resins. Its use has been increasing in the last years and research points that it may be detected in the environment in great concentrations. Moreover, this substance is classified as a pollutant of emerging relevance due to its persistence in the environmental systems and its uncertain damages to both human and animal health. Some studies connect the exposition to this compound with cancer and other diseases. In this work, we evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand pattern to it. After that, 2ml of sample were periodically purchased and analyzed in an Agilent 1220 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In
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.

TU293 Soil dissipation of paraffin oils: Improvement of the microbial degradation and impact on soil dissipation.
P. Adrian, A. Barret, CEHTRA SAS; G. Destreycker, 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 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) as produced by TOTAL Fluids, dissipated to below 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was not any substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids. Existing in any ore-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. The 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.

TU294 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 food web dynamics. For example, it is common practice 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 international concern because of its long range migration 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 clona were exposed at 20ÅC to 0.2 µg/L and 2 µg/L Hg (HgCl2) in the presence and absence of biofilm. Our aim 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.

TU295 Multiple stressor effects on resource quality for consumers: a case study with photobiotic biofilm exposed to phosphorus and ionic silver
M. Daney, K. Sanchez-Thirion, LIEC, C. Crenier, LIEC, Université de Lorraine CNRS UMR; T.M. Ciesielski, Norwegian University of Science and Technology / Department of Biology; T. M. Cienielski, Norwegian University of Science and Technology / Centre for Biodiversity Dynamics CBD; A. Gonzalez, Universidad de Las Palmas de Gran Canaria; P. Perriere, Université Clermont Auvergne; L. Ten-Hage, ECOBAM UMR CNRS UPS INPT; V. Felten, LIEC / LIEC CNRS UMR; J. Lefaiache, ECOBAM UMR CNRS UPS INPT

Autotrophic biofilms are fundamental biological compartments of many aquatic ecosystems, representing notably a major resource for many invertebrates and fish 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 primary producer species, would reduce the
biochemical quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, *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 the gammarids growth, while biofilm fatty acid contents were unrelated to this parameter. This study underlines the large indirect consequences stressors could play on basal resources quality for consumers, and, in turn, on the whole food web.

TU309  
**Soil pollution induced changes in leaf litter chemical composition and in detritivore physiology and activity.**

A. Le Navenant, LIEC  
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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 metal stressors on plant leaf chemistry, the decomposition of birch litter (*Betula pendula*) produced on 10 sites along a metallic contamination gradient to assess the effects of the contrasted litter characteristics on microbial colonization and litter consumption by the diplopod *Glomeris marginata*, used as a model detritivore. Our results reported an impact of soil contamination on leaf litter chemical composition, leading in turn to significant impacts on diplopod physiology (in particular with an increasing oxidative stress with increasing contamination) and litter consumption by, the detritivore *Glomeris marginata*. These supplements could serve as a cost-effective measure to reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.

TU310  
**Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area.**


Organic matter decomposition (tea bag index) and feeding activity of mesofauna (Bait Laminia) were studied in an abandoned mine tailing area. Six environments were studied: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Betula pendula trees > 5 m high, growing scattered under the canopy (DP+MS); B) Outside the mine tailing: 5. Polluted forest with *Picea abies* trees > 5 m high and shrubs and herbs under the canopy (DF); 6. Control forest not contaminated with *Picea abies* trees > 5 m high and shrubs and herbs under the canopy (CP). Tea bags with green and black tea were buried in each environment, to calculate mass remaining, decomposition index and organic carbon and nitrogen of the remaining material. In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully empty after 20 days was recorded to calculate the % of holes fed upon. After 50 days, the percentages of mass remaining in the tea bags were: - DP+MS: 50-55%, roths tea=90%; PF, CF and P: green tea =80-85%, roths tea =90%. These percentages were maintained until the day 110. The lower decomposition in CF and PF can be related with more abundance of resources in forest soils outside of the tailings which could induce to microorganisms to use other sources of nutrients different from tea material. However, in more stressed environments, such as mine tailings with a low resource of detritus easily decomposable, mainly the green tea, could stimulate microbial activity by a priming effect. Besides, within the tailings, the decomposition in S (the most unfavorable environment “a priori”) could be favored by the high soil temperature (average ≈28°C, as a consequence of the lack of vegetation, while in other environments the shading by plants maintained the temperature between ≈23 and ≈25°C. Feeding activity on % of holes fed upon: CF=42%, P=39%, S=31%, P+MS =21%, AF =8%, DP+MS =77%. The high % of holes fed in bare soils (S) could be related to the scarcity of resources in this environment which stimulated the consumption of the bait.

TU301  
**Effects of mineral supplements on lead exposure in free-ranging herbivores.**

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University of Calgary / Ecosystem and Public Health; M. Durakal, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mateu, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre Lead (Pb) mining has contributed to the extensive release of Pb into natural environments for centuries. In former mining districts, now on the Iberian Peninsula mainly livestock and hunting estates, Pb persisting in the soils and vegetation of affected areas may cause an environmental and health risk. Since Pb shows an important toxic mecha for both animals and people, the 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 herbivore inhabiting mining areas and thus reduce the possible exposure route to people. In our previous work, we identified one mineral supplement rich in calcium (Ca) and phosphorus (P) that specifically altered Pb solubility and absorption in a digestive tract simulation model. Here, we go one step further to evaluate the effects of that commercial mineral supplement on Pb absorption and on immune status in goats from an old mining area. Two groups of goats from two plots with similar soil Pb concentrations were selected. One group was supplemented with the commercial mineral salt for 20 days, whereas the other one served as control. Then, the Pb exposure was evaluated in blood, milk and feces, and the phytohaemagglutinin (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 found to lead to secondary poisoning, while (red)attached 5.3, milk Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 g/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 phagophagy by the animal. These supplements could be of interest for livestock owners in mining areas that could over expose to livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.
Spatial comparison of contamination and biomagnification profiles of triphenyltin compounds in sub-tropical marine environments of Hong Kong

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Biomagnification of lipophilic organic contaminants is one of the major pathways to accumulate xenobiotic substances in marine organisms. Interestingly, the magnitude of biomagnification is not necessarily consistent in organisms across the marine food chain. Triphenyltin (TPT) compounds, which are moderately lipophilic (log Kow ~3.5), are commonly used in antifouling paints on sea-going ship hulls and surfaces of mariculture structures in coastal waters of Hong Kong, Japan, China, and Taiwan. Studies have suggested that TPT can be biomagnified along the lower part of the trophic food chain (i.e., among primary producers, invertebrates, and fishes), while their magnification potential has remained unclear among the higher trophic organisms, such as larger fishes, dolphins, and seabirds. To date, only two studies have investigated whether biomagnification of TPT occurs in marine organisms at higher trophic levels; however, their findings were contradictory. Therefore, we aimed to evaluate the biomagnification potential of TPT in high-trophic organisms across a spatial gradient from the more-contaminated southern waters to the less-contaminated southern waters of Hong Kong. We have divided the western and southern waters into four sites, namely inner estuary (WI), outer estuary (WO), south of Lantau Island (SL), and southeast of Hong Kong Island (SE). Environmental (seawater and sediments) and biota samples (including molluscs, crustaceans, fishes and marine mammals) collected from the respective sites were analysed using gas-chromatography mass-spectrometry to examine the concentrations of six organotin compounds (i.e., mono-, di- and tri- butyltin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had the highest concentrations. This is partly due to historical PCB inputs into the Pearl River. Our forthcoming results on whether TPT can be biomagnified in the higher trophic organisms will further shed light on its biomagnification potential at the higher food chain with consideration of its lipophilicity and octanol-water partition coefficient (log Kow).

TU306
Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban estuary: Toronto Harbour

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Trophic magnification factors (TMFs) have been extensively used to assess the biomagnification potential of organohalogens in numerous aquatic and terrestrial ecosystems. While the trophodynamics of legacy persistent organic pollutants is relatively well known, that of emerging halogenated contaminants remains scarcely documented. This is particularly the case for short and medium chain chlorinated paraffins (SCCPs and MCCPs, respectively), which quantitative analysis remain challenging. In the present study, we aimed at investigating the biomagnification of these compounds in the trophic web of an urban river heavily impacted by urban inputs: the Orge river (near Paris, France). In addition, a comparative study was performed, using polychlorobiphenyls (PCBs) as benchmark chemicals (i.e. positive control groups for biomagnification). To this end, 45 marine organisms, ranging from primary producers to piscivorous fish (n=45), were collected in this system and analysed for PCBs, SCCPs and MCCPs. Stable isotopes of nitrogen were used to estimate trophic levels and to compute TMFs using a Linear Mixed-Effects Model (lme4) accounting for the difference of samples between taxa. Our results show the expected biomagnification of the targeted PCB congeners (i.e. TMF ~1), thereby validating both the sampling strategy and the data treatment. SCCPs exhibited TMFs in the range 0.4–2.0 and the extent of biomagnification was directly related to structural features such as alkyl chain length and chlorine content. Conversely, MCCPs almost consistently displayed TMFs < 1, likely as a consequence of their higher biotransformation rates compared to SCCPs. Such results provide additional data for the risk assessment of chlorinated paraffins.

TU307
Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin.


Copper and mercury body residues in 10 macroinvertebrate taxa were used to model the alterations in benthic community metrics due to metal bioaccumulation in mining areas of the Nalón River basin (Spain). The studied taxa are potentially useful as water quality biomonitor and cover different functional feeding styles. This is part of a larger study in North Spain that aims to develop bia quality

304
SETAC Europe 28th Annual Meeting Abstract Book
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.

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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 zooplankton 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 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.EC50 = 3.82 mg/L). As regards ecotoxicological assays, immobilization was never affected (effect < 50%), while frequency of pulsation showed a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae able to induce sublethal effects.

Tularaemia infections in Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.

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Essential metals and organic contaminants in small quantities carrying out biologic 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 for many organisms in the environment, they can 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 'n 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 over 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 hours of exposure to the contaminated food. However, lesions were reduced in animals with cadmium exposure, a non-essential metal, in more than 50% of organisms in could be observed on day 10 and those associated with more than 50% 'n animals in copper exposure were deferred to day 15. The presence of Chlorella in the digestive tract made possible to associate the injuries within trophic metal poisoning, and the prevalence of lesions with metal and exposure time.

Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web

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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 zebrafish (Danio rerio). Therefore, cryogenically ground microplastic particles, made of polypropylene (PP) and polyethylene (PE) in vials containing organic and inorganic contaminants, were added to the artificial aquatic food web, simulating the occurrence of polystyrene (PS) microplastic particles in the marine and freshwater environment. By this method, the potential toxic effects of microplastics on vertebrate consumers can be studied and compared to the effects of contaminants in traditional food web experiments. In this study, the artificial aquatic food web, consisting of zebrafish (Danio rerio) as top predators, Artemia spec. nauplii as intermediate consumers, and the following food web consumers, was set up. Results showed that the biomass of zebrafish increased steadily from 100 mg to 1.0 g L^-1 over 15 days, whereas the biomass of Artemia decreased rapidly from 17.17 to 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 BCFs 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 conversation 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)

TUL31 INTEREST OF IN VITRO BIOASSAYS (YES/YES) FOR THE SCREENING OF ENDORCINE 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 260 substances were screened, including hormone estrone, alkylyphenols, phthalates, chlorophenols,
perfluoranes, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2equ (mean: 2.1±1.6 ng E2equ). Androgenic activity was detected in 2.6 of the other hand, estrogenic and androgenic 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 estrone concentration but also with other ED (e.g. bisphenol A, perfluoranes). 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 of pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

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As part of an ongoing review of the Water Framework Directive (WFD), the European Commission (EC) is considering “effect based tools” (EBTs) for use as an instrument to allow better comparison with, and integration of EBT results with, environmental quality criteria. The current strategic approach to establish environmental quality criteria is under review in the context of the Water Framework Directive and in response to the requirement for a multi-dimensional assessment of water quality that takes into account ecological interactions. The development of benthic EBTs (e.g. Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna) and macroalgal EBTs (e.g. Ulva sp.) would eventually lead to the establishment of ecotoxicological quality criteria for these species. Therefore, a number of marine benthic EBTs were recommended to be used in such assessments. These EBTs are relatively cost-effective, fast, easy to perform and are directly applicable in the field. In addition to the marine benthic systems, macroalgal EBTs were also recommended. These include the use of the algal-bacterial assay, which is a powerful tool for the detection of endocrine disruptors (ED) in the environment.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD) in Southern Portugal

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As part of an ongoing review of the Water Framework Directive (WFD) in Southern Portugal, the Ecotoxicological Monitoring Strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD) in Southern Portugal project was launched. This project aims to develop innovative ecotoxicological monitoring strategies to assess the impact of pollution on aquatic ecosystems and to provide recommendations for the implementation of the WFD. The project will focus on the development of ecotoxicological monitoring strategies for the protection of aquatic ecosystems in Southern Portugal, including the Alqueva Reservoir, one of the most important water supply sources in southern Portugal. The project will involve collaboration between different stakeholders, including scientists, policymakers, and local communities, to ensure the implementation of the WFD in Southern Portugal.
(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 even by non-intentional releases. In order 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/MICROSCOPE 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 screening at the high levels 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 ( Ames test) with and without metabolic activation (S9). The strains used were TA98, YG1041, TA1538 and YG5185 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 viable and diverse class of compounds are considered, which 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 need to be investigated. Non-targeted analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6. José Ricardo R. M. Zwarg thanks FAPESP Project 2015/11399-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Union’s Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

TU318
NTA meets EDA: A practical example
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Organic micropolutants play an important role in the assessment of water bodies that are used for drinking water production. On one hand, micropolutants 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. PPC 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 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 micropolutants is needed. This project is an approach to analyze organic micropolutants in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken regularly over a period of one year in order to obtain an annual progression of the water pollution. A LC IMS 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 on the identification of seasonal expessions of the micropolutant 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, are banned in a number of European countries. In Italy, BTs have been banned since 1990, 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. Nassaarius nitidus (Jeffreys, 1867) and Hydrobia ulvae were compared in order to identify a specific biomarker for organo-tin compounds. Other sites indicate the presence of other types of compounds or mixtures that need to be investigated. Non-targeted analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6. José Ricardo R. M. Zwarg thanks FAPESP Project 2015/11399-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Union’s Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

TU320
Lessons Learned from Sibro Dam and River Restoration in Sweden
E. Hallqvist, C. Becker, P. Bönlöke 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 (WFD) aims to protect and improve water quality and aquatic ecology; environmental quality standards (EQS) have been established as legal tools with which to set requirements for member 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 a waterbody is defined as the percentage of the waterbody that is healthy under current conditions. The lower the status, the more significant the required management actions. In Sweden, a common national strategy is to increase the use of rivers and streams in sewage treatment plants as an alternative to reliance on fossil fuels. In the same time the goal of the Sibro Dam project was to manage the challenges, this paper summarizes work conducted over the past 2 years to manage the future of the Sibro Dam located in central-eastern Sweden. The project was initiated after previous dam repair work involving the diversion of large numbers of fish and serious consequences for nationally protected/unindigenous mussels and other aquatic life. The responsible municipality is obligated to improve ecological connectivity at Sibro Dam and regulation of Lake Bäven. The planning/implementation included preparation of an environmental impact assessment (EIA), detailed environmental engineering design for fish passage, engagement with local communities and communications between the municipality of Nyköping and Sweden’s federal court in Keywords/Fish passage; Sweden; ecological connectivity; environmental impact assessment

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment (P)
TU321
Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

307 SETAC Europe 28th Annual Meeting Abstract Book
Fish. Agonistic behavior is crucial for maintaining social hierarchy in many coral species. Efforts have been done to address the effect of environmental contaminants on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by EE2 exposure. However, the fish exposed to EE2 retained normal swimming patterns and with length of exposure. Results indicate that fluoxetine can have an effect on swimming activity in fish species. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparatively few have been done on invertebrate species. This study aims to translate these techniques to model cocktails for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Species of the marine amphipod, Echinogammarus marinus and the freshwater amphipod Gammarus pulex were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 µg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic response. Both E. marinus and G. pulex showed alterations in activity at concentrations as low as 1 ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and photocytactic 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
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Inter-species variability in marine and freshwater amphipods is used in standard ecotoxicology testing to assess environmental effects of contaminants. However, standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is rapidly 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 phototaxis and positive thigmotactic behaviours (P<0.001 respectively) however, differences in sensitivity to these assays were observed between species. E. marinus showed a significantly greater sensitivity to the phototaxis assay than G. pulex (P<0.001), while the reverse was found for the thigmotaxis assay (P=0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P<0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of very different behavioural responses. The inter-species variability in sensitivity to behavioural assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

TU327
Pharmacological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)
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Pharmacological methods are common contaminants in aquatic ecosystems. Among the most prescribed pharmaceuticals globally are the benzodiazepines (e.g. Valium), a class of psychoactive drugs used to treat anxiety and induce sedation. Benzodiazepines are persistent in the environment, and their target, the GABA-A receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (Perca fluviatilis) and Fathead minnows (Pimephales promelas) but even species conspecifics with a high stimulus found that also wild-caught zebrafish (Danio rerio) show reduced fear responses after 7 days of exposure to the benzodiazepine oxazepam (1, 10 or 100 microgram per Liter). Intriguingly, fear responses were partially restored after 28 days of exposure. Here we analyse the physiological and genetic basis of this tolerance to oxazepam, including peak cortisol levels in response to a stressor, concentrations of midbrain neuropeptides in sensitivity as well as mRNA expression of brain GABA_A 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
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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-A receptors, which are found in a wide range of animals including all vertebrates. We investigated the effect of the benzodiazepine oxazepam on behaviour using the burbot, Lota lota. We found that high levels of oxazepam affected swimming activity, diurnal as well as nocturnal, while the environmentally relevant level had no detectable effect. There was also an effect on boldness, with fish exposed to high levels of oxazepam spending more time hiding than the control- and low level fish. Interestingly, the effects of high oxazepam were no longer detectible when the fish were tested again after being kept in water without drugs for five days. Our results suggest that effects of pharmaceuticals may be reversible, if the exposure duration is relatively short and the animal have the possibility to move to uncontaminated water.

TU329
Behavioural endpoints and biochemical biomarkers as tools to investigate effects of Citalopram in brown trout (Salmo trutta f. fario)
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Citalopram (CIT) is a selective serotonin reuptake inhibitor (SSRI) which is commonly used as an antidepressant. It binds non-selectively 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 SSRIs in surface water. Several studies showed that environmentally relevant concentrations of 1 µg/L may affect aquatic organisms. The aim of this study is to investigate effects of CIT in different life stages of brown trout (Salmo trutta f. fario) with focus on development, behaviour and individual health. Both, eggs of the 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 effect 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 impaired 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 exposed for the exposure to 1000 µg/L CIT. These moved significantly less with a lower velocity than the control fish. The results of both experiments make evident that 1000 µg/L CIT affects both larvae and juvenile brown trout, on one hand by making them more agile in the aquaria, but also by depressing stress-induced flurry swimming. The study is embedded in the Effect-Net (effect network in water research) Project which is funded by the Wassernetzwerk Baden-Württemberg.

TU330
Assessing the direct and indirect effects of chemical contaminants on the behaviour, ecology and evolution of wildlife: A conceptual framework
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Chemical contaminants, e.g. metals, pharmaceuticals, pesticides, are changing ecosystems via effects on wildlife. Most studies examine a limited range of endpoints, species or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have an effect on both individual and population-level processes. For instance, altered predator-prey interactions can cascade cascading contaminants through communities, and affect species interactions and evolutionary forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we show how the consequences of contaminants can extend beyond individuals. We use altered predator-prey interactions to demonstrate cascading contaminant effects through communities, exerting both positive and negative effects on distinct populations. Moreover, contaminants can be potent evolutionary forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we show how the consequences of contaminants can extend beyond individuals. We use altered predator-prey interactions to demonstrate cascading contaminant effects through communities, exerting both positive and negative effects on distinct populations. Moreover, contaminants can be potent evolutionary forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we show how the consequences of contaminants can extend beyond individuals.
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-ethynyl estradiol EE2 (measured concentration 12ng/l) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the guppy. To examine the impact of EE2 on mate choice, we ran a standard choice assay, which was conducted in two parts to disentangle visual cues from chemical cues. First, we allowed a single male (either control or EE2) to court two size-matched females (one control and one EE2-female). In this visual cue experiment, the male was only able to see the females, but not to smell them. Second, we introduced chemical cues (control and EE2-female) to the trial tank paired randomly with the females. We found that there was no significant effect of EE2-treatment on total time males spent associating with the females, when given only visual cues. There was, however, a significant effect on courtship 'sight' display with both control and EE2-exposed males spending more time performing sight displays for control females compared to EE2-exposed females. When males were presented with visual cues only (male, female, and control), we found that males spent significantly more time with EE2-exposed females when EE2 was present in the tank compared to control females. The results of this experiment indicate that males are more affected by EE2 exposure than females, suggesting that EE2 might have led to a deficiency in prey capture and growth in fish. In addition to these alterations, RPE invaginations, photoreceptor hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In the eyes showed a darkening of the iris region after exposure to 4.5; 7 and 9 µg TBT L⁻¹weight and length, and histology of the eyes and retina. Macroscopic analysis of the eyes showed a darkening of the iris region after exposure to 4.5; 7 and 9 µg TBT L⁻¹. Histopathological analysis of the retinal pigment epithelium (RPE) indicated a hypopigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. After exposure to 7 µg TBT L⁻¹, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% respectively to controls, respectively. The histopathological changes detected in the retina and iris may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

TU332 Effects of tributyltin on the eyes, swimming, feeding and growth of newborn guppies Poecilia vivipara
D.V. Paulo, C.F. Mariz Jr, M.K. Alves, R.M. Barata, UFPE Universidade Federal de Pernambuco / Department of Zoology; R.N. Alves, UFPE Universidade Federal de Pernambuco / Zoology; P.S. Carvalho, UFPE - Universidade Federal de Pernambuco / Zoology. Although the use of the antifouling contaminant tributyltin (TBT) has been banned since 2008 by the International Maritime Organization, it still persists in coastal environments due to its remobilization from contaminated sediments and also as a result of illegal use, including tropical regions along the Brazilian Atlantic Coast. Poecilia vivipara is a promising model for tropical estuarine fish ecotoxicological studies and we focused on its feasibility to address fish early life-stage toxicity caused by TBT. Newborn Poecilia vivipara fish at six days after birth (dab) obtained from a laboratory breeding stock were exposed for 96h to waterborne tributyltin at 0.1; 1.0; 4.5; 7 and 9 µg TBT L⁻¹ plus controls and solvent controls. After exposure, we evaluated swimming speeds and trajectories of the fish, counter-current swimming resistance, ability to capture Artemia nauplii, growth in weight and length, and histology of the eyes. After exposure to 4.5; 7 and 9 µg TBT L⁻¹, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% respectively to controls, respectively. The histopathological changes detected in the retina and iris may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

TU333 Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants
S.A. Saad, S. Ang, C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology. Background: Selecting an appropriate behavioral response to a potential rewarding or threatening stimulus is critical for the survival of an animal. Therefore, organisms possess an innate ability to react to threatening and rewarding situations they are naturally exposed to. However, the ability to naturally respond to environmental cues can be severely affected by exposure to environmental chemicals. Consequently, the behavioral outcomes become unpredictable. In particular, neuroactive and psychoactive substances in the aquatic environment released by wastewater treatment plants or agricultural run-offs might potentially change the perception and interpretation of natural cues by aquatic organisms, especially fish. Aim: We are investigating whether environmental contaminants lead to attractive or aversive responses in fish, and are additionally interested in the neuronal mechanism underlying the observed behavioral response. We aim to better understand how environmental contaminants change natural behavioral responses of fish in order to better predict their impact on the ecosystem. Methods: We are using zebrafish larvae as a model organism, because they are amenable for behavioral analysis and mechanistic dissection of complex processes. Larvae are exposed to a point source of test chemical at different concentrations and the behavior is tracked with an automated video recording system. Various parameters such as the larva’s space use, locomotor activity and velocity are evaluated. Active neuronal regions are detected by staining the larvae for an endogeneous activity indicator (pERK) after the behavioral assessment. Results: The larvae at an average size of 1 mm showed an attractive response at 1 µM, expressed by an increased dwell time in the nicotine containing zone. Higher concentrations (10 µM), on the other hand, appear to be clearly aversive, and larvae tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with activating or inhibiting of the reward center in the telost brain. We are investigating whether neurotransmitters (Indoxylacrid, ThiacoIplid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepam) found in European waters trigger similar behavioral patterns. Outlook: We will dissect which chemosensory system and higher brain areas are involved in the behavioral reactions to environmental chemicals. This will advance our understanding of the impact of chemicals on fish behavior.

TU334 Urban sewage effluents into an alpine stream: are information on behavioural effects on Daphnia magna suitable to protect alpine cold adapted species? 
Y. Di Nica, University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; V. Lencioni, F. Bellamoli, MUSE-Museo delle Scienze; S. Montoirotti, Dept. of Dept. of Environmental Studies. Water Research Institute Italian National Research Council IRSA-CNRT / Dept. of Earth and Environmental Sciences; C. Ferrario, University of Milano Bicocca; S. Villa, EMA European Medicines Agency. Even if identified as pristine, mountain freshwater ecosystems could be threatened by chemical pollutants through the discharge of effluents from wastewater treatment plants (WWTPs). Effluents containing pharmaceuticals, personal care products have been detected in different alpine rivers downstream of WWTPs. Acute toxicity tests performed with Daphnia magna are among the most internationally used bioassays for monitoring the toxicity of effluents. However, acute toxicity tests do not take into consideration endpoints that may provide early warning signals about the health of the exposed populations, such as behavioral changes. Altered behavioural signals could be induced at subthral concentrations which are significantly lower than the corresponding LEC50. In this study, we compared the sensitivity as mortality and swimming of Daphnia magna, and Diamesa cinctella 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 WWTPs located in Alpine areas as surrogate of cold freshwater best adapted species. Mortality rate and behavioural responses (as swimming, analysed with two video tracking systems: LoliTrack Systems and Image3wmTRig) were compared. We also tested the average speed of larvae exposed to unaltered 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 activity in the tray, the average speed of 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. cinctella gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU335 Do silver and titanium dioxide nanoparticles influence the fish kairomone induced anti-predator defence in Daphnia magna? 
A. Beasley, University of Siegen; S. Hartmann, University of Siegen, Institute of Biology / Department of Chemistry and Biology; K. Witte, University of Siegen / Department of Chemistry and Biology. Daphnia possess a trait of phenotypic plasticity, whereby kairomones from fish induce growth and the formation of structures such as a spine or helmet. The resulting increase in body size, allows the daphnids to defend themselves from the predators in their natural environment. As the common link between green algae and fish in the food chain, daphnia are considered a key component in the freshwater ecosystem. In the absence of predation, daphnia are among the most abundant organism in the environment, 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 sunscreens, 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 kainorones 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. The non-monotonic responses in swimming performance and social interaction during swimming is essential to life whole energy metabolism and we suggest that this parameter can be a potential sensitive endpoint for determining adverse effects of pharmaceutical to non-target organisms.  

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 occur as pollutants in surface waters. The potential effect of such pharmaceuticals on aquatic organisms including invertebrates has raised some concern but many adverse effects are not well characterized. In this study, 6 behavioral and physiological parameters in the freshwater Cladoceran Daphnia magna were compared for their responses to 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 pharmaceuticals 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  
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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 metallothionein). 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 Tenciplast® tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a Lologo® swimming tunnel, briefly fish were acclimatized within the chamber for one hour and then at a starting speed of 2 b/s with a 0.5 b/s speed interval, fish were 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 swimming performance and thigmotaxis were evaluated. In the Ag exposure via water, light significantly increased maximum velocity for all treatments (p<0.05) indicating an escape-related behaviour; excepting at 100 µg L\(^{-1}\), where the maximum velocity had no difference 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 centre zone was significantly lower at 25 µg L\(^{-1}\) AgNO\(_3\), however, where animals spent more time in the centre zone when dark was dark. Results from the exposure via food are currently undergoing analysis. The current results indicate that silver has effects on swimming and response to light behaviours in E. marinus, indicating that exposed animals in the environment could be more vulnerable to predation. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP 2016/19635-4) for the 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 behavioural endpoints for regulatory ecotoxicology studies  
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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 was significantly more difficult using 25 µg L\(^{-1}\) Eptesicus; however, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeroptera, Plecoptera, Trichoptera (EPT) species. Currently, there are no agreed methods for measuring reproduction endpoints for non-standard test species, such as EPT species. EPT species often live as larvae for a prolonged period and have an aereal adult stage, and thus assessing reproductive endpoints from a full life cycle in the laboratory is extremely difficult. Therefore, for some substances, the use of reproductive effects is desirable. Although behavioural endpoints (e.g. predator response, locomotion, feeding activity) do not directly relate to the protection goals of maintaining populations, they may still have a useful role in regulatory risk assessment. For example, for organophosphates (OPs) with steep dose-response curves and a narrow exposure window between acute and chronic effects, significant differences on reproduction can be due to mortality of adults rather than true reproductive effects; therefore, designing specific reproduction studies for e.g. EPT species may not be necessary for such substances. Instead, if a risk assessment were undertaken using acute and behavioural endpoints and acceptable risks were concluded, then it would be unlikely for effects at the population level to arise. Here we report on our experimental Assessment of relevant aquatic invertebrate endpoints in one standard (Daphnia magna) and two non-standard (EPT: mayfly, caddis) test species that are suitable for use in regulatory toxicity testing, investigating the regulative needs with the practicalities of ecotoxicology testing.  

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 pollutions, development of insect resistances and biodiversity reduction. The effects of low residual doses of these chemical products on organisms that affect both targeted species (crop pests) but also beneficial insects became a major concern, particularly because low doses of pesticides can induce various effects. In addition to the negative effects, some studies highlighted unexpected positive - also called...
hormetic - affects 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 behaviour, we followed the olfactometric system among the sexual or feeding behavior of our crop pest model following application of sublethal doses of deltamethrin, methomyl and chlorpyrifos. Whereas sublethal doses of methomyl 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)  
Parvarama, University of Lethbridge / Department of Biological Sciences; E. Mohaddes, University of Lethbridge; E. Lari, G.G. Pyle, University of Lethbridge / Biological Sciences  
Fish rely on olfaction for their survival, growth, and reproduction. Impairment of olfactory function can pose a threat to fish survival on the small scale and population loss on the larger scale. Metal contaminants (e.g. copper) can impair fish olfaction. Although the copper ion (Cu2+) has diverse toxicity, whereas at least a toxicology, the impact of copper nanoparticles (CuNPs) on fish olfactory systems has not been well determined. The objective of this study was to investigate time-dependent effects of CuNPs and Cu2+ on olfactory acuity and olfactory-mediated behaviours of rainbow trout. To establish CuNPs or Cu2+ induced olfactory-impairment thresholds, inhibitory concentration (IC) curves were determined. Fish were exposed to a geometric dilution series of CuNPs or Cu2+ for 24 hours, and fish olfactory acuity was measured using electro-olfactography (EOG). Afterwards, fish were exposed to CuNPs or Cu2+ at concentrations known to impair olfaction by 50% (322 and 6.8 μg/L for CuNPs and Cu2+, respectively) for a 24 h or 96 h exposure period. The response of fish to a social cue (taurocholic acid) was studied using EOG and a choice maze behavioural assay. After the behavioural experiment, fish olfactory rosettes were dissected to investigate if there was any DNA fragmentation as a marker of apoptosis that might be induced by CuNPs or Cu2+. Results of EOG revealed that while a 96 h exposure to CuNPs caused a significantly greater impairment of fish olfactory function relative to a 24 h exposure to the same concentration, fish olfactory acuity partially recovered after 96 h exposure. Continuous Cu2+ exposure 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+ was more acutely toxic than CuNPs. Cu2+ exposure at concentrations that impaired olfactory recovery was documented for continuous Cu2+ exposure. However, the mechanism of olfactory toxicity caused by CuNPs is not clear and needs further investigation.

TU342  
Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and implications for waste disposal  
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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 most relevant findings were for PFBA (57%) and PFBS (37.5%), highlighting the increasing diffusion of short chain PFAAs respect to the already restricted C8-PFAAs. It is also interesting to note that one of the samples with the highest concentrations was a found in the pharmaceutical industry, and it was an aqueous washing solution of water ligors. The overall survey underlines the need for a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

TU343  
Regenerated Textile raw materials: chemical contamination for LCA  
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It's essential, for every actor involved in the supply chain of a textile company, to increase awareness that a regenerated material respects proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory laws and also good practice and control of environmental impact. CID (Italian Consortium for Dye 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 Substances 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-consumes materials (knitted apparel, apparel made up by carded woven and combed woolen), pre-consumes materials (combed and carded woolen, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling). Operational plan involved quantitative and qualitative assessment concerning the regeneration of the woolen-type raw material used by carding 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, PFC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals from artificial perspiration (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), PFC (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 Substances 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 adaption 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  
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Challenges for a comparative risk assessment among conventional hazardous 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 (PFB and Durable Water and Oil Repellents (DWRs)). FRs are added to fabrics to inhibit the combustion process, and typically are products with a chemistry based on halogenates. DWRs 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 ingredien metals from non-renewable 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
substances (PFASs)
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Per-and polyfluorinated alkyl substances (PFASs) are heat resistant and show a low friction resistance. Because of these properties PFASs are for example widely used in aqueous film forming firefighting foams (AFFF). PFASs are not degradable in the environment. The release of AFFF into the environment causes a contamination of complex PFASs (such as PFOS and PFOA) need years to leach from top soil layers into the groundwater or into surface water. Short chain PFASs however reach ground water resources much faster due to their mobility in soil. These contaminations already caused closed drinking water wells. Remediation is costly and long lasting. Although fluorine free foams are available and used at several European airports many firefighters hesitate to use them instead of AFFF. Restriction and authorization are regulatory measures under REACH which can be used to minimise releases of PFASs into the environment. An international regulation via the Stockholm Convention is possible as well. In addition the dialogue with stakeholders can lead to voluntary actions and may be an alternative measure to reduce environmental releases. Scientists and manufacturers need to be encouraged to develop environmentally friendly firefighting agents without fluorinated chemicals. Moreover, scientists, authorities and NGOs need to bring together knowledge about the new substances, such as analytical methods, and information on their fate and behaviour in the environment. This presentations provides an overview on regulatory actions regarding PFASs in the EU and further ideas how to substitute firefighting foams containing PFASs.

TU346
The Paradigm of Substitution - expand your view
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Many people mention substitution as the most promising option for risk reduction in the case of SVHCs. But it has to be considered that technical solutions are embedded into complex structure-effect relationships along of equally complexity. Many different properties and outcomes have to be considered. Otherwise a thorough assessment of the applicability of an assumes alternative will fail. The surface treatment sector as a major cross-sectional community of service providers has long term experience with innovation and substitution suggested by different players for many different reasons – risk reduction being one of them. In particular the SMEs have constantly been confronted with lots of different ideas and approaches. Hence they have deep insight into unexpected side effects and regrettable outcomes. And they are able to give indicators for real promising and applicable approaches to substitution. The authors will present some significant examples of substitution attempts – and they discuss arguments why they might be considered successful – or not.

TU347
A pilot case on how Socio-Economic Evidence can inform Risk Management decision making to assess Substitution versus Recycling for non-ferrous metals slags in safe use applications
H. Waerentschoot, M. vander Straeten, Eurometaux
The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the increasing complexity of articles leads to increasing amounts of hazardous substances and impurities being available for recycling or reuse. Recycling processes in the metals sector produce besides pure substances for safe reuse, also final slags that collect some of the impurities that cannot be recovered at economical conditions. In parallel, the human health and environmental effects data generated by EU REACH and CLP Regulations lead to increasing hazard identifications and harmonised classification standards. Hazard endpoints of Very High Concern like CMR (carcinogens, mutagens and reproductive toxicity) or respiratory sensitisation may trigger substitution-based Risk Management Measures but also reduce the reuse in safe applications for “precautionary reasons”. In such cases, socio-economic evidence may be helpful to assess costs and benefits from a broader perspective, including Circular Economy and carbon footprint considerations.
A pilot study conducted at a non-ferrous plant specialised in the recycling of complex end-of-life articles and materials allowed to evaluate this impact and develop a tool for assessors to check knowledge to what extent a change in a relevant hazard classification could impact the reuse capacity of final slags. The tool allows metal companies to assess their situation in respect to Substitution (materials loss or disposal) versus Reuse in safe applications.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (P)

TU348
Ecotoxicity of the hydrolate byproduct of three biopesticides on the unicellular green algae Chlamydomonas reinhardtii
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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 showed 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 (hydrolates) have been separately obtained and 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 from the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia absinthium (Tereul, Spain), Dittricia 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 three 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.

TU349
Ecotoxicological evaluation of the hydrolate byproduct of Satureja montana on Daphnia magna and Vibrio fischeri
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The increasing demand of natural biopesticides 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 antimicrobial activity. Furthermore, plant extracts from this 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 are 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 hydrolate 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 fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolate of S. montana is likely to cause toxic effects on D. magna and V. fischeri but only high dilutions (LC50 values in the range of 0.5% in both cases). These studies allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products.

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on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydrocarbons, obtained by semi industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Ditrichia graveolens and Lavandula latifolia. The effects on the microbial community has been assessed using the community-level physiological profile – CLPP. This method relies on the ability of the microbial community for degrading different carbon sources present in Biolog Ecoplates®. The acute toxicity of hydrocarbons was also tested by Eisenia fetida bioassay. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latifolia (LC50 in the range of dilution of 10-2). All three biodegradates 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. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University
Alpine 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), the test agents, with ethanol and solvent and tergitol in a ratio of 5:1. 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 AGEO showed no mortality on the tested fish during 96-hour incubation. Therefore, 48-h LC50 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 oil against Cyprinus carpio
H. Jeon, K. Kim, H. Kim, Y. Kim, Y. Choi, S. Lee. Kyungpook National University
Recently, many researchers have developed natural insecticides to control insect pests using plant essential oils (EOs) due to their eco-friendly nature. Cinnamon EO is one of the 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 were determined in a static condition for 40 days. When cinnamon EOEC was prepared, they were mixed with ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different kinds of surfactants (Tween 80, Sodium dodecyl sulfate (SDS), Nondient, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Koliphor, Tergitol and Mixture of SDBS and Nondient) were tested for the formulation and tergitol showed the lowest toxicity to the fish in an acute toxicity test. With the result of the acute toxicity of cinnamon EOEC, chronic toxicities of cinnamon EOEC was determined in 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treated five concentrations were 0.08, 0.16, 0.64, 2.56, and 5.12 ppm and the mean survival rate was 8.48 ± 0.7. The survival rate of the control group was 93.3 ± 0.58 and the positive control containing ethanol and tergitol was 9.0 ± 1.00. The mean temperature and pH of the test water was 24.06 ± 0.58 °C and 7.51 ± 0.03, respectively. The mean of dissolved oxygen of the test water was 7.29 ± 0.07 mg/L and the mean of hardness was 82.14 ± 2.04 mg/L. After the complete exposure, the mean of length of alive fishes was 3.00 ± 0.17 cm and the weight was determined as 0.37 ± 0.17 g. With these results, cinnamon EOEC may be considered as safe, natural insecticides for the environment.

TU353
Thiosemicarbazone scaffold for the design of antifungal and 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, oilseeds, 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 aflatoxin production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perilldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and 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 cyto- and geno-toxicity 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.

Understanding human and environmental exposure to chemicals in urban systems (P)

TU354
Electronic products are related with household exposures in Canadian residents
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Key Words: electronic products, hand wipes, household exposure, FRs and plasticizers Novel flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs), organophosphate esters (OPEs), and phthalates esters (PAEs) have wide applications as flame retardants (FRs) or/and plasticizers in consumer products, building materials, and industrial uses. Their wide-spread use has led to population-wide exposures (Carigan et al. 2017; Hammel et al. 2016, Hoffman et al. 2015). Some of these exposures have been related to adverse health effects (e.g., Carigan et al. 2017). Therefore, information on major exposure sources is needed to reduce exposures and ultimately prevent adverse health outcomes. Here we report on a household exposure study of Canadian women by determining levels of selected FRs and plasticizers in paired household air and dust, hand surface wipes of participants, as well as wipes of principle household electronic devices and food dishes. We also evaluated changes in the 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).

314 SETAC Europe 28th Annual Meeting Abstract Book
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
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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 propose a new approach to model emissions of ENPs from paints. This approach 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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The occurrence of parabens, triclosan and triclocarban in personal care products (PCPs) is related to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC, and the associated connection with the CPCPs in our daily life. In this study, ten parabens (methyl, propyl), 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 (PPF, 49%) and butyl paraben (BuP, 41%). TCS had only 20% of detection rate and TCC were 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 ng/g) were found at skin cares, sunscreen, face cleanser, eyeliner, body/hand lotions and lipstick. The daily exposure levels of parabens were associated with the consumption of CPCPs. The daily 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 cosmetic (3 basic cosmetics, 1 UV protection products, 3 hair products, 3 body products and 2 cleansing products) for adults and 10 kinds of consumer products (2 cosmetics, 3 oral supplies and 7 household products) for children and 11 kinds of food containers for household. Survey was conducted on 505 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. The number of subjects were determined by proportionate sampling based on age distribution of mother and children. The composition ratio in children’s sex and age distribution from 0 to 4. All cosmetics investigated in this study were used on a daily basis and usage rates from 52.1% to 98.0%, except 9.9% for hair styling product and 7.7% for deodorant. The frequency of food intake by food containers ranged 2.52 to 17.39 times a month. The use of children's oral supplies varies according to the age of the child. There were a significant difference in the mother’s usage rates of lotion, hair products and vinyl 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 then transformed into dialkyl phosphoric esters, such as DEAMPy (diallyl diethylamino pyrophosphate, TCPY, metabolite of chlorpyrifos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-hydroxycoumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pirimidyl (IMPy, metabolite of diazinon) and 2-dethylamino-6-methyl pyrimidin-4-ol (DEAMPy, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxbenzoic acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxbenzoic acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as a biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using isotope-dilution liquid chromatography-tandem mass spectrometry (LC-MS/MS). Human urine samples (n=199) from Italian children at 7 years were analyzed. Neuropsychological and psychomotor development of the children was assessed at 18–40 months by using the BAYLEY scales. In addition, neuropsychological development and intelligence were assessed at 7 years by using the NEPSY-II and the WISC, respectively. The compounds detected the most were DEAMPy (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMPy 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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Department of Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology Department
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 concentrations than high molecular weight PAHs (pyrene and benzo[a]pyrene). Most of the increased levels of napthalene and phenantherene 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 the homogenized placenta of mothers who smoked in the third trimester of pregnancy. Not significant correlations were found between PAH levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity
J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; I. chestnate, in use ARC Arnot Research & Consulting; L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; X. Zhang, University of Toronto Scarborough / School of Engineering and Applied Sciences; B. Gievchki, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences
The aggregate exposure pathway (AEP) model is a conceptual framework to help aggregate exposure to information including (i) production, use and release, (ii) chemical fate and concentrations in various multimedia (urban and rural environments, biota), (iii) external exposures (e.g., contact rates), and (iv) internal exposures (e.g., blood concentrations) for human and ecological receptors. Some exposure models include elements of the AEP framework and are useful tools for organizing data, quantifying chemical concentrations throughout the exposure-exposure continuum and identifying research needs to address uncertainty in chemical evaluations. We present an overview of the Risk Assessment Identification And Ranking-Indoor and Consumer Exposure (RAIDAR-ICE) modelling framework. RAIDAR-ICE includes direct and indirect near-field exposures and can include far-field exposures for aggregate human exposure assessment. The RAIDAR-ICE model is parameterized in this case study for about 200 organic chemicals comprising a broad range of chemical properties representative of commercial chemicals to demonstrate model applications for exposure and risk-based prioritization. Based on assumed emissions to air in the indoor environment, intake fractions (used for ranking exposure potential) range from 0.0018 to 0.37 emphasising the relatively high potential for human exposure to airborne emissions. A comparison of the XRF metal concentrations to to ICP-MS data indicated that the AEP model calculated critical emission rates allows for the calculation of risk (bioactivity) specific differences in toxicokinetics. In absence of information, the model calculated critical emission rate based on uncertainty in the model and its required input parameters are presented.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBONYI STATE IN SOUTH-EASTERN NIGERIA
S. Anika, UNIVERSITY OF NIGERIA, NSUKKA; V. Ahur, Federal University of Agriculture Makurdi / Department of Veterinary Physiology, Pharmacology and Biochemistry; P. Onyeyii, Federal University of Agriculture Makurdi / Department of Physiology Pharmacology and Biochemistry
Lead is a soft, corrosive 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 acro

TU362 Evaluation of potential risk of rare earth element contamination from leachate originating from electronic waste disposal
M. Makome, Scientific Services, Cape Town / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. Scialla, University of Calabria, CMT / Department of Earth and Environmental Sciences; A; V. Ahur, Federal University of Technology, Enugu / Department of Environmental Science; M. Fia, Federal University of Technology, Enugu / Department of Chemistry; V.K. Ochoma, University of Nigeria, Nsukka / Department of Chemistry
Rare Earth Elements (REEs) form critical elements required in technological applications. 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 associated environmental and health usually exposure assessment of REEs. This study further identifies the potential for lead contamination which can also result to severe environmental pollution which can pass acro

TU363 A stonework snail as a new biomonitor of metal contamination in the urban environment
E. Rota, B. Braccino, R. Dei, University of Siena / Department of Physical Sciences, Earth and Environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Department of Chemistry, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment; Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhales fine particles, is a promising indicator of exposure to ambient and indoor environments. P. papillaris, which is commonly found in urban environments, is widely used as biomonitor 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 countryside, this three studies characterized their chemical composition. Chemical composition of the soft tissues of P. papillaris (purged of the gut contents) showed the highest Cd, Cu and Zn concentrations at the most trafficked sites. Data from faeces suggested that this species ingests large amounts of inorganic particles scraped from the stone surfaces, as indicated by the very high Al, Cr, Fe, Mn, and Pb concentrations. Most lithophilic elements and Pb are scarcely absorbed in the snail digestive tract and soft tissues mainly accumulate Cd and essential elements such as Cu, Zn and Mn. Although the chemical composition of the shells was characterized by low concentrations of all analyzed elements, the samples collected at the most trafficked sites had significantly higher Cu, Fe, and Zn concentrations. This bioaccumulation in P. papillaris shells likely remains after death, potentially providing a historical record of the snail exposure to metals over lifetime.

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada
M. Dodd, Royal Roads University / School of Environment & Sustainability
This study was conducted to determine heavy metal distribution in surface soils in Greater Victoria, BC, Canada. Soil samples were collected from 190 residential and community gardens and analyzed using a portable XRF. A subset of the samples were analyzed by ICP-MS. A comparison of the XRF metal concentrations to the ICP-MS data indicated that the XRF was a suitable technique for the rapid analysis of the large number of samples collected. Elevated concentrations of metals including Pb, Cu, Cr and Zn were found in some garden soils. Based on homeowner interviews, historical maps and archival reviews, Pb contamination was primarily attributed to the use of lead paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automotive

316 SETAC Europe 28th Annual Meeting Abstract Book
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 there is no risk associated with ingestion of metal contaminants with the diet.

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 M. Letrari, University of Milan / University of Insubria / DSAT; S. Armiraglio, Municipality of Brescia / Museum of Milan / DeFENS; F. Mapelli, University of Milan; E. Zanardini, C. Morosini, M. Legras, Castel, UniLaSalle Campus Rouen / Aghyle Unit Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomeration and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. At European level, soil quality regulations are not homogenous; in France, the legislation is mainly based on the contents in vegetables or fruits, the link with the soil never made. Some studies have highlighted the potential risk of metal contamination of vegetables grown in urban areas and the lack of site-specific risk assessments. However, experimental trials are still lacking on the potential of using urban soil as a good substrate for producing vegetables for domestic consumption.

We assessed the quality of the soil on a site in the Rouen agglomeration (Normandy, France) for three purposes: pasture, a food-producing area and market gardening area. However, the city raises questions about the future management of this last area already cultivated for many years. We have analyzed the main physicochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban samples was above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies are needed before planning urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU366 Vertical movement of PCBs in agricultural soils impacted by an historical contaminated site: using SoilPlus model to predict discharge, dynamics of movement in soil, and rhizoremediation potential A. Di Guardi, University of Insubria / Department of Science and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Terzaghi, University of Insubria (CARD; DefENS); F. Piccoli, University of Milan / DEFENS; F. Mapelli, University of Milan; E. Zanardini, C. Morosini, University of Insubria / DSAT; S. Armiraglio, Municipality of Brescia / Museum of Natural Sciences; V.M. Sale, S. Anelli, P. Nastasio, ERSASF Among the national priority polluted sites, the SI Brenza 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 80s. About 100 Ha of agricultural areas were contaminated by a mix of Persistent Organic Pollutants (POPs, mostly PCBs, dioxins, furans) and heavy metals (Hg, As) in variable concentrations, often exceeding the safety limits for agricultural soils. The contamination of runoff irrigation with contaminated waters. PCBs were measured in three different agricultural areas and in three different points per area, in vertical cores up to 1 m depth. The resulting samples were representative of 0-10, 10-20, 20-30, 30-40, 40-60, 60-80, 80-100 cm. The results of concentration measurements with depth (for about 80 PCB congeners) confirmed a general tendency of PCBs to be confined in the first 30 cm of the soil profile. The concentration of PCB 28 ranged from 150 to 250 µg/kg in the top 30 cm to about 0.6 µg/kg at 1 m depth; PCB 209 (peculiar of Caffaro production) ranged from 1500 to 13000 µg/kg in the top 30 cm, descending to about 13 µg/kg at 1 m depth. A gradient was also observed along the runoff water flow direction. These concentrations of PCBs were then compared to those obtained by the SoilPlus model (a multilayered dynamic multimedia fugacity model) and used to predict discharge amounts and conditions regulating vertical movement. The objective was to reconstruct soil concentration profile during the historical contamination to predict discharged amount, potential for additional vertical movement, and conditions regulating chemical bioavailability for future PCB rhizoremediation.

TU367 Metals and metalloids in inhalable fractions of urban road dust C.L. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Rasmussen, Health Canada Road dusts highly enriched with iron and metalloids such as Cu, Sh, and Zn, due to road surface attrition and wear of automotive components. Despite the importance of road dust as a source of inhalable particles (< 10 µm), little has been published regarding elemental enrichment patterns in particle sizes relevant to inhalation exposures. The goal of this study is to evaluate the contribution of road dust to airborne particulate matter, focussing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air sweepers: the bulk hopper debricos and finer dust box samples. The 50th percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 inhalable and 32 bulk samples) were subjected to a 4-acid digestion (HF, HClO4, HNO3, and HCl) followed by multi-element determination using Inductively-Coupled Plasma Mass Spectrometry (ICP-MS). Results showed that the inhalable fractions of road dust were enriched with metals and metalloids relative to the bulk debris, including Cd (0.55 vs. 0.25 µg/g), Zn (649 vs. 252 µg/g), Sh (8.2 vs. 2.2 µg/g) and Pb (80 vs. 54 µg/g). The enrichment of elements of known toxicity in the inhalable fraction is of particular concern, given the bioaccessibility of this particle size range. Available data on the total weight of road dust collected by the City of Toronto each year, combined with the elemental concentrations of the road dust determined in the present study, provides the means to calculate annual flux estimates. For example, Pb loadings in the inhalable fraction alone are estimated to range between 70 kg/yr and 141 kg/yr, which is a significant source relative to the city-for-metal of 513 kg/year of atmospheric Pb emissions reported by industries and municipal facilities in the National Pollutant Release Inventory. This example demonstrates the importance of non-exhaust forms of traffic emissions which have not been included in emission inventories to date. Next steps will involve the collection of whole, unfraccionated road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.

TU368 Sequential extraction and particle size distribution of Cd, Cu, Pb and Zn in street dust of Belgrade (Serbia) T. Djodjevic, Faculty of Chemistry, University of Belgrade; N. Zaric, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Solevic Knudsen, IChTM / Department for Chemistry The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb, and Zn in mobile phases extracted from different size-fractions in street dust particles from Belgrade, the Capital of Serbia. The metals investigated were chosen as some of the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractioned into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier et al., 1979): adsorptive and ion-exchangeable phase (using ammonium acetate at the moderately reducing pH range of 6.8 to 7.0), the water soluble phase (using 0.01 M HNO3), and organic sulphide phase (using hydrogen peroxide acidified with nitric acid). These fractions were analysed by inductively coupled plasma optical emission spectrometry (ICP-OES) using an ICP iCap6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the Serbian national Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were higher than the Maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bounded mainly in the second phase. Pb and Cd were predominantly associated with the first phase. Pb and Cd were largely present in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. References: Regulations about allowed quantities of dioxins and harmful matters in soil and irrigating waters and methods about their analysis, Official Gazette of the Republic of Serbia, No. 23/94 (in Serbian) Sequential (SETAC Europe 28th Annual Meeting Abstract Book 2019; 317) by Solenic, T. and S. van Vliet. Sequential and Coupled Plasma Optical Emission Spectrometry (ICP-OES) using an ICP iCap6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the Serbian national Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were higher than the Maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bounded mainly in the second phase. Pb and Cd were predominantly associated with the first phase. Pb and Cd were largely present in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. References: Regulations about allowed quantities of dioxins and harmful matters in soil and irrigating waters and methods about their analysis, Official Gazette of the Republic of Serbia, No. 23/94 (in Serbian) Sequential (SETAC Europe 28th Annual Meeting Abstract Book 2019; 317) by Solenic, T. and S. van Vliet.
Guo, Indiana University - Bloomington / SPEA; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control; P. Kurt-Karakus, Bursa Technical University / Environmental Engineering Department; L. Melymuk, Masaryk University / RECEPTOX Research Centre for Toxic Compounds in the Environment; L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; M.E. Shoeb, Environment Canada / Atmospheric Science and Technology Directorate; T. Shibata, American University of Cairo / W. Stubbings, Indiana University - Bloomington / School of Public and Environmental Affairs; C. Turgut, Adnan Menderes University / Environmental Toxicology and Biotechnology; M. Venier, Indiana University / SPEA; G.M. Webster, Simon Fraser University / Faculty of Health Sciences; C. Yang, M.L. Diamond, University of Toronto / Department of Earth Sciences.

Oxidative Potential of Ambient Water

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 fluorides. 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 new OPEs investigated include isopropylated triarylphosphates (ITP) and tert-butylated triarylphosphates (TTBP) and a di-tert-butylated triarylphosphate and di tert-butylated triarylphosphate. These compounds are used as flame retardants, but are also used in hydraulic fluids and as plasticizers. ITP is primarily used in foam and is a component of Firemaster 550 whereas TTBP is in Firemaster 600. Preliminary results indicate ITPs and TTBP levels are found in the ng/g range in these dust samples. ITP is the only one of the typically analyzed OPEs compounds such as tris(2-butoxyethyl)phosphate (TBP), tri(2-chloroethyl)phosphate (TCEP) and trischloropropylphosphate (TCP). Although these are the new to us and only recently included on some national regulation lists, these compounds are found in NIST CRM dusts that were collected in the mid-1990s thus have been high production volume chemicals for many decades. These compounds are of concern because they have long range transport potential as one ITP isomer was sought and found in arctic water and sediment. A few studies have shown that humans are exposed to ITPs due to detection in wristbands and metabolites in urine. These compounds are also of concern due to their reported toxicity especially related to neurological effects.  

TU370

OXIDATIVE POTENTIAL OF PARTICULATE MATTER COLLECTED AT INDUSTRIAL AND URBAN SITES

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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 the 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/PM2.5 samples and to size-segregated samples collected by a 10-stage impactor. Sampling were performed 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, cation, macro- and micro-elements, total organic content, elemental carbon and water-soluble organic carbon, 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: species whose concentration is very different in the two areas, such as secondary inorganic ions, seem thus to play a negligible role in the ROS generation. Each assay showed a different sensitivity towards the oxidant species: the DTT method was more sensitive to organic substances, while the AA method was more sensitive to transition metals. The period in microcosm experiments and the DTT assay developed a greater affinity with particles in the fine mode, while AA responded mainly to particles in the coarse fraction. DCFH results appear to be driven by a competition between several factors, some increasing the response and some suppressing it. Fang, T. et al.: Oxidative Potential of Ambient Water-Soluble PM2.5 in the Southeastern United States: Contrasts in Sources and Health Associations between Acetic Acid (AA) and Dithiothreitol (DTT) Assays. Atmos. Chem. Phys. 2016, 16, 3865–79. 10.5194/acp-16-3865-2016 Huang, W. et al: Optimization of the Measurement of Particle-Bound Reactive Oxygen Species with 2′,7′-dichlorofluorescin (DCFH), Water Air Soil Pollut. 2016, 227, 164. 10.1007/s11270-016-2860-9.

TU371

Chromatographic determination of the pathway of nevirapine in wastewater at a wastewater treatment plant

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Emerging pollutants (EPs) are defined as substances that have been detected, which is not included in the routine monitoring programmes at the EU level, and whose fate, behaviour and ecotoxicity effects are not well understood. Pharmaceuticals used in the treatment of HIV, known as anti-retrovirals, are becoming prevalent and there is a need to quantify and minimise any adverse affects to aquatic and human health. Nevirapine (NVP) is commonly used in the anti-retroviral treatment of HIV infection. It is known as a non-nucleoside reverse transcriptase inhibitor of the dipryridodiazepine class, commonly used to minimize viral resistance. This study reports the isolation and chromatographic characterisation of NVP in wastewater samples, with concentrations ranging between 250 to 500 ng/L. Further evaluation of the impact of NVP on the aquatic ecosystem was also considered and reported in this study. Keywords: Anti-retrovirals; Emerging pollutants; Chromatography; Wastewater

TU372

Lumichrome blue: a selective photometric reagent for chlorine dioxide analysis in water

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Drinking water supply companies have traditionally focused their efforts on providing a product with health guarantees, a safe and clean water. Disinfection has been the main purpose of the water treatment. A broad range of disinfectants and technologies are available. Chlorine dioxide has been increasingly used because of its ability to avoid the formation of trihalomethans (THMs), the most common and well-known disinfection by-products. NN-Diethyl-p-phenylenediamine (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. Given this circumstance and the need of having a selective method for chlorine dioxide analysis, several UV–VIS spectrophotometric methods have been evaluated by our group (1). Here, the results using leucomethylene 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 – amaranth, lissamine green, and choro 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 from the samples. The method is currently developed (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).

TU373

Fate and effects of triclosan in subtropical freshwater benthic microcosms

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Triclosan (TCS) is one of the top10 most commonly detected organic pollutants in the aquatic environment. However, little is known about the toxicity and bioaccumulation of sediment-associated TCS. We examined the effect of sediment-associated TCS on the snail, Viviparidae Bellamya bellamya, and the worm, Limnodrilus hoffmeisteri, and assessed worm bioaccumulation during a 28 days sedimentation period in microcosms. The TCS was added to the microcosm system. The results showed that TCS was detected in worm tissue with biota sediment accumulation factor (BSAF) values ranging between 0.67-6.3, suggesting that TCS could be accumulated in worms. The results of mass balance assessment showed that, during the experiment period, TCS amount in the microcosm was reduced 3.4% to 11.4% and 3.5% to 19.9% in the systems with and without macroinvertebrates, respectively. Based on the experimental conditions used, we conclude that sediment-associated TCS (8 µg/g dry weight (dw)) is unlikely to affect, at least in the short term, survival and growth of snails and worms in sediments, with no observed effect concentrations (NOECs) of 8 µg/g dw for both
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.nimbios.org/workingsroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification and mechanistic understanding 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 service GCT population provides will differ depending on the level of EE2 in the system. If EE2 concentrations are low, then management would need to focus on controlling BT populations. For high concentrations of EE2, management first needs to focus on reducing EE2, followed by control of BT. The second case study is an example where game fish species responded differentially to exposure to the insecticide, as a result of interspecific interactions, and the economic valuation of this service needs to take into account with angler preferences. The service of water clarity for recreational activities was valued using threshold-based estimations of days fit for recreation. We provided concrete examples of how ecological modeling can be used to quantify impacts on ecosystem services from data gathered in standard testing. We discuss challenges and ways forward.

The Need for Resilience in Environmental Impact Assessment (P)

TU374 Joint Annual Meeting of the International Society of Exposure Science and the International Society for Environmental Epidemiology (ISES-ISEE 2018)
M.L. Diamond, University of Toronto / Department of Earth Sciences

Challenges in setting, meeting and measuring specific protection goals for plant protection products (P)

TU375 French Phytopharmacovigilance: a national scheme for monitoring the adverse effects of plant protection products
F. Botta, ANSES / DER; F. Eymery, T. Quintaine, M. Hulin, J. Rety, O. Yamada, M. Merlo, ANSES
Phytopharmacovigilance is the latest complement to ANSES’s existing missions concerning the assessment of the risks associated with plant protection products before marketing, and the issuing and withdrawal of marketing authorizations. It is also fully in line with the third component of the Ecophyto plan. This national plan, established for the first time in 2008, was recently renewed. It aims to reduce pesticide uses in accordance with the requirements of Directive 2009/128, establishing a framework for Community action to achieve the sustainable use of pesticides. A specific scheme for funding these studies is planned through a tax on sales of plant protection products payable by the marketing authorisation holders. To meet this objective, phytopharmacovigilance relies on three fundamental and complementary methods of data collection and knowledge production: a network of surveillance or vigilance bodies, collection of spontaneous reports and ad hoc studies on the adverse effects of plant protection products. These studies are financed by HPV to portray three different needs: 1) when the information provided by the surveillance and vigilance bodies is seen to warrant clarification, 2) to investigate spontaneous reports or 3) to collect new data / information. To identify the adverse effects of plant protection products on biodiversity and ecosystems, Phytopharmacovigilance is based on the systematic and regular collection of information produced by the existing surveillance and vigilance bodies, covering risks and impacts on wildlife, crops, fauna, flora, air, water, and soil. In the full article (2 pages word/pdf), a detailed list of studies and network working on “Pesticides impacts on biodiversity” and “Monitoring of pesticides (water, air, etc.)” is described.

TU376 Measuring and Modeling Aluminium Bioavailability and Toxicity to Aquatic Organisms
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The ability to accurately predict the aquatic toxicity of aluminium (Al) in natural surface waters has eluded scientists for the past several decades. In 1988, the US Environmental Protection Agency (USEPA) released nationally-recommended ambient water quality criteria for Al of 7.50 and 8.7 µg/L as acute and chronic criteria, respectively. However, these applied only to waters with a pH between 6.5 and 9.0, and the chronic toxicity database was limited. Therefore, in 2009 we assembled a team of scientists to help expand this database and identify a means for measuring and predicting the toxicity of Al to aquatic organisms as a function of water chemistry. A series of chronic toxicity tests were performed, as part of this effort, with several freshwater species. The species were selected to meet requirements for the EU REACH dossier, USEPA water quality criteria or European Water Framework guidelines for environmental quality standards. To develop bioavailability models, multiple tests with a green alga (Pseudokirchneriella subcapitata), a cladoceran (Ceriodaphnia dubia), and a fish (Pimephales promelas) were performed across a range of DOC, hardness and pH conditions. These latter data were included in the development of a biotic ligand model (BLM) for the prediction of toxicity as a function of water chemistry. The toxicity data sets were also used to develop a multi-linear regression (MLR) model to provide a simplified means to predict toxicity as a function of DOC, hardness, and pH. Due to its complex environmental chemistry, measurement of the “toxic” form of Al in natural waters cannot be performed using the conventional “total” or “dissolved” analytical approaches. Studies have recently been completed which allows for the measurement of “bioavailable” Al in natural waters where suspended solids are present and contribute to measurements of total Al, but are non-toxic. The presentation will focus on modeling Al toxicity and measuring Al in natural waters.

TU377 Modelling impacts of chemicals on ecosystem services
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Sulphur: conflicting protection goals
G. Brouwer, Delphi / team fruitteelt; F.M. Bakker, Eurofins-MitoTox
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)
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 purposes and goals, the use of existing and new metrics, the integration of process-related and outcome-oriented ways of measuring ecosystem resilience, 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 interconnections in space and time caused by natural 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 ESA Scientific Committee, 2016. Recovery in environmental risk assessments at EFSA. EFSA Journal 2:016; 14(2):4313. 85 pp
assessment
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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 addresses 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 nanoremediation, 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 criteria. We measure the quality of the stakeholder involvement activity against these criteria.

TU385
Assessment and Management of Radiation Risks following a Nuclear Accident: The Shamisen Project Recommendations
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The Fukushima Daiichi 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 decontaminated areas

TU386
SETAC Ecosystem Services Interest Group
S.E. Apitz, SEA Environmental Decisions Ltd

Air Pollution, Biomonitoring and Human Health (P)

TU387
Assessment of Indoor Radon Concentration and Trace Metals Composition in University Building Microenvironments
M. 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 (PM$_{2.5}$) composition and the equilibrium equivalent radon (EEC$_{eq}$) concentration in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM$_{2.5}$ samples and indium-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 PM$_{2.5}$ 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 Building 1 and 2, the annual effective dose and the carcinogenic risk were found to be 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.

TU388
Paradigm for PM2.5 Chemical and Biological Characterization: Paired Home and Personal PM2.5 Samples in Kheri, India
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The global public health impact from household fine particulate matter (PM$_{2.5}$) is extremely large however, there is a limited understanding of health effects associated with specific PM$_{2.5}$ chemical constituents as well as the underlying mechanisms of these adverse health effects. These research gaps can be addressed through use of a high-throughput screening platform to quickly gain biological response data. A subset of homes in Kheri, India that participated in the Prospective Urban and Rural Epidemiological (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM$_{2.5}$. In 6 households, personal air monitors collecting PM$_{2.5}$ were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM$_{2.5}$ filters for each household. PM$_{2.5}$ was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM$_{2.5}$ samples of the same collection method were pooled (n=6/group) and the soluble fraction of PM$_{2.5}$ from DMSO extraction was prepared for developmental toxicity testing performed in zebrafish (n=32/treatment) starting at 6 hours post fertilization (hpf). Aliquots of the pooled samples were used for chemical analysis (polycyclic aromatic hydrocarbons (PAHs, n=20), elements (n=20)) and oxidative potential assessment with methods identified and those used for the filters. Significant differences were observed in oxidative potential between personal and home PM$_{2.5}$ for both individual and pooled samples. Significant mortality in zebrafish was observed starting at 24 hpf in personal PM$_{2.5}$ samples and by 120 hpf in home PM$_{2.5}$ compared to blank filter controls. Chemical analysis is underway to allow for correlations to be investigated between these biological responses and chemical constituents. This research is the first study to use paired home and personal PM$_{2.5}$ samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM$_{2.5}$. Importantly, it outlines procedures for large-scale analysis of the PURE-AIR study which includes planned PM$_{2.5}$ measurements in 4,000 homes and will ultimately allow for correlation of human health effects with chemical and biological data to identify improved health metrics for PM$_{2.5}$ exposures.

TU389
Toxicity of airborne particulate matter as a factor to choose the most convenient school
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One of the critical decisions parents have to face is choosing a good school for their kids. Proximity, high ratio of teachers to students, and access to convenient educationalinfrastructures are the driving factors determining school’s choice. However it is used to assume that environmental air inside schools is safe enough.
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred as "fine PM") is considered as the most injurious one. Since this pollutant is potentially very harmful, toxicity of PM$_{2.5}$ on lung cells has been widely studied. However, most of the publications on this topic are focused on studying PM$_{2.5}$ effects on human alveolar cells for short periods of time after applying doses far higher than environmental levels. To surpass this gap, we developed this present study. In it, we collected two fractions of fine PM (PM$_{2.5-10}$ and PM$_{10-20}$) in three classrooms of three schools 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 released in the two PM sizes or three sampling sites. However, differences arose when comparing the levels of seven cytokines (MCP-1, TNF-α, INF-γ, G-CSF, IL-6, IL-7, and IL-8) versus exposure times. These differences became significant after 24-48 h from exposure, and increased till reaching the maximum value after 72 hours. Results from this study will be useful not only to better understand the way of action of PM$_{2.5}$, but also to schools managers and parents.

TU390
Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Visits in Taiwan
Y. Lan, C. Chang, C. Chung
China Medical University
Abstract The purpose of this study was to assess the effects of extremely high air temperatures in hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using 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 daily high temperatures. Results indicated the great influence of PM$_{2.5}$ on 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 a 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 Dibenzyl Ethyl Ethers Released from Primitive E-Waste Treatment
L. Li, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment
Abstract Processive e-waste potentially releases abundant organic contaminants to the environment, but the magnitudes and mechanisms remain to be adequately addressed. The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the released PBDEs were largely in thermal treatment and open burning, respectively. Airborne particles (87%) were the main carriers of PBDEs, followed by residual ashes (13%) and gaseous constituents (0.3%), in thermal treatment, while they were 30%, 43% and 27.2% in open burning. The output-input mass ratios of $\Sigma$PBDE were 0.21-10 in thermal treatment and 0.01–0.36 in open burning. All PBDEs were largely affiliated with 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 castings, compared to 0.44–0.56 and RL–0.55 µm from printed circuit boards. The main emission mechanisms for lightly and heavily brominated BDEs were suggested to be evaporation and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implicated a noteworthy redisposition process during atmospheric dispersal.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter
F. Kasu, M. Schuhmacher, Universitat Rovira i Virgili / Chemical Engineering; J. Rosiña, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rosiña i Virgili University / Departament d Enginyeria Química
Abstract According to last estimations, there are globally around 6.5 million deaths as a consequence of exposure to air pollutants. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{2.5}$, PM$_{5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers Tisch TD70-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer) in 2011.

Subsequently, chemical characterization of the particles (through the analysis of metals, soluble ions and carbonaceous materials) was performed. Preliminary results show that both indoor and outdoor levels of PM are higher in winter than in summer. Indoor/outdoor ratios of particles are varying, showing some schools higher PM levels indoors, while the opposite phenomenon is observed in others. Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles trend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.

TU393
Good news to lazybones kids: increasing sleeping time decreases exposure to airborne particulate matter
F. Sánchez Sobrón, Universitat Rovira i Virgili / Chemical Engineering; F. Noardo, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Guarner, Universitat Rovira i Virgili / Department of Industrial Engineering
Abstract We present a study aimed at elucidating the influence of outdoor physical activity on the indoor particulate matter (PM) levels. To achieve our goal, 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 PM$_{2.5}$ addiction and other mental illnesses after exposure to extreme daily high temperatures. 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 Overri, Nigeria
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Abstract Despite that cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among Cement workers. A study on the effects of cement dust exposure on the blood levels of some antioxidants enzymes and vitamins have not been adequately addressed especially in a black-African environment and particularly Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and 35 controls were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELSA while antioxidant vitamins such as vitamin E and vitamin C were determined by Spectrophotometric techniques. There were progressive significant increases in blood level of vitamin C, vitamin E, catalase and glutathione peroxidase from Cement Workers to Dealers and Controls (non-cement workers), (P<0.0010, P=0.0011, 0.0010).
P=0.0001, P=0.001 and P=0.0011) respectively. There were significant decreases in blood levels of vitamin C, vitamin E, glutathione peroxidase and catalase (P<0.002, P=0.0004, P=0.0001, P=0.0004) respectively in Cement Workers.Dealers compared to Controls. But no significant difference in SOD (P=0.627) on comparison of Cement Workers/Dealers with Non-Cement Workers (Controls). There was significant decrease in blood levels of vitamin C (P=0.0147), SOD (P<0.001), Glutathione peroxidase (P=0.0016) and Catalase (P=0.0001) respectively when compared with Cement Dealers. There were non-significant positive correlation of Vitamin E with; Catalase, SOD, Glutathione peroxidase and Vitamin C (r =0.2567, r = 0.3150, r =0.04598 and r = 0.2018 respectively). There were non-significant correlations of catalase with glutathione peroxidase, vitamin E, and vitamin C (r=0.058, r=0.256 and r=0.13) respectively, but there was a positive significant correlation of catalase with SOD (r=0.4173). This study suggest that Exposure to cement dust may lead to reduction in blood levels of vitamin C, Vitamin E, Catalase, Glutathione Peroxidase, and SOD in cement workers/Dealers. The observed reduction/decreases in the antioxidants were progressive from control to Cement Dealers and to cement workers. Key words; Cement dust, antioxidant, enzymes, vitamins.

TU395 Implementing NH3 mitigation strategies in a pig farm: different approaches to evaluate the environmental impact. C. Baldi, Università degli Studi di Milano / Department of Environmental Science and Policy; F. Fermo, Università degli Studi di Milano / Department of Chemistry; M. Guarino, Università degli Studi di Milano / Department of Environmental Science and Policy.

Ammonia is an atmospheric pollutant causing acidification of soil, nutrient-N enrichment of ecosystems, and eutrophication of terrestrial and aquatic ecosystems. When in gaseous form, NH3 has a short atmospheric lifetime and usually deposits near its source. In the atmosphere it reacts with other compounds to form ammonium sulfate and ammonium nitrate aerosols, leading to the formation of secondary inorganic aerosol (PM2.5) that are a potential health hazard. Due to their smaller diameter and increased atmospheric lifetime, these particulates are able to travel long distances before being dry or wet deposited to the ground surface. This allows them to travel from rural areas to urban locations where they mix and build up in the atmosphere leading to smog or transportation to other areas. The particular unfavorable meteorological and orographic conditions of the Po Valley make this one of the most polluted region of Europe. Particulate matter pollution often exceeds the EU standards and WHO air quality guidelines for health protection. Because a main source of ammonia emissions, the agro-zootechnical compartment plays a key role in the secondary PM formation. Indeed, secondary inorganic aerosol from NH3 accounts for 40% of PM2.5 mass at the urban sites, and its contribution is even bigger in the rural sites. This study aims at evaluating the environmental performance of different NH3 mitigation strategies applied to Italian pig farms. Different mitigation scenarios are compared, considering the application of silos and pig bedding. Indeed, the available Technologies Reference document for the Intensive Rearing of Poultry and Pigs. Different strategies can be applied to determine the effectiveness of mitigation options: the 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 efficiency and the farm’s overall integrated performance. The study compared eight mitigation options: manure storage and spreading. The reduction of NH3 emissions from pig farming management steps can have a positive effect in NH-related impact categories, such as PM formation, terrestrial acidification 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. S. Wang, Jinan University; L. Gao, E.Y. Zeng. Jinan University / School of Environment.

Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study develops an in vitro method to estimate the inhalation bioaccessibility of PM10 fraction using biological fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmityl-sn-glycero-3-phosphocholine, with Tetras as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results have shown that the bioaccessibilities of individual PAH compounds increased with the increasing incubation time and reached the steady state within 10 days. None of significant difference was found for the individual PAH bioaccessibilities between with and without adding glass microfiber membrane into the incubation system. Furthermore, the PAHs absolute recoveries, calculated by sum of PAHs masses in Tenax, artificial lung fluid, and residual particle dividing the initial masses, were from 92% to 112% in ALF and 75% to 99% in Gamble’s solution, suggesting that this developed in vitro method could be well appropriate to evaluate the inhalation bioaccessibility to particulate hydrophobic organics matter. In addition, the PAHs bioaccessibility were found to increase with particle size, but decrease with the increasing hydrophobicity. It is noteworthy that via the human health risk assessment, the particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

TU397 Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixing effects on human health. Z. Novakova, Masaryk University; J. Novak, Masaryk University / RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Kucukca, P. Prihlova, P. Prokes, Masaryk University / RECETOX; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department.

Air pollution remains a major concern 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 time period, bioaccessibility, coarse particulate phase, and size PM2.5 size-fractions were sampled. Moreover, samples were also fractionated according to polarity. Human-based in vitro bioassays were employed to study endocrine-disruptive potentials, AhR-mediated induction of detoxification mechanisms, and cyto- and xenotoxicity to the human respiratory tract. The results show that the studied effects were associated mainly with particulate phase. The most significant effects were attributed to the easily inhalable fine and ultrafine particles. This distribution pattern was found for example for AhR-mediated toxicity, estrogenicity, and androgenicity. The studied toxic potentials were elicited mainly by chemicals in the polar fraction containing relatively high levels of oxygenated-polycyclic aromatic hydrocarbons (oxy-PAHs). This study confirms that several molecular mechanisms of toxicity are at work in complex mixtures and highlights the complexity of pollutant mixtures. For further understanding, the results will be discussed together with the results of the chemical analysis which focused on PAHs and their derivatives, nitro- and oxy-PAHs. This research was supported by project GACR P503 16-11537S.

TU398 Human health assessment of air pollution exposure to tuberculosis risk in regions of Taiwan. H. Lin, National Taiwan University; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; Y. Yang, C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Bioenvironmental Systems Engineering.

BACKGROUND: Ambient air pollutants from anthropogenic sources play critical roles in the prevalence of tuberculosis (TB). Association between ambient air pollution and TB disease burdens should be clearly elucidated. Several studies found that air pollutants were highly likely to pose adverse effects on antimycobacterial immunity mechanisms, increasing risk of TB development. OBJECTIVE: The main objective of this study was to assess the contribution risks to TB incidences resulted from ambient air pollutant exposure. METHODS: A population-based probabilistic risk assessment framework was incorporated with air pollution concentration database and epidemiologic dose-response data to assess contribution risks of air pollutant-associated TB incidences in Taiwan regions. The contribution concept was quantified by using the population attributable fraction (PAF). The air pollution-PAF relationships were assessed by employing a three-parameter Hill model based on hazard ratio data of TB exposed to air pollutants. The contribution of air pollution exposure to TB was evaluated by applying multiplications of PAF likelihood and TB incidence rates. RESULTS: Both under severe and moderate scenarios, the results revealed that the most likely air pollutants significantly contributing to TB incidences were carbon monoxide (CO) and nitrogen dioxide (NO2) in regions of Taiwan. Additionally, the particular matter (PM2.5) and nitrogen oxides (NOx) also were likely to contribute to TB incidences in some regions. CONCLUSIONS: We suggested that the contributions of air pollutants mainly from diesel combustions (CO, NO2 and NOx) to TB incidences are of great concern. Furthermore, the human health risk assessment framework provides an alternative perspective to interpret the effects of air pollution on TB burdens. Keywords: Human health risk assessment; Air pollution; Tuberculosis; Population attributable fraction; Probabilistic risk assessment.
TU399
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 pollution at local, national and international level. In addition, powders can alter aquatic and terrestrial ecosystems when they reach the surface waters and soils as a result of transport and deposition events. Road transport and traffic contributes greatly to emissions of PM2.5 and PM10 and an important contribution to the non-exhaustive emission is due to the wear of brakes. The European Life+ COBRA (LIFE13 ENV/IT/000492) project aims to create a safer alternative to the pads currently used, replacing the phosphoric binder with a new cementitious hydraulic binder. The here presented evaluated the eco-and toxicological potential of particulate matters generated in laboratory conditions using test benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumor bronchial epithelium BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sublethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

TU400
Toxic oxidation transformation products of phenanthrene measured in laboratory generated secondary organic aerosol particles
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Oxidized transformation products (OTP) of polycyclic aromatic hydrocarbons (PAHs) haven in some cases, been demonstrated to be more toxic than their parent PAHs. In the atmosphere, the secondary organic aerosol (SOA) particles formed as a result of PAH oxidation are commonly referred to as secondary organic aerosol (SOA) particles. Recently 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-ringed PAH, were observed in varying ratios. Developmental toxicity testing with zebrafish (Danio rerio) will be conducted using embryos (n=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 evaluating morphological 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 diolethithiolate (DIT) 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
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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) followed by GC-MS/MS. This data set 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)
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The special events 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 passing the area) and small industrial activities located in the town. To this purpose, the approach based on the use of PM samplers coupled with a wind-select sensor, allowing a selective PM10 and PM2.5 sampling downwind to specific emission sources, has been used. Furthermore, the chemical characterization of the PM collected has been carried out in order to explain specific emission patterns, and to assess the concentration levels of the micro-pollutants emitted by local sources and particularly toxic for health. Two sampling sites have been identified in the area, respectively urban and urban background site, and equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic specific compounds. 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 selecting sampling device, PM10, PM2.5

TU403
Forecasting global atmospheric visibility based on air quality and meteorological data
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Simultaneous and continuous measurements of visibility, meteorological parameters, including relative humidity, wind speed, wind direction, temperature, pressure, relative humidity, and the concentrations of six atmospheric pollutants (PM2.5, PM10, SO2, NO2, CO, and O3) were obtained for several cites around the globe. The characteristics of visibility and relationships with air pollutants and meteorological factors were investigated using multiple statistical methods. Analysis demonstrated that within a certain relative humidity range, visibility is the exponential function of the 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 visibility due to the air pollution. The resulted 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 including secondary particle
F. Nagashima, Kyushu University; K. Nsansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University
Countries and regions in Asia have played an important role in producing intermediate products and final commodities today and supplied their products around the world. Productions and consumptions of goods and services in the Asian countries have clearly contributed to the economic growth in the world, whereas those economic activities brought about environmental loads. Particularly, China’s emissions of air pollutants such as fine particulate matter (PM<sub>2.5</sub>) have caused some severe environmental and public health hazards. Especially in China, with its large population of more than 1.4 billion people, severe air pollution caused by emissions from mobile and stationary sources has been a major health concern. In this research, the health impacts associated with the PM<sub>2.5</sub> 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<sub>2.5</sub>, almost of these results doesn’t include the effects of “secondary” PM<sub>2.5</sub>. This study developed the secondary PM<sub>2.5</sub> concentrations emitted on every intermediate processing step from the Emissions 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 consumption contributed to the secondary PM<sub>2.5</sub> emissions in Asian are estimated U.S. 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 pollutants 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<sub>10</sub> daily mean limit value (50 µg·m<sup>-3</sup>). For a better understanding of these phenomena, the identification as exhaustive as possible of the contribution of various sources emitted in the region was estimated. 185 sites were performed on the identification of 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 in front of the Straits of Dover. PM<sub>10</sub> levels were measured using MP101 analyzer (Environment SA®) and collected using the DAB08 sampler (Digitefl® 30 m<sup>3</sup>/h) on a daily basis. The characterization of PM<sub>10</sub> was performed considering major and trace elements, water-soluble ions, EC/OC as well as tracers of biomass burning (levoglucosan), primary biogenic emissions (arabitol, mannotriol) and marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM<sub>10</sub> levels on the coastal site, identify PM<sub>10</sub> sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non-Linear Matrix Factorization (CWNNMF) 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<sub>10</sub> concentration peaks. The impact of marine traffic and a high proportion of aged 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<sub>10</sub> 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. Jollivet, University of Michigan

Effective planning of airshed pollution mitigation is often constrained by a lack of integrative analysis able 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+ species, and further computes population exposure by inhalation and ingestion. From an emitter perspective, the spatial distribution of population exceedances 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 Australian point sources were estimated for benzene and formaldehyde. Our source apportionment identifies the main sources contributing to exposure at five locations of interest. Overall, this presentation demonstrates the relevance of addressing exposures both from an emitter perspective well-suited to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation.

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Geochimistry; J. Mueller, C. Paxman, X. Wang, The University of Queensland / Queensland Alliance for Environmental Health Sciences

Polyurethane foam passive air sampler (PUF-PAS) are the most commonly used passive air sampler for a range of semivolatile organic compounds (SVOCs) such as regulated persistent organic pollutants and polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are used in global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use similar double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatial 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 Imagined Quantification
N. van Alst, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; R.L. Jensen, Aalborg University; J. Vollertsen, Aalborg University / Civil Engineering Department

Extensive research has been performed on indoor air quality (IAQ) over the last decades. This includes investigating mechanisms of deposition in lungs and on surfaces, as well as determining particle types and sizes. However, microplastic research in indoor air has been lagging behind. With the strides in microplastic research in the last years renewed interest has now arisen on microplastics as a form of indoor air pollution. This research focusses on microplastics in indoor air, with emphasis on the potential exposure to humans as a result of inhalation. This is simulated using a mannequin set up to simulate indoor air. For sampling, a mannequin takes in air through the mouth, which is led through a copper cooling pipe to the filtering unit. The copper pipe meets a filter holder on which a 0,8 µm cut 20 mm SterilTech 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 in selected locations within the universities' work environment. Samples have been divided up into continuous sampling and intermittent sampling under active living/workings 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 to 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) Focal Plane Array (FPA) detector is used. All samples are treated in the same manner: first, samples are cut into small pieces and then dissolved 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 polycyclic 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 fibres 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 as one of the most versatile and inexpensive manufacturing technologies to develop new materials and sensors to monitor toxic volatile organic compounds (VOCs) in the air. Sensors based on polymeric fibers look extremely attractive for the low cost and great versatility of the raw materials that can be easily tunable, according to the transducer used and the application of interest, taking part to the resulting sensing features (selectivity and sensitivity). Therefore electrospun nanofibrous and environmentally friendly materials have been designed and fabricated in order to detect polycyclic aromatic hydrocarbons (PAHs). Such a nanotechnology has been focused on the challenging goal of obtaining conductive sensors for the monitoring of air pollutants employing suitable scaffolds of eco-friendly (poly)hydroxybutyrate) 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 have both persistent 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 sensors can be tuned by introducing differently functionalized macromolecules (Me-tetraphenylporphyrins) 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 performance of the new composite electrospun sensors have been used to develop sensors for microplastics. Samples have been divided into continuous sampling and intermittent under active living conditions. Yet, no information is available on the overall variability in global monitoring data introduced by differences in PAS designs are used by numerous global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use similar double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatial 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.

TU411
Determination of Cross Compartment Concentration Gradients of Poly cyclic Aromatic Hydrocarbons using PE Passive Samplers
N. van Alst, Aalborg University / Civil Engineering Department; R.L. Jensen, Aalborg University; J. Vollertsen, Aalborg University / Civil Engineering Department

Several polycyclic aromatic hydrocarbons (PAHs) are considered as human carcinogens or toxic to reproduction, and are thus a relevant class of “substances of very high concern” according to the European Chemicals Legislation REACH. Emission of PAHs is mainly caused anthropogenically by the incomplete combustion of fossil fuels. Due to the hydrophobic behaviour of these compounds a significant accumulation within soils has been observed. Recently decreasing 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 air samplers have been used to detect PAH concentration gradients of the 16 EPA PAHs at this interface as well as the respective flux direction. Atmospheric monitoring 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 in situ with 30 µm thick PE sheets. A numerical approach, based on the double film diffusion model, was applied to the experimental data in order to deduce the atmospheric concentration over time. Seasonal deployments illustrate significant variations with 10 fold higher PAH concentrations in the atmosphere during winter compared to summer monitoring. Concentrations within the soil depicted homogenous profiles, considering Phe as representative PAH (PAHs, respectively), some of which are known to pose potential human health concerns. We sampled four approaches for predicting the location of reactive sites of the double diffusion model. These approaches are compared in order to evaluate the variability of their predictions. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU412
Evaluating Computational and Structural Approaches to Predict Transformation Products of Atmospheric Polycyclic Aromatic Hydrocarbons
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Polycyclic aromatic hydrocarbons (PAHs) undergo transformation reactions with atmospheric photochemical oxidants, such as hydroxyl radicals (OH*), nitrogen oxides (NOx), and ozone (O3). The most common PAH-transformation products (PAH-TPs) are nitro-, oxygenated-, and hydroxylated-PAHs (NPAHs, OPAHs, and OH-PAHs, respectively), some of which are known to pose potential human health concerns. We sampled four approaches for predicting the location of reactive sites on PAHs (i.e., the carbon where atmospheric oxidants attack), and hence the chemoselectivity of the PAH-TPs. The four approaches are: 1) Clar’s prediction of
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 NPAA, OPAA, and OHPAA products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the low volatile 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 explain the environmental chemists to prioritize which PAH-TPs might be formed in the environment; the organic chemists to prioritize which PAH-TPs should be synthesized to verify their presence in the environment; and the toxicologists to prioritize which PAH-TPs should be analyzed for their toxicity and potential human health implications. Future direction of the study is to expand the prediction to screen for PAH-TPs from other parent-PAHs as well as alkylated-PAHs.

TU413 Spatial distribution of gas-phase Polycyclic Aromatic Hydrocarbons along South America and Antarctica
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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 sources, and inefficient 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 XAD-2 resin at each site. Resins were deployed for 12 months during 3 consecutive years at 42 sites (16 sites in Brazil and 26 distributed in Argentina, Chile, Peru, Uruguay, Venezuela and Antarctica) covering different backgrounds (rural, urban / industrial and remote). Passive samplers and XAD2 resins were prepared as described by Wania et al. (2003). XAD-2 resins were extracted by hexane: dichloromethane (1:1), purified and analyzed by gas chromatography/mass spectrometry (GC/MS). The following PAHs were analyzed: naphthalene, 2-methyl-naphthalene, 1-methyl-naphthalene, acenaphthene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenzo[a]anthracene and benzo[ghi]perylene. Results, reported as sequestered amount of each compound per m2 of PAS, were compared to published laboratory values of PAHs at all sites. PAHs with higher molar weight (low vapor pressure) were below the detection limit or levels were in the background range. Conversely, PAHs with lower molar weight (low vapor pressure) were quantified. XAD-2 resins and PM2.5 from the LAPAN project have been collected in various regions of South America and Antarctica. Due to differences in PAH levels, we can conclude that PAH levels are generally lower in Brazil than in Argentina, Chile and Peru, and that the PAH levels are significantly lower in Antarctica when compared to Brazil and Argentina. The quantification of PAHs from the LAPAN project can be used to assess the atmospheric deposition of PAHs in the region and to evaluate the potential impact of PAHs on human health and the environment.

TU414 Importance of Dermal Exposure to Polycyclic Aromatic Hydrocarbons Derived from Barbecue Fume
J. Liu, S. Xie, Jinan University; C. Wu, L. Bao, Jinan University / School of Environmental Science and Engineering; S. Tai, Peking University / Laboratory for Earth Surface Processes College of Urban and Environmental Sciences; E.Y. Zeng, Jinan University / School of Environment
Despite the ubiquity and carcinogenicity of polycyclic aromatic hydrocarbons (PAHs), their dermal absorption for the general population has not been adequately addressed. Aiming to verify the importance of dermal absorption for PAHs, we investigated the presence of PAHs in horse hair. Two sets of hair samples were collected approximately 17 h before exposure until 35 h after exposure from 20 participants and analyzed for nine hydroxyl (OH)-PAHs. Air, food, and cotton clothing samples were analyzed for 16 PAHs. Based on the occurrence of atmospheric PAHs, dermal absorption of low molecular-weight PAHs was greater than inhalation intake. In addition, the net excreted amounts of OH-naphthalene, OH-fluorene, OH-phenanthrene, and OH-pyrene via dermal contact were 367, 63, 98, and 28 ng respectively, comparable to those via combined dermal and inhalation exposure, which were 453, 98, 126, and 38 ng. The ratios of excretion to intake via dermal contact were 0.11, 0.03, and 0.043 for fluorene, phenanthrene, and pyrene, respectively, higher than those for inhalation (0.097, 0.016, and 0.025). These results indicate that dermal absorption is a significant exposure route of PAHs. In the case of BBQ fumes, dermal absorption is a more important pathway for intake of low molecular-weight PAHs than inhalation.

TU415 EDS Mapping of Particles As A Component of Lichen Biomonitoring in Seattle, Washington
G.T. Guddal, Western Washington University; J. Miller, A. Johnson, Western Washington University / Environmental Sciences Department; R. Sofield, Western Washington University
Lichen are an increasingly popular medium for conducting air quality monitoring due to their sensitivity to SOx and NOx, as well as their bioaccumulation of airborne material. This study incorporates characterization of particulate matter (PM) on the surface of lichen Ramalina farinacea to map exposure to air pollution in three industrial clusters in Seattle, Washington, USA. The PM was characterized using scanning electron microscopy with energy-dispersive X-ray spectroscopy mapping to determine PM size and composition. We also measured biomonitoring of certain substances in the lichen such as chlorophyll, chlorophyll c, chlorophyll d, chlorophyll f, chlorophyll degradation, malondialdehyde, and usnic acid. Principal components analysis has identified which geographic locations and particle types correlate the strongest with increased metal accumulation and physiological response in the lichen.

TU416 TBARS in horse hair as an indicator of oil industry pollution
M. Kovačević, Department of Biology, University of Osijek; T. Plavac, B. Kutuzović Hackenberger, University of Osijek / Department of Biology
Air pollution is a major problem today. Although there are many tests that measure the presence of certain substances in the air, it is important to measure the impact of various pollutants on living organisms as well. Horses that spend time outdoors are exposed to environmental influences, and some of them are measurable in horse hair. The aim of this study is to assess how pollutants of the oil industry affect biological markers in permanent horse hair from mane and tail and whether the concentration of thiobarbituric acid reactive substances (TBARS) can be used as biomarker of oil industry air pollution. The horse hair samples from mane and tail were collected from two areas. One near Slavonski Brod, where an issue of air pollution is present due the outdated refinery plant in Bosanski Brod, and the other near Osijek where no apparent air industry pollution is present. The concentration of TBARS in samples was measured fluorometrically. The samples were cut into segments to detect differences in duration of exposure through the age of hair. The concentration of TBARS was significantly higher in horses exposed to polluted air (Slavonski Brod site). When segments were analysed according to the age of hair it was noticed a constant difference in concentration of TBARS between roots and top for mane and tail. A significant correlation between age of hair and concentration of TBARS was noticed. Although further research is needed, a concentration of TBARS in horse hair could serve as a simple and inexpensive method for monitoring air pollution by oil industry.

TU417 Morbidity for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates
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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 potentially environment-related disease would be really useful. Methods. Liguria Region hospital discharge records from 2001 to 2013 have been collected. Only admissions for cardiovascular disease, respiratory disease or neoplasms as primary diagnosis were included. Hospital discharge rates, standardized by age and compared with Regional mean, were represented using geographic maps with a color scale identifying different disease distribution. For those disorders showing significant difference with regional mean, disease distribution was compared with emissions of air pollutants, estimated by Lichens biomonitoring. Results. La Spezia Province Hospital Discharge rates for potentially environment-related disease 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 those of 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
Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)

TU420  
Ecological risk assessment of conazol fungicides in arable soils of the Czech Republic
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Concentration- and time-dependent dissipation, partitioning and plant accumulation of selected fungicides, insecticide, herbicide and transformation products in sand and soil
N. Neuvirthová, Masaryk University; Z. Bílková, Masaryk University / RECETOX; J. Vasicová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Brejska, Masaryk University / Faculty of Science RECETOX

Evaluation of pesticides and fungicides transport using passive sampling devices in a vineyard catchment in South West France
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In vineyards of South West France, fungicides account for nearly 80 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 chemical integrator 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 specific compounds. The main objectives of this study were to: (a) test the effectiveness of a combined method for the determination of long-term residues in soil (b) to evaluate the potential health effects on the benthic community and (c) to assess the potential risks to biota associated with a high input of pesticides.
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 were amenable to exposure to Iprodione
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European Union countries have about 12 million agricultural holding, and approximately 172 million hectares (39% of the total European land surface) of agricultural areas. Pesticides are used extensively in agricultural production to prevent pests, diseases, weeds or other plant pathogens to reduce yield losses and to guarantee a good harvest. In the recent decades, numerous studies have suggested adverse health effects associated to long-term pesticide exposure. Serious concerns have been raised about health risks resulting from occupational exposure. Nevertheless, the knowledge of occupational exposure levels and determinants to pesticides are still limited. The CANEPA project (Cancers and Exposures to Agricultural Pesticides) aims to characterise external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, was assessed the disease of Korean vectors of cabbage white was performed in several apple holding, situated in south-west of France. Dislodgeable foliar residues (DFR) and pesticide residues on equipments or apples (wipe sampling) were studied during the different activities of apple growing (treatments, re-entry tasks, harvests). Atmospheric levels of pesticides (outdoor and indoor) were also determined using passive samplers (Polyurethane Foams, PUF) and low-volume samplers instilled in this the study was mainly focused on two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry (LC/MS-MS). Levels of pesticide residues and source characterisation will be present. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU424
Intra-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 deaths of Korean vectors of cabbage white was performed in the delta Tria and the ditta Tria in the study the main focus was on two fungicides (captan and dithianon). 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 CMIT/MIT, have remain unsolved. This is mainly due to a lack of concordance. CMIT/MIT, with the aim of testing the simultaneous effect of active principles and additives present in the products. Laboratory experiments were conducted using the filter paper test (FPT): E. fetida was exposed to increasing concentration of Prosaro® or Amistar®, being the highest dose of treatment the recommended one for the usage in wheat farming. Field investigations were conducted transplanting E. fetida in cages in the soil of wheat and durum wheat fields before and during treatment with different combinations of the 4 fungicides. E. fetida specimens from laboratory and field work were analysed to evaluate vitality, potential neurotoxic effects (inhibition of acetylcholinesterase activity (AChE)), phase II enzymatic activity levels of CAT and GST was observed. The content of protein carbonyls significantly (p < 0.05) was determined (29.88 (25.98-34.37) μg/ml of Iprodione) while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased significantly (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces trioplar and microneurules divisions at 17.5 and 25 μg/ml 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.

TU425
Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione

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 U ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment. with 5% CO2 (v/v), at 37 °C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5x104 cells) and for genotoxicity parameters in agarose plates. From the MTT assays, the LCS0 was determined (29.88 (25.98-34.37) μg/ml of 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 trioplar and microneurules divisions at 17.5 and 25 μg/ml 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
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The use of plant protection products in agriculture can affect non-target soil organism and have a negative effect on the health of the ecosystem. In particular, information on toxicological effects of fungicides are very poor or absent, despite their widespread use. The aim of this study was to evaluate the potential toxic effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826 species). We choose commercial products with the aim of testing the simultaneous effect of active principles and additives present in the products. Laboratory experiments were conducted using the filter paper test (FPT): E. fetida was exposed to increasing concentration of Prosaro® or Amistar®, being the highest dose of treatment the recommended one for the usage in wheat farming. Field investigations were conducted transplanting E. fetida in cages in the soil of wheat and durum wheat fields before and during treatment with different combinations of the 4 fungicides. E. fetida specimens from laboratory and field work were analysed to evaluate vitality, potential neurotoxic effects (inhibition of acetylcholinesterase activity (AChE)), phase II enzymatic activity levels of CAT and GST was observed. The content of protein carbonyls significantly (p < 0.05) was determined (29.88 (25.98-34.37) 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 trioplar and microneurules divisions at 17.5 and 25 μg/ml 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
329
SETAC Europe 28th Annual Meeting Abstract Book
E.N. Velebrosky, 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

Dilorcan 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 C12-lifetime of dicloran is impacted by the seawater Biolog (7.5 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms at nearly double the concentration in seawater as opposed to freshwater. Chlorothalonil quickly degrades to 4-hydroxychlorothalonil via soil degradation and hydroxylchlorothalonil can desorb back into the water column where it can be photochemically degraded. The degradation rate and half-life of hydroxylchlorothalonil is very short, but differs significantly between freshwater (32.5 min.) and seawater (301 min.). Both dilorcan and hydroxylchlorothalonil have similar proposed photodegradation pathways, therefore the potential for enhanced phototoxity due to salinity variation is possible. Dilorcan 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 on salinity of chemical toxicity may warrant changes to future chemical assessments.

WE001
Development of a modelling framework for estimating the sorption of pharmaceuticals in soils
L. Carter, University of York / Environment Department; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department

Ionisable pharmaceuticals comprise a significant and increasing proportion of chemicals used in Europe. At typical environmental pH, ionisable pharmaceuticals can become charged. Speciation can alter the fate and behaviour of a chemical in the environment including its sorption potential to soils and sludge. It is essential that the behaviour is recognised within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of ionisable chemicals in soils. However, these models are typically based on training sets containing a multitude of organic chemicals and their ability to predict ionisable pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches, that take into account sorbent properties (i.e. soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of ionisable chemicals (i.e. cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anionic pharmaceuticals still performed poorly (r² < 0.5). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values whereas prediction was considered as acceptable for sorption of organic anion 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 (iPiev. grant n° 115735) for the financial support.

WE002
Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change
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Sunlight illumination of surface waters induces several photochemical reactions that plotly affect (e.g. hijacking), while in the latter case a role of photoreactive compounds and of 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 transformation. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrite that can produce several light-induced photoreactive species and photoreaction transformations. The transients include, among others, the hydroxyl (OH) and carbonate (CO32-) radicals, singlet oxygen (\(\text{O}_2^*\)) and CDOM triplet states (\(\text{CDOM}^\cdot\)). Their occurrence in surface-water environments is linked to irradiance and to key water parameters such as chemistry and depth [1,2]. The photoform transformation 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 disturbances 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 clarity (browning), while in the latter case a role of photoreactive compounds (e.g. phytoplankton blooms, treeline shifts, extended drought periods) would play key roles depending on the context. [1] Vione D, Minella M, Maurino V, Minero C. 2014. Chemistry Eur. J. 20:10590-10606. [2] Rosario-Ortiz FL, Canoica S. 2016. Environ. Sci. Technol. 50:12532-12547. [3] Avetta P, Fabbri D, Minella M, Brigante M, Maurino V, Minero C, Puzii M, Vione D. 2016. Water Res. 105:383-394 [4] Mione L, Leoni B, Salmaso N, Savoye L, Sommaruga R, Vione D. 2016. Sci. Total Environ. 541:247-256.

WE003
How Pharmaceutical Industrial waste can make your medicines ineffective
N. Verma, Baddi University of Emerging Sciences & Technology / Pharmacy

Spread over 838 square kilometres in Himachal Pradesh’s Solan district, the Baddi-Barotwala-Nalagarh (BBN) industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste has concerned about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into busy 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 identified as one of the most polluted and affected region. 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 also support small-scale manufacturers to install and implement environmentally sound treatment and disposal technologies. 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
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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 assessments methods for pharmaceuticals according to AMED’s strategy and evaluated the risks. We have measured the environmental concentrations (MEC) of 31 kinds of active ingredients in marketing medicine, using liquid-chromatography with mass spectrometry, in representative seven urban rivers in Japan, once every four seasons in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L areshown below: olmesartan (51ng/L), valsartan (445ng/L), candesartan (5ng/L), losartan (176ng/L) for antihypertensive agents, and sulpiride (54ng/L) for antipsychotic agent, citalopram (15ng/L) for antidepressive agent, bezafibrate (200ng/L) for hyperlipidemia treatment drug, crotamiton (845ng/L) for antipruritic agent. Among target ingredients, the detection 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 concentration of sucralose measured at the same time. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candesartan, olmesartan, lorazepam, rosuvastatin and epinistine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider lower dilution ratio in the environmental fate assessment, which sets it. Regarding the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.000001% of chlorbic 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 offer a cheaper alternative to the costly and unreliable 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 in four-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 excreted from the body and degraded during sewage treatment, the population excreted from the body and degraded during sewage treatment, the population excreted from the body and degraded during sewage treatment, the population excreted from the body and degraded during sewage treatment, 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 a small study locations (metformin, gabapentin, atenolol, desvenlafaxine, fexofenadine, clotrimazole and paracetamol). PECs may be best used for prioritisation over use in more sensitive applications, such as risk assessment, as PECs were consistently shown to underestimate API concentrations.

WE006 The role of the water-sediment simulation test and its outcome in the environmental risk assessment (ERA) of pharmaceuticals
D. Gildenmeister, Umweltbundesamt / German Environment Agency / IV2.2 Pharmaceuticals; S. Schmitz, S. Zahorski, German Environment Agency / UBA / IVAP Pharmaceuticals; A. Hein, L. Römmelhah, German Environment Agency / UBA / Section IV 2.2 Pharmaceuticals
In view to the revision of the "Guideline on the environmental risk assessment of medicinal products for human use" (EMEA/CHMP/SWP/447/00, 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 to sediment triggers further assessment in the next tier of the guideline. Derived half lives were not used in refined predicted exposure concentration (PEC) calculations and transformation products (TP) were not specifically considered in the ERA. Now, UBA evaluates the data received in the last 10 years in order to determine the gaps and the benefit of the current fate assessment for the overall risk assessment e.g. classification of persistence. Especially the role of TP in the environment due to their frequent higher mobility compared to the parent compound is considered in the present research. As a first step-an overview is prepared on the overall performance of pharmaceuticals in the water environment in the presented research. 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 a so-called chemical characteristics e.g. lipophilicity / hydrophilicity 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 groundwater contamination. The identification of relevant TP is still often missing in provided studies. The water sediment simulation test is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiving OECD 308, the results should be better included in the ERA and communicated.

WE007 Expert System to Inform BCF Testing Strategies for Pharmaceuticals
A. Agatz, IBACON GmbH / Environment Department; L. Carter, University of York / Environment Department; P. Andrews, A. Nellis, SimOmnics; S. Owen, AstraZeneca / Safety Health Environment; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; J. Timmins, SimOmnics; 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 characteristics of ingredients by interpreting the current fate assessment for the overall risk assessment e.g. lipophilicity / hydrophilicity 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 groundwater contamination. The identification of relevant TP is still often missing in provided studies. The water sediment simulation test is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiving OECD 308, the results should be better included in the ERA and communicated.

331 SETAC Europe 28th Annual Meeting Abstract Book
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 these 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**

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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 tissues is the leading cause of adverse effects, as it is in humans. On the basis of this mechanistic starting point, we propose a quantitative Adverse Outcome Pathway (AOP) approach to evaluate the environmental and pharmacodynamic aspects of NSAIDs toxicity. After extracting all NSAIDs toxicity data available in the scientific literature, we applied drug uptake models to predict the plasma concentrations at which different effects would occur in laboratory studies. As all NSAIDs act by inhibiting the enzymes COX1 and/or COX2, we applied mixture pharmacology approaches to express the plasma effect concentration as a specific concentration (nominal concentration) and one control. When we were sure that a new generation of larvae (< 2 biting midge Chironomus riparius) 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 target multi-scale adverse effects. The major strength of the model is the ability to express the toxic potential of NSAIDs mixtures, expressed as diclofenac-equivalents. We propose that this mechanistic approach may provide a useful predictive tool to support the implementation of effective NSAIDs ecopharmacovigilance strategies and facilitate the regulatory interpretation of past and future toxicity data.

**WE009**

**Evolution in the lab - How can we study the chronic exposure to pharmaceuticals over multiple generations?**

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Larvae exposed to non-target organisms based solely on toxicity data is slowly 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. Because of its high affinity to NE reuptake transporters (SERT), norepinephrine transporter (NET), and dopamine transporter (DAT), CBZ is transported to organisms. A similar approach like CBZ? To answer this question, the non-biting midge Chironomus riparius was cast as a test organism for a multi-generation experiment. 2400 chironomid larvae (< 24 h old) were taken from a laboratory culture to set up two exposure cages – one where larvae were continuously exposed to the LC50 of CBZ (0.4 mg/L, nominal concentration) and one control. When we were sure that a new generation had started, egg clutches were taken out of the cages to set up two chronic toxicity tests. Lethal and effect concentrations of mortality and mean time to emergence were calculated using a non-linear regression model (logistic curve). Sensitivity was compared by looking at overlaps of the 95% confidence intervals (CI). Two months after the beginning of the experiment, mortality seemed to be lower in the exposed group compared to the control. However, CI of the LC50 still overlapped (0.506 to 0.882 mg/L for the control and 0.729 to 1.1 mg/L for the pre-exposed group). Four months later, sensitivity was compared again. LC50 of the pre-exposed group was higher than in the control, with no overlap of the CI (0.668 to 1.02 mg/L for the control and 1.08 to 1.96 mg/L for the pre-exposed group). After two and six months, control mortality of both groups was low and emergence in the control stayed constant. Multi-generation experiments are a helpful tool to investigate long-term effects of chemicals on aquatic organisms. Within the first six months of the ongoing study, midges showed to be less sensitive to carbamazepine after long-term low-level exposure. Chronic toxicity tests to study the authors of exposure groups should be combined with genome and transcriptome analyses to get a full picture of adaptation processes in midges. Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support contract 02WRRM1367A).
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 needs to be addressed is to improve current understanding of the ecological risks of pharmaceutical compounds to non-target organisms in the aquatic 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 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 towards among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

**WE013 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals**

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Recent studies have demonstrated that the type 2 diabetic drug metformin and its metabolite, guanylurea. are common environmental contaminants found in the ng/gL 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. 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

**WE014 Effects of benzoylecgonine exposure at different levels of the biological hierarchy on Daphnia magna**

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A number of monitoring studies have shown that benzoylecgonine (BE), a metabolite of coca, is the main illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. The few studies in this study, we estimated the stereoselective effect of 11 chiral pharmaceuticals using the fish plasma model. We found mettoprolol had high risk with an effect ratio, ER (ratio of human therapeutic plasma concentration to fish plasma concentration at steady state) that was less than 1.0, whereas propranolol, salbutamol, fluxetine 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.

**WE015 Impact of the antibiotic drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario)**

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The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antibiotic drugs as metformin (MF) has become obvious. In wastewater treatment plants, metformin is only partially retained and also transformed to guanylurea (GU) leading to high concentrations of both compounds in surface waters. However, possible effects of MF and GU in aquatic organisms are far from being understood. The aim of this study is therefore to investigate influences of MF and GU on different metabolic pathways and behaviour in different life stages of brown trout (Salmo trutta f. fario). Juvenile trout (age: 8 month) were exposed for 4 weeks at 7°C to different concentrations of MF (0, 10, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 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, alternations 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 µL 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 German Environment Agency.

**WE016 Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guanylurea on F1 progeny 28 days post hatch.**

**Z.P. Pandelides, University of Ontario Institute of Technology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science**

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 German Environment Agency. 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 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 towards among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

**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**

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-g/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 nM) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both males and females 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 raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, 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 Guanylurea J. Straub, F. Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Johnson & Johnson Environmental Health Safety Sustainability; V. D’Aco, Quantum Management Group, Inc.; T. Davidson, B. De Felice, Merck KGaA; J.G. Tell, Merck & Company, Inc / Global Safety The Environment Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concern about the potential aquatic life impacts associated with the presence of MET in surface waters. However, only limited information on the environmental fate of MET as well as its transformation products is available. A comprehensive environmental risk assessment of MET and GUU was further degraded in the environment. A comparative aquatic life risk assessment of MET and GUU in surface water is presented that is based on literature data, previously unpublished data from industry studies conducted to support new drug registration applications as well as new studies commissioned to fill data gaps. Predicted environmental concentrations (PECs) for MET were modelled based on documented usage for the USA with the PhATE model and for the European Union with the GREAT-ER model. These PECs were compared with measured environmental concentrations (MECs) for both the USA and EU. A predicted no effect concentration (PNEC) for MET was derived by deterministic procedures based on multiple chronic studies with algae (4), daphnids (5) and fish (5, two species). Both the PEC/PNEC and MEC/PNEC risk characterization ratios were well below 1, indicating no significant risk for MET with high Margins of Safety. However, since MET is known to be primarily degraded during wastewater treatment to GUU, relevant chronic studies for GUU were conducted to derive a PNEC. In addition, PECs were derived for GUU for the USA and EU as above for MET. Fate and removal/in-stream-loss parameters for both MET and GUU are aligned and PECs are derived at both the U.S. and EU. The PEC/PNEC and MEC/PNEC risk characterization ratios for GUU were also well below 1. We conclude there is no significant risk to aquatic life for both MET and its transformation product GUU.

WE019 Fluoxetine exposure modulated antioxidant and anxiety-related gene expression altering swimming activity in zebrafish embryos B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Gaggio, 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 the 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 these drugs worldwide. All 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 on the expression of genes related to oxidative stress response (sod1, sod2, cat, gpx and gst), stress and anxiety (oxfl, prl2, nyp and wnt31), as well as transporters of main neurotransmitters (slc6a3, slc6a4a, slc6a4b, slc6a11 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 gpx, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of slc6a4a, slc6a4b, slc6a11 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.

WE020 Bio-Optical probing of Beazafibrate toxicity in model marine diatom Phaeodactylum tricornutum B. Danus, MARE / Marine and Environmental Sciences Centre / Centre de Oceanografia; A. Matos, BiotiSBiosystems and Integrative Sciences Institute / Plant Functional Genomics Group, T. Cabrita, IPMA IP; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; I. Caçador, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE Marine and Environmental Sciences Centre The occurrence and fate of pharmaceutical active compounds in aquatic environments has become a major cause for concern due to their effects on humans and aquatic ecosystems. The high consumption of blood lipid regulators is leading to increased occurrence of fibrates in natural streams and wastewater effluents. Fibrates are a class of drugs derived from fibrac acid widely used to reduce plasma triglycerides and raise the level of high-density lipoprotein cholesterol. Specifically, Beazafibrate is extensively used as a lipid regulator with consumption greatly increasing over the years in developed countries. Due to its large use and its persistence, beazafibrate has been detected in surface and drinking waters as well as in wastewaters. This can have various impacts on marine life, including on marine primary producers and thus impacting the whole system productivity and functioning. Exposing the model diatom Phaeodactylum tricornutum to a range of environmentally relevant concentrations of beazafibrate (0–60 mg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometry. Beazafibrate exposure impacted both photosystems, which reduced the algae ability to harvest photonic light and convert it into an electron flow, and thus its chemical energy production (ATP). This may result from a direct effect of beazafibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipid membrane system. Moreover, triglycerides (TAGs) are known to protect the photosystems against photoinhibition. The reduction of TAGs could lead to burnout of the photosystems due to excessive energy being absorbed, as observed by the high incoming photonic energy flux, this way reducing the number of active reaction centers in the algae and thus its photosynthetic ability. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for fibrates toxicity testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.

WE021 Environmental Risk Assessment for the Active Pharmaceutical Ingredient Mycophenolic Acid in European Surface Waters B. Straub F. Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental 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/necotoxicity and on sales amounts for the products containing MPA in Europe. Both a new biodegradation study and an older sediment/water fate test were conducted to derive a PNEC. In addition, PECs were derived for MPA for the USA and EU as above for MET. Fate and removal/in-stream-loss parameters for both MPA and GUU are aligned and PECs are derived at both the U.S. 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 MPA and its transformation product GUU.
After use, pharmaceuticals and their residues eventually end up in the sewage system. Sewage treatment plants reduce the nutrient load of waste water, and while organic micropollutant removal occurs concomitantly by bacterial activity and sorption onto many contaminants, including pharmaceuticals, they are not always completely removed. 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, and the antiepileptic carbamazepine, 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. PHARMA project and Cytothreat, 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 environment through their mode of action. For an in-vivo study, we used a diverse range of aquatic test species. A top 10 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 concentration guidelines 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.

**WE025** SETAC Pharmaceuticals Interested Group
G. Maack, German Environment Agency / Ecotoxicological Assessment

**WE026** What makes a chemical substance a 'natural substance'? A case study in the context of the EU veterinary medicines marketing authorisation procedure
T. Hahn, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; C. Floeter, HAW Hamburg / Department of Environmental Engineering; S. Schwanbeck, G. Koenecker, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment

The marketing authorisation process for veterinary pharmaceuticals in the EU and other countries requires an environmental impact assessment (EIA) for each veterinary medicinal product (VMP). This EIA follows a phased approach with conservative estimates of environmental exposure in phase I, which may later require refinement by experimental data in phase II. Core of the phase I assessment is a catalogue of 19 questions on use and characteristics of the VMP under consideration. These questions aim at establishing an initial predicted environmental concentration, which, together with information on therapeutic use and targeted animal species, may trigger the necessity to perform an in-depth phase II assessment. According to question 2 in the phase I assessment a substance is exempted from further investigation when there is scientific proof that it is a natural substance “the use of which will not alter the concentration or distribution in the environment”. At first sight this definition appears unambiguous. Nevertheless may it be a hurdle for applicants because no further guidance is given which criteria apply for acceptance or rejection of a given concentration as ‘natural’. Here, we present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

**Obsogens and lipid disruptors (P)**

**WE027** Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses

Exposure to PFOS (perfluorinated octyl sulfonate) has been related to toxic effects on lipid metabolism, immunological response, and different endocrine systems. We present here a combined metabolomic and transcriptomic analysis of zebrafish embryos exposed to different concentrations of PFOS (30-1000 ppb) from 48 hpf to 120 hpf. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest concentration. Functional analyses of the observed changes revealed at least three major modes of action: alteration of PPAR signalling and lipid metabolism, effects on cell-cell interaction, perhaps linked to effects on the immune response and neuronal system development, and a general alteration of the development, reflected by an alteration of different development- and metabolism-related signalling pathways, likely affecting to cell cycle functions, and
to the metabolism of proteins, nucleotides, and amino acids. The results suggest a complex, multiple endocrine disruption-like toxic effects, at 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 transcriptomic levels at concentrations 10 to 100 below the macroscopic NOAEL.

**WE028** Impacts of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss).

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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, an in vitro 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, 0.75, 150, 300 and 600 µM of ω-linolenic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 2 mM MeHg in 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, the composition of FAs 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 exposure of obesogens constitutes 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 organisms. Such phenomena are a priority issue in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolites on aquatic organisms, we carried out experiments to assess the toxicity of metformin and its metabolites towards rainbow trout adipose tissues 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 mature 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 3T3-L1 preadipocytes of mouse (MSCs) to mimic either white or bone cell lineages. Future research using MSCs cells as model for adipogenesis will not only look at the differentiation to white adipocytes. 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 become a major concern. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolites on aquatic organisms, we carried out experiments to assess the toxicity of metformin and its metabolites towards rainbow trout adipose tissues 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 mature 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 3T3-L1 preadipocytes of mouse (MSCs) to mimic either white or bone cell lineages. Future research using MSCs cells as model for adipogenesis will not only look at the differentiation to white adipocytes. 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.

**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 analysis of the composition of the digestive gland, gives information on the energy level of the organism, this energy is mobilized in the different stages of its life cycle. When the organisms are subjected to severe stress conditions, it has been observed the mobilization of these reserves to maintain homeostasis, in short periods of time. In this work, an evaluation of the composition of the digestive gland of juvenile catarina clam exposed to the metals Cd, Cr, Pb and their mixtures was carried out to determine their energy content. Bioassays with water replacements were carried out. The organisms were exposed to 1 subthalial concentration of each metal (LC50) of 0.35, 5.0 and 3.0 mg L−1 of Cd, Cr and Pb.
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bligh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Krusal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treatments was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease in lipid 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)

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 to the soil from injection points located on the cutter head and inside the bulk chamber to give the conditioned soil properties necessary to guarantee that the EPB machine will work in the proper way. The excavation process produces a large amount of spoil material rich in foaming agents that can have an impact on ecosystems. The possible way-of-use of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Currently, there are no threshold limits in European legislation for these components nor comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained as the main component of two commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Moreover, the degradability of one product was evaluated in the presence of an additive used to improve the compaction 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 dehydrogenase activity especially in the S2 soil. In the latter case, the higher persistence of the product can be ascribable to the detrimental effect of the additive on the microbial abundance and activity.

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 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 to the soil from injection points located on the cutter head and inside the bulk chamber to give the conditioned soil properties necessary to guarantee that the EPB machine will work in the proper way. The excavation process produces a large amount of spoil material rich in foaming agents that can have an impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil threshold limits in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcosm experiments were set-up with soil samples conditioned separately with the foaming agent P1 (85 mg/kg SLES concentration) or P2 (83 mg/kg SLES concentration). Some soil samples were previously sterilized in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcosms, consisting of untreated 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 (DAPI counts), cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community by the Fluorescent In Situ Hybridization (FISH) method. Although an initial negative effect on microbial abundance and viability was observed, at the end of the experiment SLES was no longer present in all soil samples. The results showed a significant increase of soil microbial and cellular vitality when comparing the control vs treated soils. SLES was completely biodegraded at day 28 and a shift in the microbial community was observed comparing the control vs treated soils. In particular, a significant increase in the Gamma-Proteobacteria group, which includes bacteria able to transform SLES, has been found.

Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

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1. Foaming agents with better environmental impact: 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 conditioned by a third-part laboratory as a confidence test. Besides 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 stage when compared to traditional products, meaning that their provision of organic material to the conditioned soil is lower. 2. Environmental results with soils conditioned with the Polyfoamer ECO products Various laboratory tests have been carried out with the new foaming agents of the Polyfoamer ECO line of products and samples of soil coming from different TBM projects. The results obtained with two samples of soil from an Italian project are described: the material called “M” (a
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 soil is involved. Several environmental conditions 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

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These excavation rocks are made of rock fragments contaminated by the additives used during excavation and to preserve the tunnel boring machine (TBM) from wear, block and clogging. Surfactants and polymers are used in mechanized tunneling to facilitate the excavation process as by-products (e.g. land covering) or its discharge as a waste depends on the kind of conditioned soil and target organism tested. Therefore, 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 balance of bioassays. For this purpose, a series of experiments were performed, containing two soils with different geopedological characteristics, conditioned with two different foaming agents at the same treatment ratios (TR, L/m^2) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox test with the bacterium Vibrio fischeri, Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and elutriate from each mesocosm were analyzed in order to determine the residual concentrations of the anionic surfactant AES. The overall results obtained showed different ecotoxicological response depending both on the kind of soil and the type of foaming agent products. The preliminary 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
Expedition 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 poured in the process. The aim of this research is 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 their extraction. Commonly accepted standards were tested. The research project will 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 expedient 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 expedient information on the presence in the spoil of the chemicals often used in mechanized tunnelling. The results of preliminary laboratory tests convinced that the expedient 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 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 fewer precise laboratory tests. Methodologies have been selected to be used directly for monitoring large volumes of spoil involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

WE042
Toxicity of several additives used in mechanized tunneling: effects on daphnids, algae and cress.
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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 effect 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 analyzes 8 surfactants and 4 commercial polymers, using a multidisciplinary approach to determine their reference thresholds for both water and soils, accounting of the effects on ecological targets. The chemical composition of the technical mixtures was determined by liquid chromatography coupled with high resolution mass spectrometry. The main chemical components were analyzed in silico to highlight the potential similarity with other pollutants, already listed in our environmental framework regulation. Finally, the toxicity of the various agents has been evaluated by tests with Daphnia magna, freshwater algae and cress. Chemical characterization identified 15 molecules present in all the surfactant mixtures, although in different proportion. No similarities with compounds already regulated by the Italian Environmental Act were found by the in silico analysis. All the tested surfactants were toxic for the aquatic organisms at concentrations comparable to those that can be found in leachates of conditioned rock debris. The additives resulted non toxic for the terrestrial plant at concentrations theoretically found in conditioned rock debris.

PBT/pvP & PMT/pvP substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P)

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-ethyl-hexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogBAFWere 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.

Hyalatella 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 (EC1107/2009) 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 vertebrate animals. Theres 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, Hyalatella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimental BCF values from through bioaccumulation studies with Hyalatella are similar to those obtained from fish (Schlechtien, 2012). Further work is presented in order to (i) increase the data base of Hyalatella - fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges since Hyalatella as an aquatic invertebrate can be quite sensitive. The results from
few BCF studies with *Hyalella* supports this species as suitable test species for bioaccumulation testing and supports planned activities on OECD level.

**WE045**
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 dataset includes dietary BMFs in whole fish obtained under laboratory-scale conditions closely resembling or directly referring to the OECD 305-III guideline. In total, BMF data were available for 29 ionizable chemicals (of which 10 are perfluorinated chemicals), including 24 acylglycine-aminobutyric acids, and four perfluorinated carboxylic acids. A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a log*Kow* was not a sufficient predictor of BMF, although with significant positive correlation (R=0.40), and b) that significant correlation was shown only with log*Kd* at pH=3 (R<0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R< -0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., 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 (to determine relevant lipophilic and hydrophilic). Estimation of BCFs from BMF for the investigated chemicals will be also performed and verified with existing BCF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radio-labelled test chemicals.

**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 of fragrance substances is a key endpoint in environmental hazard and risk assessment, especially for substances with a high octanol water partition coefficient (log*KOW*). To measure the BioConcentration Factor (BCF), a tiered approach is followed starting from the assessment of the octanol water partitioning coefficient as a measure for lipophilicity, which is often used as surrogate for lipid partitioning up to an experimental BCF value which is considered as the gold standard for fish bioconcentration assessment. We have applied a series of non-animal methods 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 these compounds, were investigated in a flow-through test on the invertebrate Hyalella azteca resulting in a BCFSS or kinetic < 500 L/kg. Finally an experimental fish BCF of ~500 (OECD 305) confirms that the fragrance composed of various isomers is not bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered-weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.

**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 processes in aquatic food web models only. Different variables are 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 of aquatic ecosystems. The TMF is calculated by using the FMEP and will be tested in a pilot 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 patterns in the context of the food web taken against a known standard (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 compartments in a food web. The calculated TMF may only be used to offer alternatives to animal testing when sufficient and supportive evidence is provided.

**WE048**
Obstacles in identifying PBT/vPvB-substances under REACH for high tonnage chemicals


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 dossier of substances manufactured or imported in quantities of 100 to 1000 tons per year (tpa) is evaluated in the current project on REACH compliance. This is a follow-up project on substances registered in quantities of 1 000 tpa or more. Substances registered in quantities of 1 000 tpa or more suggest that the main obstacle in identifying substances with PBT/vPvB properties are shortcomings in data quality, data gaps or inappropriate data-waiving/adaptation approaches. A minimum of 12% (for abiotic degradation) and a maximum of 61% (for ecotoxicity) of the dosiers were found to be “non-compliant”. It was recommended that registrants should thoroughly review and update their dosiers in order to fulfill the information requirements. This can be achieved either by using appropriate standard tests, providing a sound justification to waive data or using appropriate surrogate data. The poster will show preliminary results on the dossiers of substances registered in the tonnage levels of 100 to 1000 tpa per year and its
WE049
PBT/vPvB: All equally bad or some worse than others? - How to inform risk management
K. Thiele, 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 different properties. These imply 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/vPvB. 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/vPvB. 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, particularly in sewage sludge and sludge-based composts. The usage of OPEs 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 polynomial parameter linear free energy relationships (ppLFERs) to represent partitioning, and 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/vPvB. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE052
Polymers: The Next Frontier in Environmental Hazard Assessment
A. Carrage, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Colaman II, Kao

Polymers are a very large and diverse class of chemicals widely used in cosmetic and personal care products. Their use and function are essential in creating high performing products that meet the needs of consumers. As used in cosmetic formulation, polymers can act as thickeners, emulsifiers, conditioners, opacifiers, film formers, rheology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together. They have a full range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example. Currently, the majority of large molecular weight polymers are exempt from chemical regulations around the world (e.g. REACH) or are largely considered of low concern based on a minimum set of physical-chemical properties (e.g. FIFRA). However, there is a speculation that these regulatory exemptions, specifically the REACH exemption, could be removed in the next 5-10 years. If this is the case, many previously untested chemicals would then need an environmental hazard assessment supported by an ecotoxicological dataset. This dataset may include aquatic toxicity testing, read-across to structurally similar chemicals that have been tested, weight of evidence toxicity estimates based on physical-chemical properties, or all of the above. However, the same variety of physical-chemical properties that allows polymers to have so many 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,
**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 regulation does not provide a sufficient approach towards ionisable substances. The objective of the project is to refine the P assessment of ionisable 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 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 criteria for pharmaceuticals.

**WE055**

**Assessment of the persistence of ionisable 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 Authorisation 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 ionisable substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphoric characteristics, the chemicals intrinsic properties (e.g. water solubility, log Kow) change as a function of the environmental pH. This deficiency 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 ion and ionisable substances in the PBT-assessment, sorption and degradation patterns of charged model substances carrying either a positive, negative or non-charged functional group will be investigated. Further, the sorption behaviour of 14C-labelled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonylic acid and 4-n-Dodecylbenzyltrimethylammonium chloride in soil simulation tests (OECD 307) will be investigated according to their mineralized, extractable and non-extractable fraction. Non-extractable residues will be investigated further. In addition, the sorption 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 Osnabrück / Physics; G. Ür, K. Hideg, T. Kalai, University of Pécs / Organic and Medicinal Chemistry; M. Mathies, University of Osnabrück / Institute of Environmental Research

In the environmental soil-solution system, sulfonamides (SAs) are used in animal husbandry for treatment of infections. After application of manure of treated livestock to soil, SAs 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/or binding to soil organic matter. The paper presents a new approach of using stable magnetic spin probes to investigate the spin label immobilization of SAs to soil humic acids and to distinguish between sorption, sequestration and covalent binding. Leonardite humic acid (LHA) was mixed with laccase to enhance the amount of reactive quinone groups of LHA and then incubated with nitroxide spin labelled analogues of sulfadiazine (SDZ, HO-4888) and N-acetyl derivative of HO-4888 (N-Ac-SDZ, HO-4917). The labeling at the pyrimidine moiety of SDZ leaves the aniline moiety susceptible to covalent binding to LHA, which is blocked by the N-acetylation. A broadened ESR signal was observed for HO-4888, which indicates strong restriction of the reorientational motion of the spin probe, i.e. immobilization due covalent binding of the aniline moiety of SDZ to reactive quinone sites of LHA. This signal increased immediately after incubation and was used to determine the first-order reaction kinetics of the covalent bond formation. A fast reaction with a half-life of 0.108 h and a slower reaction with a half-life of 14.9 h of covalent binding as well as a reduction half-life of 642 h for the unpaired electron were determined. The treatment of LHA with laccase corroborates the covalent bond formation by oxidizing non-reactive hydroquinone to reactive quinone moieties, which could react via a nucleophilic addition with the amine functions of the bound SAs. A broadened ESR signal was also recorded after SDZ used in animal husbandry for treatment of infections. After incubation with LHA. However, this signal declines in contrast to the increase of the signal of HO-4888. This immobilization is caused by unspecific sorption to LHA, not by covalent binding, which is blocked by the N-acetylation. The decrease is attributed to the reduction of the nitroxide spin label and has a half-life of 98.4 h. In a further experiment with the antioxidant Na-ascorbat the reaction constants of the bound and free SDZ were found to be almost identical demonstrating that SAs are probably not physically entrapped, at least with soil humic acids.

**WE057**

The role of non-extractable residues in the environmental risk assessment from regulatory perspective - requirements and challenges

A. Wiemann, UBA Umweltbundesamt; J. Hogeback, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. GildeMER, Umweltbundesamt / German Environment Agency / IV 2.2 Pharmaceuticals; D. Löffler, T. Ternes, German Federal Institute of Hydrology

Non-extractable residues (NER) arise from different regulatory frameworks. In some cases NER are integrated in the calculation of predicted environmental concentrations (PEC) or are an issue in the authorisation decision. The significance of NER in the assessment of persistence (e.g. PBT, vBvP, POP classification) has been more or less neglected in the past. However, new developments as reflected in guideline revisions (e.g. ECHA R.11, 2017) highlight the importance of NER in testing, registration and potentially in the calculation of concentrations 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 remodelled in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenic bound NER) are considered to be irreversibly 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 research funded by UBA.

Thermofraction tests in soil with 13C-labelled substrates 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 different NER, NER assessment levels and 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 / Analyt.

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 to 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 full 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’.

A new model with 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 as well.

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 13C-15N-glyphosate 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. Polese, 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 / DTU Environment

The combination of dynamic simulation and stable isotope techniques allows tracking the assimilation of pesticides into biomass [1]. Here, we simulated the fate of co-labeled 15N-glyphosate in an OECD guideline 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 15N and 13C were balanced. The model considers two biodegradation pathways for glyphosate, namely the sarcosine-pathway with complete mineralization, and the incomplete pathway with AmP as terminal metabolite. AmP was partly 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 AMP and CO₂, formation of living and dead biomass (proteins) and chemical adsorption. At the end of the experiment (80 days), 70-90% of 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., Miltner, A., Trapp, S., & Schäffer, A. (2014). Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics in Soil – A Synthesis. Crit Rev Env Sci Technol, 44(19), 2107–2171. [2] Wang, S., Seiwert, B., Kästner, M., Miltner, A., Schäffer, A., Reemtsma, T., Q. Yang, Nowak, K. M. (2016). (Bio)degradation of glyphosate in water using a 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.

WE060 Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia A. Aleksanyan, Hazardous Substances & Waste Policy Division / Head of Division; Y. Buinyayyan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology investigation; V. Khachatryan, National Institute of Oncology / Thoracic Surgery Department; F. Petrosyan, UNIDO BAT/BE Project(Armenia)

Sources of environmental pollution by persistent organic pollutants (POPs), either used ourselves or previously applied, may include landfills, many of which do not meet sanitary and hygienic standards and, at open burning of wastes, become a source of dioxins and furans. Investigation was carried out on soil samples taken in different marzes (provinces) of the Republic of Armenia at the boundaries of landfills and agricultural lands or water basins in the vicinity of towns Ararat (Ararat Marz), Hrazdan (Kotayk Marz), Sevan (Gegharkunik Marz), Gavar (Gegharkunik Marz), Ararat (Ararat Marz), and Shushi (Nagorno-Karabakh Republic). The obtained soil samples were analyzed for determination of the following POPs: - hexachlorocyclohexane (HCH) isomers: α-, β-, γ-, δ-HCH; - DDT isomers: 2,4'-DDT, 4,4'-DDT, - DDT metabolites: 2,4',4'DDE, 4,4'DDE, 4,4'DDD, 4,4'-DDE; - Hexachlorobenzene; - Hexachloropropene; - Aldrin; - Dieldrin; - Chlordane; - DDT isomers and metabolites, certain Diocox-like polychlorinated PCBs were detected at concentrations exceeding the established norms.

WE061 Improving the interpretation of Non-Extractable Residues (NER) in degradation assessment

A. L. Brock, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU / DTU Environment

Criteria for the assessment of chemical properties, potential (eco)toxicity, and environmental behaviour of industrial chemicals in general, and particularly for REACH substances, biocides, pesticides, and veterinary medicines are summarized in specific European legislations. The regulatory views on NER formation differ considerably, with two extremes of assuming them as either degraded residues or non-environmental residues. This may be changed if clear indications for ultimate degradation or irreversible immobilisation are available. Further research is needed to determine the types of NER of chemicals in environmental matrices can be experimentally discriminated by sequesetered, (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered potential (eco)toxicity hazards and/or as well as the total amount of polychlorinated biphenyls, as maximum allowale concentrations (MACs) are set for the aggregate amount of these compounds. On the analogy, concentrations of other POPs pesticides and all studied POPs are also considered on the whole (summarary concentrations) as obvious indicator of soil pollution by the studied POPs. In the investigated soil samples HCH isomers, DDT isomers and metabolites, certain Diocox-like polychlorinated PCBs were detected at concentrations exceeding the established norms.
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’ persistent fate is due to environmental fate assessments that fail to quantify photochemical degradation 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 photolysis are important to quantify in order to accurately characterize the environmental fate of fungicides.

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 direct photolysis and indirect photolysis. Direct photolysis involves molecules that absorb sunlight and are transformed as a consequence. Indirect photolysis involves reactive transients such as ‘OH, CO−1, •O2 and the triplet states of chromophoric dissolved organic matter (CDOM*). They are generated by irradiation of photosensitizers such as CDOM (producing ‘CDOM*, ‘O2 and •O2), nitrate and nitrite (producing ‘OH). Among these transient species, ‘O2 is certainly the most abundant one in presence of natural water (which is a consequence of the poorly known nature of CDOM) and reactivity. Still, ‘CDOM* is involved into the transformation of several organic pollutants. In this work different triplet sensitizers that may be used as surrogates to estimate second-order rate constants with CDOM have been studied in silico. In particular, the experimental second-order reaction rate constants measured for the photodegradation of 49 phenol derivatives and 9 CDOM proxies (1-nitronaphthalene (1-NN), riboflavin (Rb), 4-carboxybenzophenone (4CBP), and antraquinone-2-sulfonate (AQS)) have been used to derive Quantitative Structure-Activity Relationships on the basis of theoretical molecular
In this paper solubilization of persistent organic pollutants, PAHs, PCBs, pesticides and emerging pollutants, as PBDEs or PCN, was investigated in water samples, using some anionic, cationic and non-ionic surfactants. These pollutants are well known for their considerable toxicity, persistence and bioaccumulation toward both human health and environment in addition to their low aqueous solubility. However, the use of surfactants to water solution enhances solubilization of hydrophobic organic compounds. Above the critical micelle concentration (CMC), surfactants exist as aggregates in solution and hydrophobic compounds migrate to hydrophobic micellar core of the system. This technique would be a versatile and predictive method to traditional liquid-liquid extraction with hexane. The physical and chemical properties as size, shape, ionic strength and hydrophobicity are important to identify the appropriate surfactant depending on the type of compound to be removed. The method consists in two steps: a) removal of analytes from aqueous solution by the micelles; b) removal of the organic solvent followed by micellar deformation with addition of NaCl. Both steps are effective, easy and with high recovery of pollutants. Furthermore, the samples are already in the solvent for quantitative analysis. The removal of analytes from aqueous solution was verified by comparing UV-Vi 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 non-ionic surfactants and their micellar size. Yet another important aspect is the choice of phenols is motivated by the fact that they are the most likely compounds to undergo triplet sensitisised phototransformation in sunlight. 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 sensitisers. 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 sensitisers, and to predict the photodegradation of new and existing substituted phenols and similar compounds on the basis of their chemical structure.

In silico Tools to Assess the Confidence of QSAR Model Predictions

In this presentation an overview of these regulatory challenges is provided with an intermediate recommendations to address water treatment processes for active substance approval.

The identification of persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic (PBT) and very persistent very mobile (vPvB) chemicals. In order to identify and assess the potential of the substance, if released to the environment, to transport to pristine water bodies and raw water used for drinking water owing to their ability to concentrate in marine organisms such as birds, fish, shellfish, and mammals.

In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidelines documents for non-regulated substances, data-gaps have recently been identified by EPCs 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 this respect, specific conclusions of active substances submitted under the 3rd group of the Annex I Renewal Programme (AIR3) are evaluated for different applied ways of addressing ozonation and chlorination during the registration process. A statistical overview of the results shows whether water treatment processes have been addressed successfully. An overview of these regulatory challenges is provided with intermediate recommendations to address water treatment processes for active substance approval.

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The identification of persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic (PBT) and very persistent very mobile (vPvB) chemicals. In order to identify and assess the potential of the substance, if released to the environment, to transport to pristine water bodies and raw water used for drinking water owing to their ability to concentrate in marine organisms such as birds, fish, shellfish, and mammals.

In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidelines documents for non-regulated substances, data-gaps have recently been identified by EPCs 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 this respect, specific conclusions of active substances submitted under the 3rd group of the Annex I Renewal Programme (AIR3) are evaluated for different applied ways of addressing ozonation and chlorination during the registration process. A statistical overview of the results shows whether water treatment processes have been addressed successfully. An overview of these regulatory challenges is provided with intermediate recommendations to address water treatment processes for active substance approval.
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 shown that it has established the relevant criterion. The substances on the candidate list is the most effective and management strategy. With the protection of drinking and waste 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. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE072
How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

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UGA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PMT). The purpose of the visionary work is to quickly identify substances and for ground water used as drinking water (human health concern). QSAR screenings using the free online Danish QSAR DB were performed on 2,372 mono-constituent organic substances. For persistence (P) algorithms as used for the persistence 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 (M) and very mobile (vM) 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 equating 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 UBA and the developed QSAR algorithms were able to identify substances in EFSA and other management tools. 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 add 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

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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 great number of chemicals in commerce, relatively few chemicals receive much 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. The list of those 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 many unique and critical properties on high-end performance garments, workwear, roadside, and clothing. Within the non-polymeric PFAS category, fluorotelomer-based surf-active agents (e.g., “fluorosurfactants”) are used in complex multi-component formulations such as Cleaning Products, Paints, Coatings and Aqueous Film Forming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and are generally classified at a high persistence and mobility class B (i.e., hydrocarbon & polar solvent liquids) fires. The remarkable strength of the C-F bond provides products with superior resistance to extreme thermal, chemical and environmental conditions. While this unique stability makes these products ideal in many end-use applications, as well as in protecting people, equipment and property, it also makes them resistant to degradation and persistent in the environment. Each of these and other fluorotelomer-based pollution of surface, ground- 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 fluorochromal 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 project was initiated to constitute a national action in the PFAS field, 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 whih will end in 2020. LIFE Phoenix project aims to show how a new integrative PFAS pollution management system, supported through innovative forecast tools based on ongoing monitoring, can manage risks related to the diffusion of persistent mobile organic contaminants (PMOC) such as short chain PFAS. This project will develop a set of institutional procedures and tools to assess and possibly prevent as well as respond to risks for environment and human health with the contribution of multidisciplinary specialists who will develop tools, protocols, guidelines and indications to assist policy-makers in taking decisions and implementing effective prevention measures for environment, human health and the socio-economic context. All project activities will focus on a real scale case constituted by the PFAS pollution in the provinces of Vicenza, Verona and Padova (an area of 930 km²), and involve national authorities managing risks and emergency. The project will validate and compare some innovative technological tools for the mitigation of PFAS concentration in the water through a pilot plant adopting different techniques for the purification of irrigation water and drinking water, using full-scale plant (wetland system) and physico-chemical plans breakdown system (filters). The technologies applied to these experimental sites will be incorporated into an integrated management system that will serve as a model for managing analogous chemical pollution events from persistent and soluble polar substances.
Wastewater effluents: How research can improve risk assessment and regulation (P)

WE079

Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study

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Aquatic pollution resulting from industrial activities, especially textile, leather, food and agrochemicals, is a major concern. Dyeing process of fabrics produces approximately 90% of the total textile wastewater, containing very low concentrations of residual dyes. Colored wastewaters reduce light penetration in the water column, and affect photosynthesis of phytoplanktons. In addition, azo dyes are synthesized from carcinogenic compounds, such as benzidine; this can threaten the aquatic biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct Blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia).

The microalgae was exposed to 4, 8, 16, 32 and 64 mg L⁻¹ DB15 (96 h, 25°C, and continuous illumination of 120 μmols m⁻²s⁻¹); the effects of DB15 on photosynthetic pigment and macromolecules content, proteins, carbohydrates and lipids were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations included 100, 200, 300, 400 and 500 mg L⁻¹, at 25°C, 16.8 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L⁻¹ DB15 (7 days at 25°C, 16.8 h photoperiod, 1x10⁵ cell mL⁻¹ of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (IC₅₀: 13.0 mg L⁻¹) than C. dubia (LC₅₀: 450 mg L⁻¹). Chlorophyll a and b were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations.

Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all DB15 concentrations were significantly higher than that measured in the control. In the highest DB15 concentrations, total progeny, number of released clutches, and reproduction were significantly decreased in C. regaudii; but age at first reproduction was significantly increased at 20 and 25 mg L⁻¹ DB15. Results demonstrated that DB15 dye caused toxic effects of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into waterbodies.

WE080

Integrated biomarker response calculation as a useful tool to assess the impact of effluents on the health status of fish

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Integrated biomarker response calculation as a useful tool to assess the impact of effluents on the health status of fish

Wastewater treatment plants (WWTPs) are considered as one of the major sources of micropollutants in the aquatic environment. Many compounds have been linked to toxic and endocrine effects in aquatic organisms. The present study examines the impact of three WWTPs situated on different streams in Southern Germany on the health status of fish. Two WWTPs were located facilities treating municipal sewage and the other WWTP treating industrial effluents. We assessed health status of fish from the downstream biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct Blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia).

The microalgae was exposed to 4, 8, 16, 32 and 64 mg L⁻¹ DB15 (96 h, 25°C, and continuous illumination of 120 μmols m⁻²s⁻¹); the effects of DB15 on photosynthetic pigment and macromolecules content, proteins, carbohydrates and lipids were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations included 100, 200, 300, 400 and 500 mg L⁻¹, at 25°C, 16.8 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L⁻¹ DB15 (7 days at 25°C, 16.8 h photoperiod, 1x10⁵ cell mL⁻¹ of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (IC₅₀: 13.0 mg L⁻¹) than C. dubia (LC₅₀: 450 mg L⁻¹). Chlorophyll a and b were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations.

Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all DB15 concentrations were significantly higher than that measured in the control. In the highest DB15 concentrations, total progeny, number of released clutches, and reproduction were significantly decreased in C. regaudii; but age at first reproduction was significantly increased at 20 and 25 mg L⁻¹ DB15. Results demonstrated that DB15 dye caused toxic effects of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into waterbodies.
In industrial sectors, water is used in large amount in production cycles. In the field of Medical Devices (MDs) production, for example, water is used, both as an ingredient and as a necessary element for production. The re-use and the recycle of the wastewater represents a priority area in the strategic plan of the European Commission for a sustainable water management and also considering the scarcity of water resources caused by the climate changes. The aim of this study is to assess the impact of treated wastewater quality discharged from Medical Device and pharmaceutical industries, by identifying a suitable set of tools in order to support the potential re-use of treated wastewater, taking into account both microbiological and eco-genotoxicological parameters. The study was carried out on three MDs industries in Italy, which perform the recycle of the wastewater in their own system processes. Samples were collected inlet and outlet of wastewater treatment plants. The microbiological parameters –P. nitrospira, Bacterial Total Count (BTC), E. coli, Enterococci, Staphylococcus sp., Pseudomonas sp. A set of ecotoxicological bioassays was selected for this study, namely the bacterium Vibrio fischeri, the algae Selenastrum capricornutum, the crustacean Daphnia magna, the fish Danio rerio (Fish Embryo Toxicity Test) and the plant Sorgum saccharatum, in order to represent different trophic levels and thus to assess any potential effects of effluents on diverse trophic levels. Some of the investigated microorganisms were exposed to subinhibitory concentrations of CR were more affected by higher concentrations of mg L⁻¹. We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 hours light/dark 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 ozonation. 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 foamed with organic and a non-organic foam layer. A second ozonation treatment group exhibited a two-fold increase in treated water samples of all microbiological parameters and the absence of E. coli. The ecotoxicological assays highlight a significant toxicity of the wastewater before the treatment while an evident decrease has been recorded after it. Sublethal effects for Danio rerio embryos and genotoxic effects for Vicia faba’s micronucleus frequencies have been reported. Even though not yet conclusive, this approach can be considered a useful and promising tool in the reuse management of industrial wastewater and an initial support to the policy in this field.
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. A promising tool to reduce 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 of heavy rain event. Additionally, a sewage sludge sample was tested, 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 antiandrogenic 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.

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 wide-spread occurrence of active pharmaceutical ingredients (APIs) in African wastewater. 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 Basin (WNA) in Kenya is an example of such impacted areas. The wastewater generated from the city’s informal settlements and the insufficient WWTT 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 discharges from pharmaceutical factories also contributes to the occurrence of APIs. Hitherto, the published investigations provided evidence of APIs occurrence at concerning concentrations, but little is known about the processes underlying the E-fate of such contaminants. Processes such as distribution to suspended solids, colloids and dissolved organic matter, the quality of these sorbents, and the ability of the biodegrading bacteriological community to adapt to and degrade a contaminant are key in determining its E-fate. The impact zone generated by sewage 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 individuation 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 antiretroviral nevirapine, commonly used in Africa, has showed persistency (similarly to studies on the antiepileptic carbazepine 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 obtained findings 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.

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, CSOs occur ~1–2 times per week as its Victorian sewer network struggles to cope. Herein, a temporal study of the River Thames is presented to identify CSO-related occurrence of pharmaceuticals, including metabolites and transformation products. Daily samples of river water, influent and effluent wastewater were analysed using a validated method involving solid phase extraction (SPE) and liquid chromatography and high resolution accurate mass spectrometry (LC-HRMS). The work was divided into four parts: (a) the identification of CSO markers based on the occurrence, fate and bioactivity of pharmaceuticals; (b) confirmation of the determination of 30 pharmaceutical/metabolite occurrences in influent and effluent wastewater; (c) determination of CSO markers in receiving river water over a six-week period; (c) suspect screening to identify metabolites/transformation products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent, a CSO marker was identified including caffeine, bezafibrate, 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 outfall. It was evident that CSO markers were persistent, with the potential 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 were combined using unsupervised clustering to gain a deep 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

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 (WWTPs) is limited. Our research showed that of the 18 compounds investigated only imidacloprid, was not detected at the three WWTPs included in the study, confirming that municipal wastewater discharges contribute to the presence of pesticides in the aquatic environment. Using a suite of bioassays (high-throughput bioluminescence assay using the target species Vibrio fischeri, yeast estrogenic screen (YES) and yeast androgenic screen (YSAS)) the bioavailability of APIs was assessed 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 biodegradability 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 physiochemical 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 was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality
WE090

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 (NAdDW) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final 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 be reduced by UV light. This is a product related difference in the degradation potential of TiO\textsubscript{2} for the selected PPPs was observed. However, for a final statement whether TiO\textsubscript{2} 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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One of the options for energy generation through the degradation of industrial and domestic effluents using electroactive microorganisms, these systems coupled to build wetlands (BES/WC) acquire the capacity to treatment effluents of various kinds. Although several studies have been developed to evaluate the efficiency of these systems for chemical oxygen demand (COD) removal and energy generation. To this aim, it was implemented two plastic containers with a volume of 20 L and an operating volume of 0.96 L, packed with river gravel and planted with phragmites sp., carbon felt was used for the construction of anode and cathode, both with a surface of 0.72 cm\textsuperscript{2}. The distance between both electrodes was 6 cm without proton exchange membrane, both electrodes were connected by a resistance of 1000 Ohms. The feeding was performed by gravity applying four pulses of 1.5 L/h, using synthetic water whose composition was similar to data reported by Yadav et al., (2012). The effect of two types of contaminants was evaluated azo dye (AD) and alkylphenols (AP), the voltage measurements were made daily after 20 days of operation, the time necessary for the development of the biofilm (from 9:00 h in intervals of 2h). The
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mAm\(^{-2}\) and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13:00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a sustainable option for the utilization of energy from domestic wastes from secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto A Sawdust-Based Adsorbent

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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 medium. The removal of crystal violet from aqueous solution by sulphuric acid treated sawdust has been of interest. The presence 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 results were compared with predicted values, and the model developed was highly significant, with correlation coefficient of 0.985. The adsorption in all the dye systems investigated followed Freundlich isotherm, and the maximum monolayer adsorption capacity was between 18.87 - 24.39 mg/g, depending on the composition of the adsorbate matrix. The adsorption kinetics was well described by the pseudo-second order model (R\(^2\) > 0.95). All the eight adsorbate systems investigated were endothermic (\(^\Delta H\) positive; 35.30 to 43.66 KJ mol\(^{-1}\)), thermodynamically feasible (\(\Delta G\) < -2.30 to -6.13 KJ mol\(^{-1}\)) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

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Diurnal patterns of metal concentrations from influent and effluent wastewater were determined using multielement analysis (ICP-AES) and ICP-MS analysis for a number of elements such as As, Cr, Cu, Ni, Pb, Cd and Zn. Diurnal patterns of metal concentrations are important for understanding the potential effects of these metals on aquatic ecosystems. The study aimed to determine the diurnal patterns of metal concentrations in two wastewater treatment plants (WWTPs) in Norway, one with primary treatment (WWTP A) and the other with secondary treatment (WWTP B). The results showed that diurnal patterns of metal concentrations were highly variable, and the concentrations of metals such as As, Cr, Cu, Ni, Pb, Cd and Zn were highest during the day and lowest during the night. The study also showed that diurnal patterns of metal concentrations were influenced by both primary and secondary treatment processes. The study concluded that diurnal patterns of metal concentrations in wastewater are important for understanding the potential effects of these metals on aquatic ecosystems and for developing effective strategies for wastewater management.

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 Philipsburg’s wastewater treatment plants 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 efficiency of the wastewater treatment plants in removing pathogens from its effluent. Further identification and presence of absence of invertebrates in the sampled riparian zone will determine if effluent has any impacts on invertebrate diversity.

WE097 The DemO3AC-project: Chemical and ecotoxicological investigations of the wastewater treatment plant Aachen

S. Schüey, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; Y. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shumakivich, Institute for Environmental Research (RWTH); D. Pfeiffer, Institute for Environmental Research; D. König, Institute for Environmental Research; K. Schärer, RWTH Aachen University / Institute for Environmental Research; H. Hollett, RWTH Aachen University / Institute for Environmental Research;

Micropollutants (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 adverse effects 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 river. These samples were taken as both native samples and extracts. To include various adverse effects a broad test battery was conducted (acute, chronic, mechanism-specific, in vivo and in situ) along with chemical analysis. The analysis of 60 MPs showed mainly the presence of pharmaceuticals and plasticisers/phthalates. In total 52 substances could be detected. A general elimination rate of about 55 % was determined. The toxic potential was high in the WWTP inlet for D. magna, D. subspicatus and D. rerio. A. fisheri showed no effect. However, the toxicity was already markedly reduced at the outlet of secondary clarifiers within the WWTP. No acute and chronic toxicity was detected in any of the Wurm samples. Similar results were obtained in in situ feeding experiments with G. pulex. No significant differences in feeding rate between the sampling sites were recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the matogenic and endocrine effects originates by discharge of MPs into the WWTP Soers. The second part of this project will contain comparative studies investigating the situation after the implementation of the full-scale ozonation. This project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia.

WE098 To use or not to use: sewage overflow dredgings

M.H. Waelman, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system,
several species with different trophic levels growing together, where each species has its own economical value. Macroalgae can be used in such systems, usually at the exit point of the ponds, acting as biofilters and reducing the nutrient loading released to the environment. Contaminants such as antibiotics used in aquaculture can bioaccumulate in these organisms, passing to higher trophic levels. More recently, with the inclusion of macroalgae in human diets not only in Asia but also in other regions, we can ultimately ingest high levels of these contaminants, which are not eliminated the same way as other fish products. Exposure tests were performed with the macroalgae Ulva lactuca in order to evaluate the effects of Enrofloxacin in growth. Antibiotic concentrations were measured in seawater and macroalgae discs at several sampling points, after immersion in an Enrofloxacin bath at two different concentrations. These results can help comprehend how IMTAs respond in order to prevent contamination with antibiotics. As biofilters, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application
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Production animal farms are proposed to act as reservoirs where genetic material from resistant bacteria might transfer to human- or animal-associated bacteria including zoonotic pathogens. In the present study we followed two swine and two dairy farms and quantified ARGs and MGEs with 363 primer pairs using a high-throughput qPCR array. Samples were taken from fresh manure, stored manure, unfertilized soil, soil fertilized with manure, and tile drainage water from ditch, which was sampled before and after land application. We aimed to answer the following questions: do ARGs disseminate to the environment (field soil and surface waters), are ARGs enriched in stored manure, and are ARG abundances elevated in soils at crop harvesting time. For evaluating the ARG mobility potential, genes related to MGEs were also quantified. DNA was isolated from the soil and manure samples with the PowerSoil DNA Isolation Kit (MO BIO Laboratories). Quantitative PCR reactions were conducted using TaqMan GeneChip Real-time PCR system. The ΔCt values, ΔΔCt values, relative gene abundances (R), and fold changes (FC) were calculated with R version 3.2.3 and RStudio Version 0.98. In total 182 out of 363 ARG and MGE qPCR assays were positive in one or more samples. Out of the positive assays, 161 targeted ARGs and 21 MGEs. Fresh manure had the highest diversity of ARGs and MGEs with 130 positive assays, followed by stored manure and manured soils. The number of positive assays decreased in fertilized soil between the 2 and the 6 week sampling points. Only 29 assays were positive in unfertilized soil samples. Manure had the highest relative abundances of ARGs, and these manure-associated ARGs were not detected in unfertilized soil or ditch water sampled before fertilization. Likewise, ARGs abundant in unfertilized soil or in ditch water were not abundant or even detected in manure. 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 clearly decreased from fertilized soil to fertilized 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 sulfonamide 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 (μg L⁻¹ to low μg L⁻¹), they have been specifically designed to be biologically active at low concentrations in human tissue therefore it is reasonable to expect 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 concentrations has been widely proven. Ciprofloxacin (CIP) and flumequine (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 y 100 μg/L each) during 21 days with the aim of studying toxicological responses along with the time for recovery. The results allow us to establish post-exposure depuration. Bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPx activities and LPO levels), detoxification (GST activity) and neurotoxicity (AchE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

WE103
Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies
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In recent decades, pharmaceuticals in the environment have been concerns for environmental safety. Especially, the residual antibiotics in the environment could lead to adverse effects on non-target organisms, contamination of food and drinking water supplies, and increased antimicrobial resistance (AMR). Since 2000s, in Korea, the policies for reducing antibiotics usage, such as Separation of Dispensing and Prescribing of Drug, or Restriction of Adding Antibiotics in Animal Feed, have been enforced in view of public health management. The Korea government has been strengthening the writing policies about the reducing antibiotics usage 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 20s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, 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 Hat, Dong Soo Lee, Application of emission estimation model to the environmental risk assessment of the pharmaceuticals commonly used for human and veterinary purposes, Annual Meeting of Society of Environmental Toxicology and Chemistry, Brussels, Belgium, 2017

WE104
Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics
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Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects upon microorganism communities and to human health through antimicrobial resistance. They are designed to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (ASRIT; proven not to be sensitive for antibiotics) are used to represent all bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established.

Direct and indirect effects of antibiotics in the leaf-shredding macronvertebrate Gammarus fossarum
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Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macronvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., via altered microbial community 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 24 h exposure or to a 48 h exposure to a constant waterborne CIP exposure. The two latter experiments revealed that leaves that were microbially colonized in the presence of CIP, or a combination of 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 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’ food 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 aminglycoside 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 offlux 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
S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences
353
SETAC Europe 28th Annual Meeting Abstract Book
University of Coimbra; A. Freitas, A. Vila-Pousca, INIAV- Instituto Nacional de Investigación Agrícola y Veterinaria; J. Rosa, CFE Centre for Functional Ecology / Department of Life Sciences University of Coimbra; J. Barbosa, INIAV- Instituto Nacional de Investigación Agrícola y Veterinaria; F. Ramos, Faculty of Pharmacy University of Coimbra; P. Reis-Santos, L.A. Duarte, M.P. Pais, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE - Marine and Environmental Sciences Centre;

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 on the Atlantic coast of Portugal was established as a case study 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 antidepressant drugs, hormones and veterinary drugs. The results showed that Tetracycline (Z=0.198, p=0.897) and Ciprofloxacin (Z=1.568, p=0.118) in concentrations up to 18.6 μg L⁻¹ for oxytetracycline suggesting a high 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, among other matrices, minerals and organic matter. In the perspective of this research, the 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 (EMEP/CCE/CPMP/VWP/1173/05). 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 indicates that the estimated PECsoil 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 effective contribution of CIPR in the contamination of water bodies 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.

How do marine and freshwater cyanobacteria react to long term exposure of antibiotics? Is there a potential for increasing antibiotic resistance in the environment?

J.H. Heseding, C. Fioeter, Hamburg University of Applied Sciences / Environmental Engineering

An increasing amount of pharmaceuticals are detected in water bodies all over the world. Antibiotics are of special concern for the environment: Due to the high amount of medication, its specific activity against prokaryotes and a possible antibiotic resistance formation in the environment, the long-term effects will have to be taken into consideration. Cyanobacteria have prokaryotic target structures of antibiotics and are of high importance for the primary production and nitrogen cycle in marine waters. To investigate the long term effects of antibiotic exposure on limnic and marine cyanobacteria, the limnic cyanobacterial test according to OECD 201 and the marine cyanobacteria test describing by Heseding and Floeter in 2016 were employed. Exposed cultures were recultured at the end of the test and then reexposed to the same antibiotic active substance as part of a repeated test. As test organisms Synechococcus leopoliensis (limnic cyanobacteria) and Synechocystis sp. (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.

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. The investigation included three antibiotic scenarios (1) exposure to the bacteriostatic agent Tetracycline, (2) exposure to a mixture of Sulfamethoxazole and Trimethoprim bacteriostatic agents that are commonly prescribed together and (3) exposure to the bactericidal agent and broad-spectrum antibiotic Ciprofloxacin. 24 h feeding assays were performed using Alnus glutinosa leaf discs of 1.3 cm Ø 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 mg/L, 20 mg/L and 2 mg/L). The leaf discs were photographed at the start and finish of the investigation and these images underwent analysis with Image J software in order to calculate the area consumed. After 24 h, the 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,
Impact on the microbial communities of WE114 sites. Fluconazole levels ranged from associated with polluted waters. Some isolates in the present study are pathogenic krusei, C. tropicalis were analysed with liquid chromatography coupled to a quadrupole time selective media and incubation at 37°C and identified using biochemical methods. 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, aquaculture bacteria. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, su1 and su2), 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 is practically mobile丁DSW 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 inhabited environments J. Mauzer, University of Helsinki / Food and Environmental Sciences; K. Parnainen, J. Hultman, W. Muziarski, University of Helsinki; R.D. Stedfeld, J.F. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; M. Virta, University of Helsinki

The persistence 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, aquaculture bacteria. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, su1 and su2), 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 is practically mobile丁DSW 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.


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 marker for antibiotic resistance (the intI1 integron) 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 intI1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

WE113 Pollution in the Moos River: Fluconazole and fluconazole resistant pathogenic yeasts species M.E. Monapathi, North West University (Potchefstroom Campus) / Microbiology

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 Moos 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 isolates were sequenced. The genetic environment of the gene (e.g. presence in mobile DNA element). We have used the combination of different methods for obtaining that information: Parallel quantitative PCR array for high throughput quantification (1), epicPCR(2) for host information and Inverse-PCR(3) for analysis of the genetic environment. Inverse-P CR and epicPCR combined with DNA sequencing resolve also the sequence of the resistance gene. Samples were collected from different locations in Finland: manure from cattle and pig farms, soil that received the manure as fertilizer, sediments from aquaculture farms and effluent, influent and activated sludge from waste water treatment plant. Our results demonstrate that human activities results to the increase to the abundance of antibiotic resistance genes species. In many cases the genes are located in mobile genetic elements with increases the probability of transfer of the them between bacterial species. The host range information obtained by epicPCR revealed wide diversity on the host range of the antibiotic resistance genes in different environments. Our results can be used for the development ecotoxicological risk analysis for antibiotic resistance. (1) Karkman, A., Johnson, T.A., Lyra, C., Stedfeld, R.D., Tamminen, M., Tiedje, J.M. and Virta, M. (2016) FEMS Microbial Ecology 92 (3): ftw014 (2) Spencer, J.S., Tamminen, M., Stedfeld, R.D., lyra, C., Börjesson, L., Vigneault, F., Virta, MP. and Alm, EJ. (2016) ISME Journal 10:427-436 (3) Parnainen, K., Karkman, A., Tamminen, M., Lyra, C., Paulin, L., Hultman J and Virta, M. (2016) Scientific Reports 6: 35790

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 J.M. MARTINS, CNRS IGE UMR 5001, Univ. Grenoble / OSUG-IGE; E. François, L. Spadini, J. Granat, C. Humbert, E. Vince, M. Morel, Institut Geosciences & Environnement

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 Feucherolles (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 more significant in the OM-amended soils suggesting the influence on 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 silty 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, su1 and su2), 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 is practically mobile丁DSW 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.

EU1 Risk assessment of antibiotic resistance and related genes in Human inhabited environments J. Mauzer, University of Helsinki / Food and Environmental Sciences; K. Parnainen, J. Hultman, W. Muziarski, University of Helsinki; R.D. Stedfeld, J.F. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; M. Virta, University of Helsinki
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is 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 showed that environmental matrices vary in their susceptibility and enrichment of antibiotic resistance genes (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
C. Levantesi, M. Luprano, National Research Council of Italy / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute

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 (WWTPs). Most WWTPs 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 selection in the environmental matrices. Furthermore, SMX 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 sulfonamide 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 μg/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 I 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 (±0 days), but at the end of was significantly higher in treated microcosms than in control conditions. The abundance of sul I 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 B. Aubakirova, L. N. Gumilyov Eurasian National University / Management and chemical; F. Gigliotti, CRO BioTecnologie BT; I. Olivotto, Università degli Studi di Padova; A. Fifi, Biotecnologie B.T. Srl / Ecotoxicological

The study on Lemna minor was conducted according to the OECD Guidelines for the testing of chemicals 221. Lemna minor species were cultured in Swedish Standard (SIS) growth medium and effects of the antibiotics on growth assessed over 7 days. The results of the study showed EC50 values of each test compounds ranged from 2.8 to 21.8 mg/L. Lemna minor was most sensitive to the sulfamethoxazole, with its EC50 being below 10 mg/L. The test on algae was performed according to the OECD Guidelines for the testing of chemicals 201. Chlorella sp. were cultured in Tamiya medium and algae numbers were counted in Goryaev chamber under a microscope. The macroide substances azithromycin and clarithromycin were found to be the most toxic compounds to the algae with EC50 values being lower than 1 mg/L. In the future, it is recommended to perform assessments on the sensitivity of other less well studied aquatic species to priority AMR. AMR in Kazakhstan as well as monitoring studies to establish levels of exposure in the country. This will then provide a basis for the risk of these substances to be established.

WE119 The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams of North Carolina
A.D. Gray, University of North Carolina at Greensboro / Biology; D. T. Hoch, University of North Carolina at Greensboro / Chemistry; A.E. Hershey, University of North Carolina at Greensboro / Department of Biology

Antibiotic pollution is of concern to environmental health sciences due to the implications associated with their presence in the environment. There is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries. Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate antibiotic pollution as compared to larger systems. The present study demonstrates that antibiotics can 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 discharge from facilities that release effluent directly 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 veterinarian antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfamerazine, trimethoprim, danofoxacin, sulfaquizoxaline, streptomycin, enrofoxacin, and tylosin, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams are key sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influences the presence of antibiotics in streams in urban and rural areas.

WE120 The Role of Water Quality Analysis: Understanding our process environment to inform on AMR.
T.P. Dodsworth, The University of Nottingham / Biosciences; R. Helliswel, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering

Specifically, how WQA can contribute additional understanding with regards to antibiotic pollution in stream ecosystems. Following administration, antibiotics are only partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (WWTPs). Most WWTPs 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 selection in the environmental matrices. Furthermore, SMX 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 sulfonamide 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 μg/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 I 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 (±0 days), but at the end of was significantly higher in treated microcosms than in control conditions. The abundance of sul I increased after addition of SMX, suggesting that ARG spread is a physiological adaptation of natural microbial community to its presence.

WE121 Safety and efficiency assessment of antibiotic administration by magnetic nanoparticles in Zebrafish
WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES.

J. R. Diniz, Universidade Estadual do Maranhão / Agroecology; L. Capellini, Universidade Federal de São Paulo UNIFESP / Departamento de Química

Fullerene are allotropes of carbon produced in highly energetic processes of hydrogen or nitrogen and are found in the atmosphere, soils, sediments, and fresh water. Despite this, little information has been related to marine environments where 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.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries

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The discharge of per- and polyfluoroalkyl substances (PFASs) into the environment via wastewater is a pressing public health issue. Apart from the frequently detected PFASs, such as PFOS and PFOA, more and more novel PFASs have been reported recently. We used the target screening method to identify novel and legacy PFASs in the Nordic environment. The aim of this project is to determine as many PFASs and total organic fluorine as possible in wastewater effluents from the Nordic countries and self-governing areas, including Finland, Sweden, Norway, Denmark, Faroe Islands, Iceland and Greenland. Field collected effluent (250 mL) were extracted by solid phase extraction (SPE). Identification and quantification of target compounds was performed using liquid chromatography tandem mass spectrometry (LC-ESI-MS/MS). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE127 Quantitative evaluation of lag effect in pollutant organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylene (PTFE) membranes

Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Meyer, E. Fünfrocken, H. Beck, Saarland University, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics.

Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring 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 organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB® sorbent embedded between two polyether sulfone (PES) membranes and has been widely used for the detection of hydrophobic 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

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

R. Vitalo, Environmental Standards; L. Dupes, A. Reed, Environmental Standards Inc; M. Mc Anulty, BP Exploration.

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. Blank contamination, especially during development of 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 of equipment rinse blanks. This presentation will provide details of the investigation process and the implementation of several important corrective actions.

WE123 Comprehensive Analysis of Elemental Contamination in Environmental Samples Using Liquidsolid Partitioning Liquid Chromatography-Mass Spectrometry (LC-MS/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. Particular challenges 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 quadruple 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 or isotope ratio analysis, will be presented to show the breadth of accessible applications using modern ICP-MS instrumentation.
Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of four non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SA), four tetracyclines (TCs), four macrolides (MCs), and one quinolone (QN) were detected in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APs were prominent, with mean concentrations of 4.90–266.24 ng/L in surface water and 5.07–14.73 µg/kg in sediment samples. Four MCs were prominent, with mean concentrations of 0.97–29.92 ng/L in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > MCs (25.39%) > SAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > MCs (25.43%) > QNs (14.69%) > SAs (13.90%) > QNs (3.24%) in sediment samples, and MCs (42.12%) > N-APs (34.80%) > SAs (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharged from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

**WE131** Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea

J. Lee, Y. Lee, J. Lee, Seoul National University; S. Kim, Eulji University; M. Kim, Seoul National University / Department of Health Science; Y. Kho, Eulji University; K. Zoh, Seoul National University / Department of Environmental Health

Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n = 2), fresh water (n = 24), sediment (n = 24), soil (n = 24) and freshwater fish (n = 27) samples were collected in Asan lake region, and the levels of PFCs in samples were determined. The results showed 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)

M. Celic, M. Gros, Catalan Institute for Water Research ICRA; M. Farre, IDAEA CSIC Barcelona; D. Barceló, M. Petrovic, Catalan Institute for Water Research ICRA

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 solid phase extraction (SPE) and liquid chromatography–tandem mass spectrometry using a hybrid triple quadrupole–linear ion trap instrument (UPLC–MS/MS). In order to assess seasonal variations, distribution and fate of pharmaceuticals, we designed three sampling campaigns in 2016 were performed, covering autumn, winter and spring-summer. Fifty seven and thirty one 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 antiabetic (glibenclamide) and the diuretic (furosemide). Salicylic acid was the most ubiquitous quantified compound in sediments, with a maximum concentration of 18.2 g g⁻¹. 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

h. Zhou, P. Zhang, China Institute of Water Resources and Hydropower Research IIHR, K. li, China Institute of Water Resources and Hydropower Research

Seasonal changes in water and sediments' microplastics in a Mexican estuary (Tecolutla).

L. Fischer Hernández, P. Ramírez Romo, U.A.M. Iztapalapa / Hidrobiologia, Microplastics (MP) are persistent contaminants that measure less than 5 mm, they have additives that are vectors of other POPs and metals, which can cause deleterious effects to the organisms that ingest them. MP can increase the temperature and decrease the sediments permeability. On the other hand, plastic fibers can increase the deleterious effects to the organisms that ingest them. MP can increase the temperature and decrease the sediments permeability. On the other hand, plastic fibers can increase the deleterious effects to the organisms that ingest them. MP can increase the temperature and decrease the sediments permeability. On the other hand, plastic fibers can increase the deleterious effects to the organisms that ingest them.
understand the biological significance of their presence.

**WE133**

Simultaneous biodegradation of water treatment additives: Transformation byproduct formation, impact of biode using shock dosing and salinity

T. Wagner, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / BID-ELD; A. Langenhoff, H. Rijnsdorp, Wageningen University / Environmental Technology; P. de Voogt, University of Amsterdam / IBED

Securing the supply of fresh water to fulfill the demand of the rising world population is identified as one of the largest environmental challenges in the near future. The Water Nexus research program aims at developing integral solutions for problems with water scarcity in delta areas worldwide. A significant fraction of industrial fresh water is treated in constructed wetlands. Several treatment technologies such as reverse osmosis, electrodisal dissociation 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 the use of constructed wetlands. This study is focused on 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 consist of 1H-benzotriazole (corrosion inhibitor), DBNP (biocide), glutaraldehyde (biocide), PEG (surfacant) 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 trace the occurrence of the CW treatment systems? Do the 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. Faltermeier, Eberhard Karls Universität Tübingen / Center of Applied Geoscience; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geography, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zarfl, University of Tübingen / Center for Applied Geoscience

Knowledge on pollutant transformation from laboratory experiments often fails to describe observations in the field. Thus, the CRC-CAMPOS aims to describe the fate and metabolism of anthropogenic pollutants on the landscape scale in different compartments in the Ammer catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunner River close to Tübingen (Germany) in the southwest of Germany, which is mainly influenced by agriculture. Salt tracer tests are combined with measurements of conservative ions and chemical tags to reveal the processes occurring in the Schönbrunner River. Salt tracer tests and provide information about hydrological loss and gain for the Schönbrunner River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or biochemical processes in biofilms from target screening data, mainly on pesticides. With the collected information from different disciplines, we get a larger picture about the pollutant mass transport in the Schönbrunner River and adjoining compartments.

**WE135**

Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria

O.M. Ogunbawo, 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 Environments; M. Andrés Costa, University of York / Environment Department; 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, 31.612 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 than other pharmaceuticals. The results obtained are much higher than published data from around the world, these values underline 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 occurrence of these compounds. The sampling locations were analyzed and seasonal usage or discharge. 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, CIDÉ (UV, GV, CSIC); M. Andrés Costa, Universitat de Valencia / Environmental and Food Safety Research Group; R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive

The L’Albufera Natural Park is a wetland of World Heritage, the largest natural and semi natural wetland in the Mediterranean area of Europe. It covers an area of 21,210 ha and is located in the province of Valencia, in the eastern Spain. This area is one of the most important wetlands in Europe for migratory birds and in a very high risk of loss. In this study, the presence of several emerging contaminants in sewage sludge and assessment of their environmental risk for the Albufera National Park, Valencia, Spain.

Presence of emerging contaminants in sewage sludge and assessment of their environmental risk for the Albufera National Park, Valencia, Spain

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The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the deproportion 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 sludge is used in the agriculture sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples were 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 eluates 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–glycine–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 situation and dimension of the sewage sludge. However, reports on CBs in aquaculture organisms-especially the aquatic organisms in typical epidemic areas of schistosomiasis prevalence in China-are lacking. The release of CBs from the production and use of Sodium pentachlorophenate (Na-PCP) has been identified as one of the most important sources. Dongting Lake is the second largest fresh water lake of China, which is also an area with most widely distributed schistosomiasis and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongting Lake from 1960s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. The aims of this study were to investigate/incurrent contamination status, distribution of CBs in fish from Dongting Lake.

WE139 CHLORINATED BENZENES IN FISHES FROM DONGTING LAKE
Cheng Li, Institute of Water Resources and Hydropower Research; F. Zhang, China Institute of Water Resources and Hydropower Research.

Chlorobenzences (CBs) are of worldwide concern due to their persistency, toxicity, bioaccumulation, and long-range transport. Hexachlorobenzene (HCB) and pentachlorobenzene (PeCB) are listed as persistent organic pollutants (POPs) by the United Nations Environment Program (UNEP). CBs production in China accounts for 7% of the world production. The production of the typical product HCB was 7440 tons in 2003, respectively. HCB has never been used as pesticide in China, but it was still produced as an intermediate of pentachlorobenzene (1,2,4-trichlorobenzene (1,2,4-TCB) in China. 12,1,2-dichlorobenzene (1,2-DCB), 1,4-dichlorobenzene (1,4-DCB) and 1,2,4-trichlorobenzene (1,2,4-TCB) in China was 12000, 30000 and 10000 tons in 2003, respectively. PCB has never been used as pesticide in China, but it was still produced as an intermediate of pentachlorophenol in Tianjin Dagu Chemical Company until 2003 with a production quantity of about 2000 tons/year. CBs have been used for the human medical and veterinary medicine. The aim of this study was to investigate the occurrence, concentration and distribution of chlorobenzences in aquatic organisms-especially the aquatic organisms in typical epidemic areas of schistosomiasis prevalence in China-

WE140 Occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia) V. Čerkvenik Plak, University of Ljubljana, Veterinary Faculty / Veterinary Faculty; I. Fonda, Fonda d.o.o.; M. Gombač, University of Ljubljana / Veterinary Faculty

From January to October 2015 in total 27 samples of Mediterranean mussels (Mytilus galloprovincialis) and 10 samples of sea water were collected along the Slovenian coast in the north Adriatic sea to be tested for the presence of bisphenol A. Samples were collected at three shellfish farms, at the open sea and also from the habitat of Koper and secondly one sediment sample from the harbour of Koper was also collected. Homogenised mussel tissue, shells, and sediment were extracted with acetonitrile and purified with the two solid phase extraction (SPE) steps, using at first hydrophobic polysytrene-divinylbenzene (PS/DVB) copolymer Chromabond HR-X and secondly molecularly imprinted polymer (MIP) AFINNIMIP® SPE Bisphenol A. After adjustment of pH of water samples to the value of 5, these were also applied onto the MIP SPE sorbent. Sample extracts were analysed by isocratic (sea water) or gradient (tissue, shells, sediment) reversed-phase HPLC using water and acetonitrile components of mobile phase, Hypersil Gold C18 (3 µm particle size) analytical column and fluorescence detection at excitation and emission wavelengths of 230 and 315 nm, respectively. Mean recovery rate values for mussel tissue, shells and sea water were 47%, 73% and 84%, respectively. Concentrations of bisphenol A in tissues of mussels from the farms (n = 20), open sea (n = 6) and a harbour (n = 1) were < 0.03 – 0.28 µg kg. w. w., < 0.03 – 0.46 µg kg. w. w. and 0.21 µg kg. w. w., respectively, while shells of mussels, from farms (n = 20), open sea (n = 6) and a harbour (n = 1) contained 0.01 – 0.3 µg kg. w. w., 0.04 – 0.27 µg kg. w. w. and 0.18 µg kg. w. w. of bisphenol A, respectively. Sea water at shellfish farms (n = 5), open sea (n = 4) and a harbour (n = 1) was contaminated with < 0.003 – 0.013 µg/l, 0.004 – 0.009 µg/l and 0.016 µg/l of bisphenol A, respectively. The observed concentrations indicate a relatively low contamination of the Slovenian coastal waters as a part of the north Adriatic sea, with bisphenol A, compared to available publications about Mediterranean mussels.

WE141 Toxicity of non-steroidal anti-inflammatory drug and the behavioural response in Juvenile Catfish N.O. Erhunmwunse, University of Benin, Benin City / Nigeria / Animal and Environmental Biology; I. Tong, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; A. Muhib, University of Benin Benin City / Department of Environmental Management and Toxicology

The increasing levels of pharmaceutical products in surface and underground water in third world countries is on the increase. We examined the toxicity of one ph星光山浪和人或产品can be carried out on the 56–64% of African 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, getting at air, rapid 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 96h median lethal concentration LC50 value of A cetaminophen was 800, 700, 594.5 and 358.80mg/L respectively.

WE142 Reproductive and maternal effects of Tamiflu metabolites in medaka (Oryzias latipes) Chiung Heng, Y. Wu, I. Meng Ian, W. Chen, Department of Biomedical Science, National Taiwan Normal University / Department of Environmental Biology, Kaohsiung Medical University, Kaohsiung

Tamiflu is the most commonly used anti-influenza drug. Human intake Tamiflu and excrete the Tamiflu metabolites into the aquatic environment. The Tamiflu metabolites might pose a potential risk to aquatic organisms. The purpose of this study was to assess the reproductive effect of medaka (Oryzias latipes) under low concentration of Tamiflu metabolites. This study carried out the 56-day long-term toxic, 14-day reproduction, and 21-day hatchability trial bioassays to observe the survival, growth, and egg production of the adult medaka, and hatchability of embryo, and larvae body length of F1 medaka under the Tamiflu metabolite exposure concentration (0, 0.3 and 90 µg/L). Results showed that the survival and growth rates of adult medaka were no significant difference between the control and exposure groups. However, the egg production and F1 hatching rate of 90 µg/L exposure group had a downward trend compared with control group, but there were no significant decrease. This study found that larvae body length of exposure groups were significantly shorter than that of control group. This study concluded that Tamiflu metabolite could have a significant impact on larva growth development.

WE143 Earthworms (Eisenia fetida) response to chronic exposure to trioclosan J. Zallańska, Vytautas Magnus University / Department of Environmental Sciences; D. Mitkelyte, Vytautas Magnus University / Department of Environmental Sciences; C. F. Poles, Technical University / Department of Environmental Management and Toxicology

Trioclosan (TCS) is a broad-spectrum and anti-fungal agent extensively used in industrial, household and personal care products. TCS widespread use has resulted in its introduction into environment and it has already been detected in surface waters, sediments, soil, living organisms and humans as well. The aim of the present study was to determine the response of Eisenia fetida earthworms to chronic trioclosan exposure. Earthworms E. fetida were exposed to 10−750 mg kg−1 of trioclosan in soil for 56 days. The impact of survival, growth and 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. Poles, Technical University
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; R. S. Ryu, International Institute of Science; R. Park, International Institute of Science

Residual organochlorine pesticides (OCP) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with potential significance to 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 and 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%, 0.04-0.08 and 0.2-0.4 µg/kg, respectively. The precision was reliable since the RSD percentage of replicate measurements in the laboratory was less than 20, which was the normal percent value. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDT, 4,4-DDD, and 4,4-DDE were detected at 1.3-444.9, 2.2-31.9, 4.5-863, 1.1-19.48, and 2.3-193.3 µg/kg, respectively. But OCPs in 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. Vermeulen, LPTC / EPOC UMR 5805; J. Guillard, Université de Bourdeaux / EPOC UMR 5805; M. Dévrier, University of Bordeaux / EPOC / LPTC UMR 5805; C. Neaux, INRA BORDEAUX; H. Budzinski, University of Bourdeaux 

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. During the process of grape production, the role in the environment is minimal. 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 and molecule retention; (3) the past and current soil uses impact the contamination levels.

WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland

E. Stuart, WCA Environment Limited; I. Wilson, G. Merrington, UK

Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical though that 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 severe deficiencies in the analysis and assessment of priority organic contaminants in a range of different organic materials that are frequently spread on land in Scotland. As a large number of organic compounds (in excess of 200) have now been identified in materials that are applied to agricultural land the first phase of this project has been to undertake a risk screening exercise. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.

Acknowledgement - The authors thank the Scottish Environmental Protection Authority (SEPA) for funding this work.

WE148 Microplastics in Agriculture Soil.

K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Aalst, Aalborg University – Civil Engineering Department – Section of Water and Environment; M. Simon, Aalborg University; F. Liu, J. Vollandt, Aalborg University / Civil Engineering Department

Microplastic is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. A well-developed spectroscopy such as microcouper 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. Monitored amounts of sludge fertilizer 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. Only three different size range of interest, two different IR techniques are applied for microplastic identification. This requires two different plastic extraction methods. Therefore, two sample protocols were developed – < 500µm and >500µm. < 500µm More than 500µm of soil was dried and sieved through a 500µm metal sieve. To remove the inorganic fraction a gravimetrical separation was used. For a sample of this size a custom made aerator-device was built. The sample was placed in an aerator with air for 1 hour. ZnCl2 (density of 1.7 g/cm3). After 2 days the valve in the top chamber was closed and ZnCl2 was drained so the top chamber could be removed. The fluid from the top chamber was filtrated over a 10 µm steel mesh. The device was refilled with ZnCl2 and the agitation sequence was repeated. To remove the organic fraction the filtered material was treated with enzymes for several days and oxidised with H2O2. The remaining particles were suspended in ethanol and a sub sample was deposited on a window and scanned by a state-of-the-art µFT-IR Imaging system (128x128 pixel Focal Plane Array (FPA) microscope detector). >500µm 10 kg of soil was wet-sieved through an 8mm, 6mm, 4mm, 2mm, 1mm and 500µm sieve. After the soil was dried it floated in a
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: Vulnerable Biological Markers for Sustainable Agroecosystems

R. Wahman, J. Grassmann, Technical University of Munich; P. Schroeder, Helmholtz Zentrum München / Microbe Plant Interactions; S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; T. Letzel, Technical University of Munich

Plants play an important role in the maintenance of life. Besides providing us with food, plants are also key agents in cleaning the environment, i.e., water or air, from compounds like diclofenac, which occur in water bodies in concentrations up to μg/L levels. The assilitised compounds are not excreted by the plants but stored in vacuoles. This project will focus on whether plants can eliminate pollutants from the environment and whether plants are capable of metabolizing the pollutants and to detoxify them.

These two points already have been partially clarified in phytoremediation research. However, a major problem related to this kind of research is not concerning the plant metabolitie pathways, although knowledge about those pathways, the involved enzymes and the resulting transformation products is essential. Thus, our major goal was to figure out whether the biological degradation pathways can be reflected by the analytical data obtained from polarity extended RPLC-HILIC-MS analysis.

There are several important research fields which give an original contribution to investigating the different biomarkers in leaf and root extracts of various plants. This study aims to contribute to this growing area of research by exploring new or modified secondary metabolites that appear after addition of pollutants. To the best of the authors knowledge, no research is available up to now that surveyed the changes in the plant metabolite pathways of constructed wetland plants (CWP).

Moreover, along with growth in CWP, due to possibly accumulated contaminants there is increasing concern about how those plants must be treated further, i.e., which points have to be considered regarding their disposal. We will provide a conceptual theoretical framework based on analysis of different plant extracts before and after exposure to different pollutants using novel RPLC-HILIC/ToF-MS technique. The plants were exposed in the laboratory to different pollutants. Initially, the prevalent diclofenac was chosen. After the plants reached their maturity, they were exposed to pollutants for a few days. To establish the concept at the beginning comparatively high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAMITIES-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

WE150 Pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge

R. Kodešová, A. Klement, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budějovice / Microbiological Research Institute and Aquaculture Research Institute; A. Cermak, Central Bohemian University in Pardubice / Institute of Hydrocenoses; A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budějovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabc, University of South Bohemia in Ceske Budějovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

This study was focused on a mobility of pharmaceuticals from sewage sludge in soils and their uptake by plants. Soil samples were taken from top horizons of seven different soil types (Stagnic Chernozem Sillic, Haplic Chernozem, Gleyic Phaeozem, Haplic Luvisol, Arenosol Euepif, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sludge were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. b) incubated under laboratory conditions. Next, a ponded in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. 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 Vignour Studies, recommends 1-2 large plants per 15 cm, three 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 277 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 registration test which can be conducted in a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. Data will be used based on the test species planted at three of the most relevant endpoints to evaluate any impact on the Vegetative Vigour Study endpoints (expressed as ER≥ 30 values) used in the risk assessment.

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. Using 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 present results from our past studies to share experiences of assessing plant health. We will discuss which endpoints are most sensitive, reliable and therefore most suitable for determining effects on each plant species. Finally we will discuss which of these measurements are most relevant to assess recovery.

WE153 Impact of plant density on the end points (ER50) determined for crop protection products in Non Target Terrestrial Plants Studies conducted to OECD 227, Vegetative Vigour

E. Paterson, A. Thompson, Dow Agrosciences; G. Merecaiii, Dow AgroSciences Italia s.r.l. / Ecometologie; K. Ralston, Dow Agrosciences Italia s.r.l. / Ecotoxicology; G. Karaiskou, Cambridge Environmental Assessments

Non Target Terrestrial Plant (NTPP) studies conducted to OECD 227 test guidelines are submitted as part of the registration process for plant protection products in Europe and the US. Current planting densities described in OECD test guideline 227 for Vegetative Vignour Studies, recommends 1-2 large plants per 15 cm, three 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 277 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 registration test which can be conducted in a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. Data will be used based on the test species planted at three of the most relevant endpoints to evaluate any impact on the Vegetative Vigour Study endpoints (expressed as ER≥ 30 values) used in the risk assessment.
Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.

V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); C. SULMON, ECOBIO; CNRS UMR 6553, Université de Rennes 1 / UMR CNRS ECOBIO; A. BIREDERRI, LEHNO/UMR CNRS 5073, Université de Rennes 1; S. MONY, ECOBIO; CNRS UMR 6553, Université de Rennes 1; S. Devia, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS, E. Billoir, Université de Lorraine, CNRS UMR 7360

Organisms are not alone in the environment. They interact with other individuals of the same or other species in different ways. Interspecific competition is an important interaction for herbaceous plants in grass strips. Such vegetated areas generally act as buffer strips against pollutant flows and are thus submitted to various chemical exposures. However, competition is rarely considered in environmental risk assessment. To address this point, we tested whether competition modifies the way plants respond to herbicide (isoproturon) toxicity in an attempt to link individual tolerance of organisms and community dynamic. Then we investigated the impact of competition on species sensitivity distribution (SSD), a widely used community-level risk assessment tool that usually considers monospecific bioassays only. To do so, we exposed during 25 days 6 herbaceous species (representing varied isoproturon tolerance and competition ability) to 6 isoproturon concentrations (0 to 1.75µM) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competition behavior). For each combination of species and concentrations, we exposed 3 replicates where, e.g. by degree exposure, 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.

How to consider recovery of aquatic plants in risk assessments?

U. Hommen, Fraunhofer IME; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; H. Knueger, EAG Laboratories

Exposure of non-target plants to plant protection products or other stressors can be restricted in time. For each chemical, it is not easy to determine, e.g. by degree exposure or transport. In such cases, the plants might recover if the effects are reversible. Neglecting the recovery potential in the risk assessment is definitely protective but might be over-restrictive resulting in for example unnecessary losses of crop yields. The recovery subgroup of the SETAC Plants Interest Group aims to review the different approaches to analyse recovery of plants and to make suggestions how recovery of these effects can be included in a risk assessment framework. In the present presentation, we will focus on aquatic algae and macrophytes and the regulation of plant protection products in the EU. Experimentally, recovery of algae and macrophytes can be assessed in single species laboratory tests or micro- and mesocosm studies. In refined exposure laboratory toxicity tests, usually the recovery of the growth rate is assessed since the populations are kept in the experimental growth phase. In micro- and mesocosm studies, it is possible to analyse also recovery of abundance or biomass and potential indirect effects. The differences of these two options and their potential consequences for risk assessment will be discussed. Effect modelling can be used to extrapolate from empirical data to other exposure scenarios or species. However, while the simulation of refined exposure laboratory toxicity tests seems to be straightforward, the prediction of effects under field conditions is still challenging. In addition, the use of such models in the risk assessment requires clearer criteria on which magnitude and duration of effects can be considered acceptable.

Rimsulfuron toxicity and recovery in duckweed (Lemna minor)

M. Opincarc, University of Florida / School of Natural Resources and Environment; P.C. Wilson, Z. Li, University of Florida / IFAS / Soil and Water Science

Rimsulfuron is an herbicide for which very little is known about its toxicity to aquatic macrophytes. This study was designed to evaluate the effects of rimsulfuron on the model aquatic macrophyte Lemna minor at low concentrations. This study also evaluated recovery by L minor following a 5 day exposure period. Growth rates were measured at 1, 3, and 5 days following exposure to rimsulfuron-fortified 10% Hoaglands media at concentrations of 0, 0.0003, 0.0006, 0.00125, 0.0025, 0.005, 0.01, and 0.02 mg/L. After 5 days exposure, growth rates were significantly lower than 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 horometic response was observed at the 0.01 mg/L treatment 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.

Toxicokinetic/toxidynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants

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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 toxicity of a herbicide, it is necessary to make a distinction between acute and chronic effects. The latter are measured through experiments. We then calculated toxicity values and built SSDs with and without competition effects 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.

Assessing soil toxicity of methylparaben using plants and collembola

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Methylparaben is an endocrine disrupting chemicals (EDCs) and is contained in personal care products. It may be distributed in the environment without any treatment. Therefore, it is important to assess its toxicity to organisms. In this work, we assess soil toxicity of methylparaben using plants and collembola. Plants were exposed methylparabeno 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 collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half-lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have low toxicity to mammals, but there is no data on hazard assessment for soil organisms. 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 properly treated. This study assessed the toxicity of methylparaben to plants (mung bean and rice) and collembola. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21 days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half-lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have significant physiological effects on plants even at low concentrations. The results of this study can be fundamental for soil risk assessments of methylparaben. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for SETAC Europe 28th Annual Meeting Abstract Book
managing information related to chemical risk.

**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 endophytes and 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 as an example. The methodology associated with the evaluation of these substances takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bisphenol A. Meanwhile, bisphenol A is known as a representative EDCs 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 (and its main metabolite) using the two main endpoints and evaluated the applicability of phytoestrogen, a new endpoint for EDCs 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
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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 substance with various isoforms which are used as insecticide and detergent. Although DEHP and nonylphenol are likely to release to the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll contents, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the soil toxicity of the two substances to the plants was conducted using various factors, and the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

**WE161**
Toxicity of a glyphosate based formulation on phytoplankton 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 aromatic amino acids 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. In this work the effects of a glyphosate formulation (≈44% monopotassium salt of N-phosphonomethyl glycine) on the growth, chlorophyll content and oxidative stress parameters of 4 phytoplankton green microalgae were evaluated. Cultures of *Scedesmus acutus, Ankistrodesmus fusiformis, Monoraphidium contortum* and *Parachlorella kessleri* were exposed to increasing glyphosate concentrations (0 – 75 mg glyphosate/L) and kept at 24 ± 1 °C, under continuous agitation and illumination. After 96 h, growth, IC50, chlorophyll a content and oxidative stress parameters were evaluated. The glyphosate caused a significant decrease of chlorophyll a in *M. contortum* and *P. kessleri*, but not in the other two species tested. The growth of the 4 strains was negatively affected and regarding the IC50 values *M. contortum* was the most sensitive strain (3.37 mg/L), followed by *A. fusiformis* (6.50 mg/L), *S. acutus* (14.74 mg/L) and *P. kessleri* (41.75 mg/L). In order to evaluate the relationship between antioxidant defenses and sensitivity, we analyzed parameters of oxidative stress in the least and the most sensitive strains. The exposition to 2-4 mg glyphosate/L in *M. contortum* and 30-75 mg glyphosate/L in *P. kessleri*, caused

**WE162**
Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment
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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 colonise. The uncontrolled growth of these species can be also a threat to ecosystem functioning, e.g. altering oxygen balance in the case of the aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control *M. spicatum*, which is an invasive algal 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. aquaticum* 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 consider 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
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Data requirements for the registration of plant protection products in the EU Regulation 1107/2009 indicate that a test on a *Myriophyllum spicatum* species is necessary for auxinic herbicides. The OECD 239 water sediment test with *Myriophyllum spicatum* species developed in the USA is the test of choice for substances 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 spicatum* plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. However, it needs to be evaluated if an indirect quantitative assessment of the roots in the *Myriophyllum* studies with auxinic substances would result in significantly different endpoints that may impact the overall outcome of the risk assessment for these substances. Studies with auxinic substances would result in significantly different endpoints that may impact the overall outcome of the risk assessment for these substances.

**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 monocotyledonous plant species in terrestrial plant tests. In these cases, the recommended dicot and monocot species
are Myriophyllum and Glyceria, respectively. OECD Test Guideline 239 for testing Myriophyllum spicatum in a water-sediment system was adopted in September 2014 and this test method has since been adapted to facilitate growth of the emergent, reed grass, Glyceria maxima. During 2016 and 2017, 15 laboratories participated in a ring-test with the herbicide, isoproturon against Glyceria. The objectives of this test were to establish suitable test procedures, to determine the required test duration, to characterize control variability and inform test design and to identify appropriate validity criteria. Results of this ring-test will be presented alongside progress on a second ring-test with the herbicide 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
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Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. Examinations 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 in water are easily adsorbed on sediments. 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 are frequently used as bioindicators for the environmental condition. Ceratophyllum demersum. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-6 Ni, 4-64 Zn or 0.5-8 Cd mg/L) and fresh weight, main shoot length and total shoot length were chosen as endpoints. For the bioaccumulation assays, plants were exposed to a constant metal concentration techniques, to period of time until metal concentration reached a steady state. To make sure of a constant external metal concentration, a daily renewal of the media was carried out. Besides, the influence of these metals on antioxidative enzymes activity was evaluated for the three lower concentrations of each one. These enzymes are involved in the plant defense mechanisms activated by heavy metal exposure. Determination of catalase (CAT), glutathione S-transferase (GSTM) and glutathione oxidoreductase (APOX) in A. thlaspi were measured from the total plant mass. In the main, fresh weight result 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 sings of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-14 after each metal treatment. CAT activity at test concentrations remained near control values, while APOX and GPOX enzymes showed an increase indicating possible sublethal effects.

WE166 Physiological responses of Thlaspi praecox (Brassicaceae) to Ni hyperaccumulation
T.D. Mišljenović, J. Jakovlević, S. Jovanović, University of Belgrade / Faculty of Biology Institute of Botany and Botanical Garden Jevremovac; N. Mihailović, University of Belgrade / Institute for the Application of Nuclear Energy; V. Maksimović, University of Belgrade / Institute for Multidisciplinary Research; D. Milić, University of Belgrade / Institute for Biological Research Sinisa Stanković Thlaspi praecox is a well known heavy metal hyperaccumulating plant species. The ability of T. praecox to hyperaccumulate Zn and Cd have been extensively studied, while data on Ni hyperaccumulation are scarce. Our aim was to bring more understanding to the physiology of T. praecox exposed to Ni and its 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, México, by Thlaspi praecox
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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. 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 metals in aquatic plants have led many authors to believe that they accumulate from water and/or from sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns: (1) true exclusion, in which metals are not absorbed from the plants; (2) shoot exclusion, in which metals are accumulated in the root but translocation to the shoot is restricted; and (3) accumulation, where metals are concentrated in the plant parts [4]. The present research examines the phytoextraction in situ of heavy metals by T. praecox to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo; 2) plants were collected, dried in vacuum oven and a microwave acid digestion were carried out. Metal concentrations exposures to determine the concentration of these metals in the plant, water and sediments. 3) samples of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 °C for 18 hours in Lindberg / Blue stone; 3) grinding and spraying of root and leaves in analytical mill (KIKAWerke M20); 4) acid digestion with HNO3 in plate at room temperature in plant and root leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that T. praecox accumulates Mn> Zn> Cr> Pb> Cu> As> Hg>Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as T. praecox in heavy metal accumulation and detoxification mechanisms.

WE168 Heavy metal removal by aquatic plants
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Removal of heavy metals from wastewater is a problem of industrial effluents and urban wastewater. Aquatic plants are not only sources of metal contamination. Biological methods have been recommended as an alternative for removal and recovery of heavy metals from aqueous solutions. Aquatic plant biomass represents an efficient biological source for heavy metal removal and accumulation heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including free floating Glyceria, respectively, have shown potential for metal removal from wastewater. The aim of this study is to determine the concentration of these metals in the plant, water and sediments. This time and at 3 and 5 days, respectively, plants were removed and new plants were placed in the same multi-metal system composed by Cd, Ni and Zn was assessed by growth inhibition test with the green algae, 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 measured 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 g/L 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 in an oven 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 species 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 efficiency method for metal removal and recovery.
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 outpoured the Fundão dam to ten different plant species (Avena striosa, Pennisetum glaucum, Crotalaria juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed based on 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 striosa, had EC50 and/or EC100 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 fertility by mining waste; the sensitivity of microbial cells of the plants caused 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.

Toxicity of the binary mixture Cd-Zn on Lemna gibba evaluated using morphological and oxidative stress enzyme endpoints

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. curiesen, J. Alberdi, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PR/ PRIET

Presence of various metals in aqueous streams arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental issue, as human health risks and harmful effect to living organisms occur. In the last decades the amount of Chromium in aquatic and terrestrial ecosystems has increased as a result of different human activities such as mining, chroming wood preservatives and leather tanning among others. In order to evaluate the use of preadapted strains to subletal 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: A. madrensis and N. unicellularis. These algae 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 subletal concentrations of chromium ranging from 0.42 to 73 mg/l. These concentrations were chosen base on previous experiments through range finding tests. Subletal solutions were renewed monthly and algal cells were subcultured in new medium. After the preadapted period, each subcultured exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of control 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 dilucidated the mechanism of resistance origin. The harvested cells were centrifuged and a microwave acid digestion were carried out. Metal determinations in subletal solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance observed. Further studies relative to detoxification mechanisms and chelating internal molecules as phytochelatin will be conducted to unravel the tolerance mechanisms involved.

WE171 Ecotoxicological assessment of the iron mining waste from Mariana (Brazil) on terrestrial flora using different plant species

O.R. Alves, University of Sao Paulo USP / Department of Hydraulic and Sanitation; O.A. Bandeira, T.J. Pinto, L.P. Figueiredo, University of Sao Paulo USP; E. Espindola, University of Sao Paulo USP / Hydraulics and Sanitation In Brazil it is very common to have mining waste placed in dams, especially in the vicinity of mining areas. The disposal of mining waste in dams is a serious environmental issue in Brazil, especially in 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 outpoured the Fundão dam to ten different plant species (Avena striosa, Pennisetum glaucum, Crotalaria juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed based on 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 striosa, had EC50 and/or EC100 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 fertility by mining waste; the sensitivity of microbial cells of the plants caused 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 (1) 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 (2) and reported the importance of soil microbial ecotoxicity (3). In this study, ecotoxicological effects of CuO-NPs were measured on soil microbial communities, using a set of different endpoints. CuO-NPs were either dispersed on solid soil or added to a liquid fraction of soil. Different bacterial, fungal and/or Cecropia (4) microbial ecotoxicity by plant in an agricultural soil: plant variety matters.}

WE173 Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure

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The metals Cr, Cu, Pb, Ni, and Zn are often used as fertilizers and pesticides, in wood preservation. The aim of this study was to compare the effect of two conventional varieties (Arrezzo® and Skerzzo®) with two doses of CuO-NPs. The experimental design consisted in planted and unplanted soil microcosms contaminated or not with two doses of CuO-NPs (1mg and 100 mg/Kg) before the seedling of wheat. We compared the effect of two conventional varieties (Arrezzo® and Skerzzo®) exhibiting contrasted traits reflecting different root exudation. Ecotoxicological effects were assessed after 40 and 50 days by measuring plant traits on each variety, microbial activities (respiration, nitrification and denitrification) and microbial abundance by qPCR targeting 16S RNA gene and function genes. The main physico-chemical properties of NPs were characterized by Dynamic Light Scattering in rhizosphere and unplanted soils in which ionic strength, pH and dissolved organic carbon were also measured. The results showed that the NPs hydrodynamic diameter was higher in planted soil solutions compared to unplanted one. Comparison between planted and unplanted soil showed that the plant humpered ecotoxic effects on the microbial activity of functional microbial groups without significant changes in their abundance. Arrezzo® limited the reduction of nitrification and denitrification suggesting that NPs toxicity depends on the white pepper more likely because of the effect of roots on NPs and for the microbial populations recruited in the rhizosphere that can be more or less sensitive to NPs.
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. It represents this study sublethal 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. Biochemical markers of oxidative stress of growth, such as the glutathione S-transferase activities, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the micronutrient 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, Gwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering The conventional damage methodology for plants after chemical accident only relied on the change in their phenotype such as leaf bronzing, so there had been lots of controversy because of uncertain causality and inaccuracy. The ministry of environment tried to characterize of plant damage by introducing metabolic profiling for more accurate damage diagnosis. However, target metabolite selection process was unclear and the exposure method did not reflect the chemical accident scenario, so the research results have not been put to practical use. Therefore, untreated metabolomics and vapor exposure chamber were introduced in this study to overcome the limitations of existing research. The development potential of metabolomics-based damage diagnosis tool was demonstrated using Lamiaceae (Lamiaceae) and Hordeum vulgare. 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 metabolomic approach and provided an insight into quantitative chemical accident damage assessment.

WE175 Influence of soil organic amendments on the phenolic contents in rosemary (Rosmarinus officinalis L.) plants

I. Nogues, National Research Council of Italy / Institute of Agro-Environmental and Plant Nutrition (INRA); A. Milagro, National Research Council of Italy / Water Research Institute; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; M. DE LOS ANGELES BUSTAMANTE MUNOZ, University Miguel Hernández de Elche (Spain) / Department of Agrochemistry and Environment Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean regions, grown as a common herb around the world. This species constitutes an exceptional source of different bioactive compounds, mainly phenolic compounds, with proved antimicrobial and antioxidant activity. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in the tissues considered, and the availability of the 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 applied at 60 (30 t/ha and 30 t/ha respectively) and 120 t/ha and calculated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (I). Subsequently, plants of rosemary (Rosmarinus officinalis) were planted on these soils. The efficiency of the treatments was evaluated by analysing chemical characteristics in the soil and the total contents of phenolic compounds and flavonoids in the rosemary plants grown in the different treatments. The results obtained have shown that the incorporation of the organic amendments into the semiarid soil improved soil characteristics, by increasing organic matter and nutrient contents, but also implied a decrease in the concentrations of phenolic compounds in the rosemary plants, probably due to the nitrogen fertilisation increases growth, but also leads to decreased concentrations of carbon-based secondary metabolites, such as phenolic compounds.

WE176 Leaf litter originating from trees treated with systemic fungicides - a new exposure pathway for detoxification systems

K. Newton, University of Montreal; J.P. Zuberb. D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; T.C. Schell, IMDEA Water Institute / Ecotoxicology; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; M. Konschak, University Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment Leaf litter decomposition, an important process in freshwater ecosystems, is mediated by microbial decomposers and leaf-shredding macroinvertebrates. This process can, however, be modified by chemical stressors such as fungicides. Although fungicide stress has increasingly been assessed in recent years, the systemic nature of some fungicides, which enables the uptake and distribution within treated plants, is not yet considered. Therefore, as a first step, we treated Alnus glutinosa with a mixture of systemic fungicides (SFs; azoxystrobin, cyprodinil, quinoxyfen and tebuconazole) via soil drenching at three levels (control, field application rate (FR), and 10 times the field application rate (FRx10)). During leaf fall, we collected the leaves and assessed the potential impact of the fungicides on microbial decomposers and leaf-shredding macroinvertebrates. We quantified microbial leaf litter decomposition, their community composition and the palatability of leaves after microbial conditioning for the model shredder Gammarus fossarum Koch. By assessing growth and physiological fitness of this species over multiple weeks, we additionally estimated the nutritious quality of leaf litter. Gammarids preferred conditioned FRx10 over control leaves, which may reflect changes in microbial community structure. This increase in palatability as a consequence of SF may be related to the fungicides’ ability to reduce fungal pest pressure, allowing trees to divert energy and carbon from defense to growth or storage. The same treatment resulted in a 300% increase in gammarid growth, while fungicides were still present in the conditioned leaves. The data suggest that SF may indeed have implications for microbial decomposers and leaf-shredding macroinvertebrates, while the underlying mechanisms are still not fully understood.

WE177 SETAC Plants Interest Group

S. Loutseti, DuPont De Nemour Hellas S.A.

Environmental Risk Assessment in Sediments (P)

WE178 Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination

M. de Baat, University of Amsterdam / IBED-FAME; T.V. van Meer, University of Amsterdam / IBED-DE; Department of Freshwater and Marine Ecology; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME Bioturbation activity of sediment-dwelling organisms promotes the release of contaminants across the benthic-pelagic ecosystem boundary, thereby affecting the exposure to and uptake of sediment associated contaminants at the sediment-water interface by themselves and the entire community around them. This way, bioturbation activity may contribute to species specific sensitivities to sediment associated compounds. Therefore we assessed if invertebrate bioturbation activity determines species specific sensitivities to sediment contamination. For two metals, Ni and Cu, sufficient data were available to construct Species Sensitivity Distributions (SSD). The position of the species in the SSDs could indeed be linked to their bioturbation rate: the most active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxicants. Moreover, active bioturbators can hence promote the release of sediment-associated contaminants across the benthic-pelagic ecosystem boundary, thereby stimulating delivery of contaminants from what is often the most polluted environmental compartment in freshwater ecosystems. It is concluded that trait based ecotoxicology offers a possibly potent tool for predicting sensitivity of benthic invertebrates and the benthic community to sediment-associated contaminants.

WE179 Effect based sediment quality assessment incorporating chemical fingerprinting

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Freshwater and Marine Ecology
The European Union Water Framework Directive does not require member states to monitor sediment quality. When performed at all, water authorities most often monitor sediment quality by means of chemical target analysis focusing only on target compounds, potentially overlooking ecotoxicological risks caused by (un)known mixtures of sediment associated compounds. Hence, there is an urgent need to incorporate effect-based monitoring and chemical fingerprinting into sediment quality assessment. Therefore, the aim of the present 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 forest, together with three WWTP effluent 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 PAH concentrations. Survival in the bioassay was unaffected at the urban sites, while significantly lower at all WWTP sites and two of the agricultural sites. Emergence was significantly delayed at the urban sites, agricultural sites exhibited an irregular emergence time, while WWTP sites induced accelerated emergence. Pyrene and phenanthrene concentrations were negligible at the reference site, very low at the agricultural and WWTP sites, and highest at the urban sites. Urban sites thus have a high chemical load, but survival was higher than on the agricultural sediments. Contrastingly, agglomerates at WWTP sites were bioavailable, but emerged at low and midge survival. This is likely attributable to the mode of action of the pesticides present at agricultural sites, that affect survival more than the non-specific toxicity of compounds at the urban sites. Employing bioassays allowed ranking of sediments based on biological responses rather than on the presence of target compounds. All contaminated sediments caused effects on the relatively resilient C. riparius, underlining that sediment contamination is presently understudied. It is therefore concluded that ecotoxicological sediment quality assessment needs to be included in the EU WFD.

WE109
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, 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 systems. The effect of pyrene associated with different compositions of SPS including: (i) hydrophobic organic carbon, (ii) black carbon, (iii) black carbon, and (iv) minerals and grain sizes (0-50 μm, 50-100 μm, and 100-150 μm) on the immobilization and enzymatic activity of D. magna was investigated to quantify the bioavailability of SPS-associated pyrene. The results showed that with C_{sox} of pyrene ranging from 20.0-60.0 μg L^{-1}, the immobilization of Daphnia magna in the presence of 1 g L^{-1} SPS were 1.11-2.89 times that in the absence of SPS. The control of pyrene was 83% for mineral-organic fraction of SPS, 51% for 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%). It 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 > 0-50 μm > 100-150 μm. When pyrene C_{sox} was 20.0 μg L^{-1}, the immobilization caused by pyrene associated with 50-100 μm SPS was 1.42 and 2.43 times that with 0-50 μm and 100-150 μm SPS, respectively. The protein and enzymatic activities of Daphnia magna also varied with different SPS grain sizes. The effect of bioavailable fraction of SPS-associated pyrene was mainly due to the difference in SPS ingestion by Daphnia magna and SPS composition, especially the organic carbon type, among the three sizes. According to the results obtained in this study, a model has been developed to calculate the bioavailability of HOCs to aquatic organisms in natural waters considering both SPS grain size and composition.

WE181
Sediment quality assessment in the Netherlands: Link between chemical, toxicological and ecological parameters
L. Lautz, Radboud University Nijmegen / Department of Environmental Science; J. Chai, Radboud University Nijmegen; R. Hoondert, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science; R. Van Zelm, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science Sediment quality assessment is often based on chemical analysis only, occasionally including toxicological assays. Full sediment quality assessment, including chemical and macrofauna analysis and toxicological assays, is not the standard procedure due to high costs. Based on chemical analysis only, it is not always clear whether sediment management in form of dredging and landfill or remediation is necessary. To reduce costs of sediment management on the one hand and to increase environmental benefits on the other, the right priorities need to be set. To do so, a university of Lorraine / Laboratoire Interdisciplinaire des Ecossystemes et macrofaunas. 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 (SSD) analysis was used to quantify the ecological risk associated with concentrations of contaminants. Based on the SSDs the potentially affected fraction (PAF) of species was calculated. These PAFs were used to calculate the multiple substances PAF, combining effects posed by multiple compounds. Such correlation analysis have not been conducted previously for a large dataset of field-collected sediments in the Netherlands. With our work we contribute to the quantification of relationships between chemical concentrations and toxicological assay in sediments. These relationships can be used in future analyses of predictive abilities of sediment quality and can be applied in an assessment tool for sediment management to determine management strategies.

WE182
Integrative approach to assess ecological risks of sediment metallic contamination in Lake Ohrid (Albania)
L. Minguez, LICN CNRS UMR 7360, University of Lorraine / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E.M. Gross, University of Lorraine / Laboratoire Interdisciplinaire des Environnements Continentaux; D.A. Vignati, LICN / UMR 7360; S. Pain-Devlin, Université de Lorraine - UL / LICN - CNRS - UMR 7360; S. Devin, LICN, CNRS UMR 7360, Université de Lorraine / LICN, CNRS; F. Guérolé, Université de Lorraine - UL / Laboratoire interdisciplinaire des environnements continentaux LICN CNRS UMR 7360; L. Giambriani, Université de Lorraine CNRS UMR 7360 / LICN, CNRS. It is now widely admitted that chemical monitoring of pollutants in waters and sediments is not sufficient to assess the risks caused by such pollution in aquatic ecosystems, since chemical data alone provide no indication of biological effects. Biological responses of exposed organisms need to be taken into account, allowing to define the ecotoxicological status of the studied system. The ancient lake Ohrid, the third biggest alpine lake in Europe, is known for its richness in endemic species, chosen as case study. The Albanian side, due to the presence of ultramafic rocks, was a large mining area exploited to produce nickel, chromium, and iron until the early nineties. Several ore dumps from this past activity still remain near the shoreline, representing one potential input source of these metals. Several creeks flowing across soils naturally rich in metals also contribute to metal inputs into the lake. We studied three sites along the Albanian shoreline of Lake Ohrid, and defined by different metal pressures: “Pog” in an urbanized area but considered as dimly contaminated by metals, “Mëm” and “Poj” located in the ultramafic area of the lake, at the vicinity of a Fe-Ni dump site for “Mëm”, or nearby the outlet of a creek for “Poj”. In the two sites under metallic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Ni, 138.3 mg/kg for Cr, 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
K. De Schampaertela, Universiteit Antwerpen / Department of Biology (SPHERE and ECOBE Research Groups); H. Hetjens, University of Antwerp / Department of Biology (SPHERE Research Group); J. Teuchies, E. Amato, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group); P. Meire, University of Antwerp / Department of Biology (SPHERE Research Group); R. Bluist, University of Antwerp / Department of Biology (SPHERE Research Group) Impacts of sediment metal contamination on aquatic ecosystems and their functioning remain a widespread problem. The ecotoxicological risk associated with metal contamination is dependent on metal speciation, sediment characteristics and the behavior and physiology of the affected organisms. Hence, bioavailable concentrations, rather than total metal concentrations, are often a critical factor in sediment risk assessment. Determination of bioaccumulation in organisms is a frequently used indicator for bioavailability. However, active and passive biomonitoring techniques are often time consuming and highly dependent.
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 potential indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flushing (New York), a freshwater and 3 brackish aquatic systems. Bioavailability of metals will be assessed by active biomonitoring through a 4 weeks exposure of caged macroinvertebrates, after which bioaccumulation will be determined. The organisms will be exposed both at the sediment water interface and in the water column. Bivalves, polychaetes and sandy sediments, 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. O2) 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; (ii) establish monitoring and passive sampling measurements as the sediment water interface and in the water column will be evaluated. This 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.

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 sediment. The objective of this research was to determine effects thresholds for sediment-nickel by measuring reproduction of the estuarine-marine amphipod, Melita plumulosa in 10-d whole-sediment bioassays with three nickel-spiked sediments and two field-collected nickel-contaminated sediments with varying chemical and physical properties. We compared community and response relationships observed using traditional extraction methods of metals from sediments with DGT-labile nickel to determine whether DGT can be used to predict nickel bioavailability and toxicity. Effect concentrations of total recoverable nickel (TR-Ni) to cause a 50% impairment in reproduction (EC50) were 2000 (1200-2900), 1100 (580-1700) and 1100 (740-1500) mg/kg for the silty, 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/m2 for silty, 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/m2 DGT-labile Ni) and Site 2 (1.0 mg/m2 DGT-labile Ni) sediments, respective reproductive responses were 88% (+10) and 71% (+11) of the control. This demonstrates that amphipods were responding to the labile nickel as measured by DGT and further supports its use in nickel risk assessments.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA
J. Yang, H. Li, F. Cheng, Jinan University / School of Environmental Animal Ecology; B.J. Ferrari, Centre Ecotox; S. Pesce, Ircia Lyon.
In this context, this study aimed to evaluate the impact of the Flon river stormwater overflows. In Switzerland, the Vidy Bay located in the middle of the northern shore of Lake Leman, is of particular interest as it receives a large portion of stormwater from the city of Lausanne via the Flon River. In this context, this study aimed to evaluate the impact of the Flon river stormwater overflows on the sediment quality of the Vidy Bay using a triad approach combining chemistry, ecotoxicology and the study of in situ benthic communities.
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 chemical characterization tests with chlorophenols, macroporphs and nematodes, as well as the study of the structure of oligochaete communities and tolerance of microbial communities induced by pollution (PICO T) were carried out on the results obtained showed that contamination induced by urban stormwater discharges, identified mainly as copper, zinc, PCBs and PAHs contamination, was elevated in the sediment in three of the six replicates. In the other three replicates the ecotoxicological tests did not indicate significant toxicity in this area, the study of in situ communities revealed the presence of pollution-resistant species among oligochaetes and benthic microorganisms. For the most remote sites, the effects observed in the sediments do not appear to be directly related to the stormwater discharges. The origin and dynamics of the contamination still require further investigations, based in particular on a multidisciplinary model. Overall, this study paves the way for the development of practical tools for assessing the impacts of urban stormwater discharges in lakes in Switzerland.

WE188 Ecotoxicological profiling of sediments along the River Wurm by Aachen (North-Rhine-Westphalia, Germany)
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River sediments serve as a sink and source for micropollutants. Characterized by their semi-dynamic behaviour, sediments can assimilate contaminants. Naturally occurring events such as storms, currents and flood events, as well as human activities like dredging can cause resuspension of sediments and, thus, pose a threat to aquatic organisms. So far, many investigations have been conducted to assess the biological responses in the water phase of streams being impacted by effluent from waste water treatment plants (WWTPs). However, the impact of WWTPs to sediments is still unknown. The present study was taking place within the DemO3 AC-Project aiming at assessing the ecotoxicological status of the River Wurm near Aachen. This stream is heavily impacted by anthropogenic activities, such as urbanisation, agriculture, industry, etc. Moreover, the River Wurm receives effluents from various WWTPs within the catchment area. Two of them, the WWTP Aachen Soers and the WWTP Ellendorf, served as investigative objects. Special attention is paid to the WWTP Aachen Soers, which will be upgraded by a full-scale ozonation at the end of 2017. To evaluate a possible impact of the WWTPs on the current ecotoxicological status of the stream a comprehensive ecotoxicological profiling of the sediments from 7 sites up- and downstream of the aforementioned WWTPs was performed. The samples were tested both as native and freeze-dried samples in the sediment contact assay with Danio rerio. Sediment extracts (25 g SEQ/ml) were applied for the fish embryo toxicity test with Danio rerio and the reactivity assessment of the sediments by microplate testing. The results showed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryotoxic potential (enlarged heart, insufficient blood circulation, oedema, etc.) was accounted for the sediment extracts upstream of the WWTP Aachen Soers only. Exposure to native sediments did not lead to any adverse effects in embryos of the zebrafish. However, exposure to freeze dried sediments revealed reduced reactivity of fish embryos. Observed neurological conspicuouss will be verified by further investigations. The described toxicological profiling of sediments will also be completed by chemical analysis. Phase 2 of the DemO3 AC-project will contain comparative studies in order to evaluate the possible influence to sediment toxicology after implementation of full-scale ozonation.

WE189 Comparing conventional and integrative concepts for sediment classification systems
S. Parisch, Hamburg University of Applied Sciences (HAW); S. Höss, Ecosia / Applied Ecology; S. Heise, Hamburg University of Applied Sciences / Life Sciences

Environmental regulations and guidelines in Europe for assessing the quality of aquatic sediments and dredged material predominantly demand chemical data, and decision making mostly does not integrate the information from different lines of evidence (1, 2). Ecotoxicological data requirements are often limited, with the final classification of the sample not preserving the information of all applied biotests (3). Improved, holistic characterization of sediments and dredged material is needed, to enable a better risk assessment that conserves the ecological quality, is practical and economically feasible at the same time. This poster will present the concept of a study in the scope of the Interreg project “Sullied Sediments” (http://northsearegion.eu/sullied-sediments/) and will discuss first results. The study aims at comparing and evaluating conventional and alternative, integrative and science-based sediment classification concepts for holistic assessments of sediment quality, such as fuzzy-logic based classification (4, 5). Selected concepts will be applied on the classification of sediments from inland waterways in the North Sea region. A sediment quality trial approach will assess the ecotoxicity, the ecopharmacological potential, the chemical quality of sediment samples from three catchment areas 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 meiofauna 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 Aihl et al., 2002. JSS 2: 37–42 Deckere et al., 2011. JSS 11: 504–517 Duff et al., 2003. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) Hollert et al., 2002. Ecotoxicology 11: 311-321 Keiter et al., 2009. JSS 9: 168

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 Ecológicas; M. Artal, University of Sao Paulo - USP / Toxicology and Toxicology analysis; J.A. Vendemiati, F.I. Vacchi, University of Campinas / LEAL Laboratory / Laboratory of Toxicology School of Technology; G. Umbuzeiro, School of Technology, UNICAMP / LAEG One solution for sewage disposal in several countries is primary treatment followed by chlorination and its discharge in the sea. In Santos city, SP, Brazil, 1 million cubic meters of urban effluent are discharged into the Santos bay every day, 4.5 km from the beach. To assess the toxicity of environmental samples it is important to use species that are representative of the ecosystem we want to protect. So, the aim of this work was to evaluate the acute toxicity of water and sediment samples collected in the area under the influence of this discharge using the native marine amphipod Parhyale hawaiiensis. Three campaigns were conducted. Acute toxicity tests were performed in water and in fresh and dried sediment as well water and sediment, respectively, to evaluate the toxicity of environmental samples. The results showed that the test organisms have a high sensitivity to the pollutants in freshwater, and that the sediment does not preclude the test organisms' survival. The observed toxicity is probably mainly related to organic contaminants adsorbed to the sediment particles. The sediment of the area seems to be adversely affected by the influence the outfall discharge. Acknowledgements: FAPESP 2015/24758-5 and CNPq 400362/2014-7.

WE191 Swimming in turbid water: impacts of suspended fine sediments on fish physiology
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Anthropic activities lead to increasing sediment deposition in many rivers worldwide which must be managed to preserve industrial activities and population safety. In a context sensitive site, the dredging and dumping activities are threatening actions that release downstream accumulated sediments thus increasing sediment loads 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 (Oncorhynchus mykiss) and roach (Rutilus rutilus) were exposed in semi-static conditions to 0, 200 and 1000 mg/L of non-contaminated fine sediments (silica) for 28 days, mimicking dredging operations in terms of duration and environmental concentrations. They were sampled weekly, and mortality, condition index and histological gill lesions were evaluated. Several physiological parameters were also investigated to assess the level of oxidative stress and genotoxicity. Oxidative damages in gills were investigated measuring the level of lipid peroxidation (TBARS) as well as superoxide dismutase activity (SOD) involved in oxygen radical metabolism. The level of primary DNA damage in erythrocytes was measured with the alkaline comet assay. This preliminary work highlight that 28 days of exposure to fine sediments at high concentrations do not induce drastic
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 oxidant 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**

H. Hetling, SPHERE / SPHERE; K. De Schamphelaere, University of Antwerp; Department of Biology SPHERE and ECORE Research Groups; J. Tchoules, E. Amato, L. Vervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem and are of major concern for water system management due to their impact on the surrounding water quality and resident biota. Sediments (relatively) metals can be present in a variety of 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 application of techniques to overcome 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 for (benthic) aquatic organisms 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. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

**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. Microorganism such as 1000 million copies of compounds are applied in industrial processes and consumables every year. A considerable part of it enters waterbodies from diffuse and point sources. [1] Micropolitants 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 enter into surface waters by discharge of micropolitants 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-Sooers WWTP, Germany, within the Demo-OA-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 bioassays 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 scototaxis (aversion to bright areas and natural preference for the dark) to evaluated effects of neuroactive 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**

V. Piazza, E. Costa, F. Garaventa, CNR ISMAR; D. Sartori, V. Vitiello, D. Pellegrini, ISPIRA Institute for Environmental Protection and Research; I. Lanzoni, Department of Life and Environmental Sciences Polytechnic University of Marche Ancona Italy; F. Regoli, Università Politecniche delle Marche; M. Faimali, CNR ISMAR

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 Norvety role assigned by ecotoxicology. M. Boerum (1992). 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 (pore water or elutriate) of sediment. The results of ecotoxicological analyses are then assessed as a whole at the level of “battery” (not of single bioassay), weighting the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and the toxicity potentials in the overall contamination of exposure. Chemical and ecotoxicological data are finally integrated for sediment quality assessment, following the weight of evidence (WOE) criteria, this representing an innovative approach respect to previous regulation, where chemical classification was determined by at least one parameter exceeding the threshold level and ecotoxicological classification was determined by the 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 lufenuron to aquatic arthropods in laboratory bioassays**

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Lipophylic 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 benzoazulene 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 horarius > Chironomus riparius > Gammarus pulex > Chironomus dilutus > Enallagma cyathigerum > Ephemera danica > Hyalella azteca > Sericostoma personatum > 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 10-d LC50 values was 2.2 (1.2-5.7) µg/g organic carbon (OC). This HCS value is approximately a factor of 2 lower than the 10-d LC50 estimate (4.37/7) µg/g OC for the most sensitive standard test species Chironomus riparius. Valid 28-d LC10 values could be derived for 7 benthic arthropods. These 28-d LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis horarius > Ephemera danica > Hyalella azteca > Gammarus pulex > Sialis lutaria. The HCS and 95% confidence interval derived from these 28-d LC10 values was 0.13 (0.02-1.5) µg/g OC. This HCS value is approximately a factor of 3 lower that the 28-d LC10 estimate for the most sensitive standard test species Chironomus riparius (0.49 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
population (0.79 µg/g OC) in a sediment-spiked microcosm experiment, while the HC5 from 10x-LC50's was approximately a factor of 3 higher than this microcosm threshold concentration.

**WE196**

Application of an undisturbed sampling technique for depth related analysis of aquatic organisms in water and sediment (TG 219) sediment test systems

A. Dorn, Hochschule Niederneuriher / Department of Chemistry; P. Dalkmann, Bayer AG Crop Science Division; D. Faber, Bayer AG, Crop Science Division / BCS D ETX Ecotoxicology; K. Himmel, Bayer AG, Crop Science Division / Environmental Safety; E. Hellpointer, Bayer AG, Research & Development, Crop Science / Environmental Safety; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; M. Jäger, Hochschule Niederneuriher / 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 (logKow -1) and B (logKow -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-FCUL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 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 alternative means of producing animal protein, releasing, at the same time, pressure over wild populations. Production from capture fisheries has relatively stabilized for the past decades, whereas aquaculture production of aquatic animals has followed a rising trend, amounting, by 2014, 73.8 million tonnes produced. Asia contributed for about 89 percent of that production, followed by America, with a production of around 5 percent and Europe, contributing for about 4 percent of the world’s aquatic animals’ production in 2014. Portugal is a traditional fishing country, with yet very little expression in terms of aquaculture production, focusing mainly on the rearing of fish and molluscs, whose relative production has somewhat fluctuated over the years, but reached a similar production by 2014. Most of Portuguese aquaculture facilities operate in estuaries and coastal lagoons using mainly extensive and semi-intensive rearing systems. The main fish species reared in Portugal in 2014 in transitional environments were the Gilthead seabream and the European seabass; clam production accounted for nearly 50 percent of mollusc production, followed by mussel culture. 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 extension 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.

**WE199**

Characterization of the ontogenetic variation and nutritional composition of Gilthead seabream and European seabass reared in two Portuguese estuaries

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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 aquacultures 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 fine nutritional value of the same species produced in different sites. From a consumer’s perspective, such differences may come as a disadvantage, as it is expected for a product to provide equal nutritional properties and benefits regardless its origin, especially within the same country. From the farmer’s perspective, such vulnerability requires constant monitoring of the extrinsic parameters within the facilities, in order to avoid great losses of the product. Further studies need to be conducted to define the parameters that should be regulated and monitored in semi-intensive systems to obtain the best product with the highest food quality.

**WE200**

Effects of aquaculture antibiotics on marine biofilms and on the amphipod Gammarus aequicuadratus


Infinite aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics may cause adverse effects on potentially sensitive organisms such as non-target microorganisms, primary producers or benthic invertebrates. The objective of this study was to evaluate the potential side effects of two antibiotics used in aquaculture (oxytetracycline and fluencequine) on the community composition of marine biofilms exposed to these substances and on the survival of the amphipod Gammarus aequicuadratus. Marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of oxytetracycline and fluencequine for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicuadratus organisms for two weeks. The G. aequicuadratus aquaria set up was run with two treatments in parallel: (1) with input of antibiotics only from the biolm and (2) with antibiotics administered via biolm and also spiked into the water. This was done to test different bioaccumulation routes (i.e., ingestion only and water exposure combined with ingestion). All the treatments for biofilm and crustaceans test were run in triplicate. Preliminary results show a marginally enhanced biomass growth of the biolm with increasing dose of both antibiotics.
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorous), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a higher arborescence up to 100 µg/L, while the highest tested concentration contributed to a decrease of the biofilm density. 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. aeruginosa test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

WE201
Shifts in the diatom assemblage structure and biological traits of marine 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. Intense use of antibiotics in these types of environments has led to emerging problems with antibiotic resistance, 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. Two experimental treatments were performed with the use of laboratory generated experiment field-grown marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of each single antibiotic compound for one week and then changes on chemical and biological composition were analyzed. In the second experiment, biofilms exposed to the same antibiotic concentration range were transported to field conditions after two weeks of exposure in order to evaluate their recovery capacity. In both experiments, diatoms were determined to the lowest possible taxonomic level under the microscope (Nikon Eclipse TE2000-U). The taxon abundance of the sampled quadrants of each replicate was averaged and referred to the area sampled to obtain the taxon density per replicate. The fine structure of diatoms was analyzed under a scanning electron microscope (JEOL-6100). The diatom composition, the relative abundance of species (%), the Shannon-Wiener diversity index (H’), and species richness were calculated for each sample and then summarized per treatment. The growth forms (biological traits) of species were analyzed before detachment and were grouped according to the literature. The biofilms were dominated by a reduced number of taxa, including the diatoms Brachysira apontina and Cocconetes placentula. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 µg/L) resulted in an abundance decrease of the genera 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 acquisition of a broad range of photopigments. The biofilm formation process 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, photopigments and the detection of in vivo ROS production using 3 molecular probes, were measured over 72 hours. H2O2/DFFDA was used for determining the oxidative burst, DHR 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
I. Carmall, 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 deetramethrin. Of these, cypermethrin and deetramethrin 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 297) and recently extended by Carmall, 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 other jurisdictions. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.

WE204
State-of-the-art on the use of models for the ERA of chemicals used in aquaculture
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, marine biocides) continue to raise environmental concerns. Using modern and networked eco-chemical fate models, 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 ecotoxological 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
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

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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 using Atomic Absorption Spectrophotometer while hazard quotient was calculated using the concentrations in (mg/kg ww) of heavy metals were; Fe (< LOD-11.96), Pb (0.54-1.96), Zn (< LOD-2.81), Cu (< LOD-2.31), Ni (0.015-0.998), Co (< LOD-0.086), Cd (< LOD-0.024, Cr (< LOD-0.079) and Fe (< LOD-147.9), Pb (0.92-47.37), Zn (< LOD-15.08), Ni (0.027-0.994), Co (< LOD-0.013) in muscles and livers respectively. Al and As were not detected above limit of detection in any of the analysed samples. Metals showed different affinity to tissues and levels of milkfish and mullets, whereas Cu and Cd had higher levels in the muscles than in the livers, the Cu, Pb, Fe, Zn and Ni were higher in livers than in the muscles in milkfish. In Mullet, Fe, Co, Cr, and Cd levels were higher in the muscles than in the livers and Cu, Pb, Zn, and Ni levels were higher in the livers than in the muscles. The concentration of Pb in the muscles of all analysed fish were above the Maximum Recommended Levels (MRLs) by FAO/WHIO, EU and USFDA for human consumption. Other metals were below the MRLs. The THQ for all the analysed metals were below 1 indicating that the metals are likely to present insignificant health risk to fish consumers. However, based on MRLs recommended by FAO/WHO for human consumption, the metals may pose a health risk to human as fish consumer and threatens fish biodiversity. Therefore, this research calls for regular monitoring of heavy metals in fish for consumption and strengthening pollution control measures.

WE207 Potential Toxic and Phototoxic Effects of Benzenzocyclhexen in Crayfish

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Benzenzocyclhexen is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzenzocyclhexen 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. Benzenzocyclhexen is a photobiochemical 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 flooded rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzenzocyclhexen readily hydrolyzes to benzenzocyclhexen hydrolyse, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzenzocyclhexen or its intermediate degradation products to crayfish is important to know for the possible future registration of BUTTE® in Louisiana.

WE208 Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea Senegalensis.

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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 is feed in feeds are vegetables proteins, and among plant protein sources, soybean is noteworthy. This plant has flavonoids including the isoflavones daidzein and genistein. Solea senegalensis is a flatfish of high commercial importance both in aquaculture and fisheries in Southern Europe with a wide geographic distribution and availability, and its biological cycle is well known. The aim of this work was to study the effects of the isoflavones, genistein and daidzein, on juveniles (weight 1.23 ±0.41 g) of Solea senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20°C and a photoperiod of 12L:12D. In this species, the maximum 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 acetyltachopholine as a substrate after inhibiting butyrylcholinesterase with iso-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/ml 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 Cadiz 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

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In the 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®. Its main advantage is that it performs a simultaneous assay on Vibrio fischeri, plus 2 freshwater bacteria against only one for Microtox® (Vibrio fischeri). Its main advantage is that it performs a simultaneous assay on Vibrio fischeri, plus 2 freshwater bacteria against only one for Microtox® (Vibrio fischeri). Using a set of narcotic substances with different hydrophobicities and two bioassays, the in vivo effects of the narcotics tested and one petroleum based complex substance) a comparison of both tools would be the better tool to evaluate effects on bacterial species. While it was recognised that the substances tested would not be directly comparable to whole effluents, this method was felt to be appropriate to compare the two assays. The in-built EC50 calculation software were also verified. Some errors were detected with the LumiMARA® effects calculation software, and these were recalculated by hand using Regtox software, when possible. We observed that Microtox® is more sensitive than LumiMARA® and that in the latter test, freshwater bacteria toxicity is generally lower than that of marine bacteria. This suggests that there may be a small but real difference between freshwater and marine bacteria toxicity however this cannot be concluded on the basis of this research. Moreover, Vibrio fischeri is the bacteria that usually has the lowest EC50 compared to other bacteria. Thus, the marine bacterium Vibrio fischeri classically used to determine the biotic effect

SETAC Europe 28th Annual Meeting Abstract Book 374
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

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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, and C90, and hydrides of fullerene (C60H12, C70H12, C84H8, and C90H12) were used as oxidizers. Fullerenes 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-benzoquinoine) and inorganic K2[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^-3 M and 10^-4 M for bacterial and enzymatic assays, respectively, while the EC50 values of K2[Fe(CN)6] were 4·10^-4 M and 2·10^-5 M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations >10^-4 g/L and >10^-5 g/L, respectively. Deterioration coefficients can be calculated to characterize changes in toxicity under the action of biotoxic 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 Phosphorum.**

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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 phosphorum was used as a biosensor to test the bioluminescence intensity as the physiological parameter tested. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure (≤250 mGy), 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 400 mGy/h). There was no noticeable effect of gamma-radiation at 0°? 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 tests 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] Kudryasheva 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. in

**WE212** Bioluminescent Assay for Toxicological Assessment of Nanomaterials

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Due to the increasing scale of production and usage of a vast number of new materials in industrial and economic activities, society is faced with problems associated with a lack of materials safety assessment regarding humans, ecosystems and the biosphere as a whole. Nowadays, numerous toxicological investigations using living organisms, cell lines, etc. are carried out in laboratories in order to assess the potential risks of using these materials and their biological effects on human health and the environment. A rapid bioluminescent enzyme inhibition-based assay was applied to predict the potential toxicity of carbon nanomaterials (CNM) presented by single- and multi-walled nanotubes (SWCNT and MWCNT) and aqueous solutions of hydrated fullerene C60(C2H2F6). This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminescent bacteria: NADP+/FDMN-oxidoreductase + luciferase (Red + Luc). A protocol based on the optical properties of CNM for correcting the results of the bioluminescent assay was developed. If the bioluminescence intensity of the nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factors. It was shown that the inhibitory activity of CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > C60(C2H2F6). The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilised enzyme system was less affected to C60(C2H2F6) than its soluble form, with an IC50 equal to 1.4 mg/L. According to EC Directive 93/67/EEC for aquatic organisms, chemicals are classified by their degree of toxicity based on IC50 values. We hypothesised that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescent method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).
as an indicator of the degree of the depth 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 the age of needle, disturbance of dormancy depth of both species clearly correlates with air pollution levels, and the trees growing in industrial areas are easier to release from dormancy and to be affected by late winter or spring frost. In urban environments the risk of frost injuries is even higher due to early spring warm spells associated with heat island effect. Scots pine is less susceptible to air pollution and temperature fluctuations than Siberian spruce, and therefore represents a better choice for urban forestry projects.

WE215
Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polycyclic aromatic 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 a fluorescent microscope. It has been experimentally revealed that the many pollutants of water bodies, it is necessary to isolate oil products and polycyclic aromatic compounds (PAHs), the flow of which in the valley is constantly increasing. On Lake Baikal, this is due to the development of tourism, the increase in the number of passenger ships and tourist bases, often not equipped with treatment facilities. The necessary system for monitoring the quality of the aquatic environment, including methods for bioindicating, not only on generally accepted test facilities, but also on representative hydrobionts for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Epischura baikalensis Sars (Copepoda, Copepoda) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. baikalensis accounts for up to 70% of the total biomass of zooplankton. Copepods 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 luminescent characteristics to possible presence 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 fluorescent 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 7copepoda 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 / 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

The work is devoted to the development of the bioluminescent enzymatic bioassay of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of their contamination was under consideration. The method of chemical analysis was used to assess the luminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2-11.3% and detected arsenic 3.05–15.39 mg/kg) were studied by the method of excitation-emission matrix (EEm) fluorescence spectroscopy. The luminescence in the spectral range 290–600 nm under excitation at 250–450 nm was detected for each extract as well as absorption spectra in the range 200-800 nm. The physico-chemical characteristics of the soils (particle size distributions, pH, humus content, etc.) were compared with the inhibitory effect of water soil extracts on enzymatic bioassay based on the coupled bioluminescent reaction of bacterial luciferase and NAD(P)H:FMN-oxidoreductase. It was revealed that the spectral luminescent characteristics of water extracts are similar for all soils and featured by three types of fluorophores with excitation maxima at about 270, 330 and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The residual activity of the bioluminescent bioassay enzymes in the presence of soil extracts was found to correlate with intensity of two first bands that is the measure of the component content. Poor correlation was found between EEm characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project no. 16-14-10115).

WE217
The comparison of enzyme systems for soil contamination bioassay
E. Kolosova, Siberian Federal University / Biophysical; D. Gulnov, Siberian Federal University; N. Rimatskaia, Siberian Federal University / Biophysical; A. Litsita, O. Sutormin, V. Kratsyuk, Siberian Federal University

Design of simple, quick and highly sensitive bioindication systems is extremely necessary for ecological soil monitoring. Enzyme systems may be a perspective basis for the development of modern methods of bioassay. With sets of enzymes, it is possible to simulate the effect of toxic substances present in natural environments on living organisms. Moreover, coupling enzyme-target with bacterial luciferase provides advantages in the signal detection. The purpose of this study is to evaluate the possibility of using various enzymatic systems for the analysis of soil contamination. In this work NADH:FMN-oxidoreductase, alcohol dehydrogenase (ADH), NADH:FMN-oxidoreductase + bacterial luciferase (two-enzyme system), NADH:FMN-oxidoreductase + bacterial luciferase + alcohol dehydrogenase (three-enzyme system) were examined. The enzyme activities were measured by addition of the model soil pollutants such as a blue copperas, the insect powder “Dyes Profi” (Bayer CropScience) and diesel fuel. The values of the toxicological parameters ??20 and ??50 (concentrations of the pollutants causing the system inhibition by 20% and 50% respectively) were determined. The sensitivity of each enzymatic test system to the aqueous extract of soil was also analysed. The blue copperas (II) – water solution shows an inhibitory effect on all enzymatic systems. The value of EC20 is from 0.088 to 8.75 μM. The insect powder-water solution also shows an inhibitory effect on all enzymatic systems except ADH enzyme system. In contrast, the diesel fuel impacts only on enzyme systems coupled with bacterial luciferase. As a result the blue copperas (II) – water solution decreases catalytic activities all enzyme systems; the insect powder-water solution decreases only NADH:FMN-oxidoreductase catalytic activity; the diesel fuel decreases luciferase activity. The addition of aqueous extract of soil leads to activation of catalytic activity of NADH:FMN-oxidoreductase: for the two- and three-enzyme systems the addition of the aqueous extract of soil leads to inhibition of catalytic activities of the enzyme systems (more than 50%).

WE218
Are changes in bioluminescence kinetics of Photobacterium phosphoreum responsive to low-dose radiation connected with genetic mutations?
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Luminous bacteria of marine origin are widely employed as biological sensors for monitoring environmental conditions, including radiation toxicity. Due to the widespread use of radioactive elements and related concerns about the increase of background radiation, special attention is lately paid to the effects of low-dose radiation on the environment. The response of bioluminescence reaction to exposures of bacteria to low-dose alpha, beta and gamma radiation has been examined in previous research. The purpose of the current study was to determine whether bacterial genetic alteration is related to bioluminescence kinetics change under low-dose exposure with alpha-emitting (241Am) and beta-emitting (3H) radionuclides as sources of ionizing radiation. Bioluminescence kinetics of Photobacterium phosphoreum in solutions of 241Am(NO3)7, 1 kBq/L, and tritiated water, 100 MBq/L, were recorded and their stages were determined as follows – absence of effect, activation, and inhibition of the bioluminescence. Assays were conducted at different stages of the bioluminescent kinetics ensuring that the doses accumulated by the samples were close or a little higher than a tentative limit of a low-dose interval: 0.10 and 0.85 Gy for 241Am, or 0.11 and 0.18 Gy for 3H. The 16S ribosomal RNA gene was chosen as a target one for sequence analysis aimed to test whether low dose radiation triggers any alterations in this universal throughout bacterial world and genetic mutations of the component content. Poor correlation was found between EEm characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by a grant from the Russian Science Foundation (project No. 16-14-10115).
LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (P)

WE219
Meet the Framework Regulation and Supply Chain secondary standards in wheat cultivation for sustainable pasta production. An example of broadleaf weed control: halauaxifen-methyl (Arylex® active)

C. Vagi, S. Cavanna, 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. It is 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, halauaxifen-methyl (Arylex® active), for the control of broadleaf weeds in spring and winter soft and durum wheat. This highly efficacious herbicide requires low use rates and its inherent properties (rapid degradation in the soil and plant) mean a low environmental and human health impact. Utilising halauaxifen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (flour, bran, bread, wheat germ, malt), and in pasta. Results will be presented and discussed. Therefore, the properties of halauaxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards. TM-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. Belbari, 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. El Hajj, 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 (TGRB) 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 and the vegetation could remove 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 TGRB 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

Y. Hahn, 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 assessment of the costs and benefits 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-González, L. Lijó, Universidade de Santiago de Compostela / Chemical Engineering; A. Núñez, L. González Louro, FEGAMP - Santiago de Compostela; E. Andrade, Universidade de Santiago de Compostela; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; S. González-García, University of Santiago de Compostela CIF Q1518001A / Chemical Engineering Urban systems can be considered as living organisms driven by materials and energy flows (urban metabolism). Once these flows are computed, the environmental profile of the city can be analysed. However, when only assessing the environmental aspects of cities, a limited view of their performance is possible, as they are complex systems in which social and economic aspects are at least as important as environmental ones. This fact raises a dilemma, since today’s developed society bases its social and economic well-being on the 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 study area; 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 (Philis 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). 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 (biodegradation of the microbial population of a 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, application and end of life sequences, including transport and other related aspects. The LCA is performed based on the methodological framework 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 included in the analysis are: Climate Change, Water Depletion, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Eutocicty. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

WE224 Life Cycle Assessment of Asphalt Mixtures vs Road Pavements D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carrion, The University of Nottingham

Road infrastructures are one of the major assets all over the world. The appropriate construction and maintenance of roads promote economic growth and development of countries. Within the field of road infrastructures, road pavements construction and maintenance require particularly high energy and raw materials consumption and generate elevated GHG emissions. For this reason, great efforts are being made in the last two decades to implement sustainable technical solutions 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 15804:2012 and GHG Protocol 2013, there is no specific methodology for selecting asphalt mixtures. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The study presented here highlights the differences between LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE225 Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourism facilities: DemEUAmed solution A. Clarét, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vergés, ECOVET; A. GONZALEZ DEL REY, A. LARPENTINO TECHNOLOGICAL CENTER / Sustainability Division; A. Calvo, IAVT - CTA, CETM / Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering

The main objective of demEUAmed 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, demEUAmed has demonstrated the integration of innovative wastewater/greywater technologies and by developing an optimised life 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. DemEUAmed 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, Catalonia, Spain. These technologies have been assessed through a comprehensive LCA, assessing the impacts for each individual technology and for the demo-site integration (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 used to assess the social aspects incurred by demEUAmed. Life cycle stages of construction and operation of technologies and facilities are considered. Final results determined that the technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demEUAmed combined strategies, the carbon footprint is reduced up to 136% (greywater scenario) or up to 62% (wastewater scenario) thanks to water recycling. 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 demEUAmed 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 demEUAmed solution.

WE226 Integrating Life Cycle Assessment and Risk Assessment to support decision making in the framework of Enhanced Landfill Mining G. Sanguv, KEU Leuven Research & Development / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering

The eco-toxological 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 might not be sufficient as the overall environmental impacts and the relative value of other impacts to accurate results. The aim of the research is to support decision making by defining 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-toxical 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-toxological 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. I. 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 considered through a life cycle analysis (LCA) perspective and compared in order to evaluate their environmental impacts and benefits provided by demEUAmed solution.

WE228
Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK
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Unsued 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. Unsued 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 disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method by the UK residents with highest estimated emission of APIs to the environment being estimated for paracetamol within the range 7.63 mg/person/day (sawageer after sink and toilet disposal) to 76.52 mg/person/day (wastewater after excretion). Based on the survey data, a life cycle assessment study was performed to assess the broader environmental impacts of typical medicinal waste disposal management practices in the UK. The functional unit of this study was 1 tonne of pharmaceutical waste generated in the UK. Three scenarios and treatments explored: incineration after returning back to the pharmacy; landfill treatment after rubbish disposal; and wastewater treatment after toilet and sink disposal. For the life cycle inventory (LCI) phase, two types of databases were used in the study: primary data from the survey study and secondary data from the ecoinvent database. Most of the datasets used in this study are from the whole of Europe (ER or the United Kingdom (GB). To carry out the life cycle impact assessment (LCIA) phase, the method that has been considered is LCID 1.0.8 2016 midpoint with AIPs. Meanwhile, USEtox 2.0 was also used in this study to calculate characterisation factors for the AIPs 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
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Tomasini-Montenegro, C. a,c, Weil, M. a,c,e HHI, Helmholtz-Institute Ulm, Helmholtztr 11, 89081 Ulm, Germany a ITAS, Institute for Technology Assessment and Systems Analysis, Karlsruhe, Germany a KIT, Karlsruhe Institute for Technology, P.O. Box 3640, 76021 Karlsruhe, Germany 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, a transformation of the energy system with a high share in renewable energy sources is necessary to reach a decarbonized energy supply. In particular, considering an energy system with active solar share to wind 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 approach 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
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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 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 IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). About 100 products and services are evaluated by using this calculation tool. However, the case number of studies using hotspots analysis tool are few, advantages and limitations are unknown. In this research, the usefulness of environmental hotspots analysis through a variety of case studies for Japanese products.

WE233
Environmental burden reduction in the FTA framework using network analysis
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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 TPP member is increased. In addition, with the importance of the improvement of environmental efficiency at industry level of a specific country, it is important to establish 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 circumstances, mega-regional Free Trade Agreement have been identified as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental 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 centrality 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, we identified the 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 emission from China and Russia are connected to other TPP member countries through the supply chain network. Finally, this study is the first to identify the critical sectors and transmitters. In the case of other FTA framework, similarly, mining and qualifying sectors in Russia and China tend to be critical sectors. Replacement of the mining goods suppliers is not easy. Therefore, FTA member countries should make a guideline for acquisition of greener materials and parts produced in the critical sectors.

WE234
Developing life cycle assessment to fight climate change
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Climate change targets could only be achieved with the contribution of greenhouse gas reduction from several GGR technologies and practices. This study (i) presents some methodological approaches for LCA of GGR technologies and ii) discusses their strengths and weaknesses. The preliminary comparison and development of approaches was based on a bibliographic review combined with expert discussions. The approaches have been classified according to their completeness, uncertainty and complexity. Several approaches were discussed: combining LCA with agent based modelling; combining LCA with climate scenarios from integrated assessment model IAM (IAM) used to assess future trajectories for GHG and climate change; combining socio-political factors with consequential LCA or using agent-based modelling for the socio-political factors affecting the choice of results from the equilibrium.
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 economic allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial acidification, 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 glycerin used to produce the thermoplastic. The paper may contribute to the eco-design of a new biobased product using an abundant residue from the tropical agriculture industry 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 biomonitors (P)
The use of lichens as biomonitors of air quality is inexpensive and effective. Whether from other than mercury may also help elucidate the potential sources of these elements: number of historic gold mining sites that are known to have persistent high levels of Mercury is a persistent pollutant present in all ecosystems. The prevalence and spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada Spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada 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 levels of mercury and arsenic in sediment. The relative contribution of local and natural 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 lichens (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 ± 591 ppb (n=340). Significant variation in mercury concentrations was observed, with the highest levels observed in samples collected from sites facing the ocean, while the lowest levels were observed at higher altitudes. In addition, the comparison of THg concentrations with those from other studies in the region revealed a negative correlation between THg concentrations and altitude, indicating that the influence of atmospheric transport is significant. The results of this study suggest that lichens can be a useful tool for monitoring mercury and other trace metals in environments with high levels of anthropogenic air pollution.
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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Yohannes, Hokkaido Univesity / Laboratory of Txicology; K.M. Muzandu,
University of Zambia; H. Mizukawa, Hokkaido University / Environmental
Veterinary Sciences; Y. Ikenaka, Hokkaido University / Graduate School of
Veterinary Medicine; H. Nakata, Hokkaido University; R. Dowling, J. Caravanos,
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Medicine
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 mean 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 in dogs and the distance between the mining area and their home. 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,
methylethylketone, nitric acid, formic acid, and toluene. In this study, we conducted
acute toxicities of these six 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 well 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 the range of 6.0 to 6.5. At least five diluted serial solutions were used to
determine LC50 values, whereas pure acetone was used in the control group. LC 50
values of sulfuric acid, methanol, methylethylketone, nitric acid, formic acid, and
toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 g/kg 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
chemical among the tested chemicals. Using the filter papers, methanol and
methylethylketone 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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C. Mazzia, University of Avignon / Biologie; M. Jobin, University of Avignon; Y.

382

Capowiez, INRA Avignon; M. Rault, University of Avignon
The earthworm species Eisenia fetida is a common organism in the soil toxicity
testing framework, however, recent studies have point out endogeic species are
more sensitive to pesticide than E. fetida. Moreover, interspecific differences in the
response of this ecological group of earthworms to agrochemicals should be
investigated for a better understanding of pesticide impact at population level.
Herein, two endogeic and abundant species in the agroecosystem (Allolobophora
chlorotica and Aporrectodea caliginosa) were incubated in Oleabladan® (ethyl
parathion)-contaminated soils. Behavioural (burrowing, casting and feeding, this
latter assessed through earthworm mass changes) and biochemical
(acetylcholinesterase [AChE] and carboxylesterase [CbE] activities) were
measured after 7 days of pesticide exposure. Our results clearly showed
species-specific differences in behavioural and biochemical biomarkers, indicating
A. caliginosa the most sensitive species to this pesticide under the exposure
conditions of our study. Although CbE activity was determined in an attempt to
account for these interspecific differences because the implication of this esterase
activity in organophosphate detoxification, we found that CbE activity of both
species had the OP sensibility. However, an in vitro inhibition trial with ethyl
paraoxon evidenced a higher sensitivity of A. caliginosa AChE activity compared
with that of A. chlorotica, which suggested that this toxicological endpoint may
contribute to the interspecific differences of behavioural responses such as cast
production rate. Our findings suggest the use of more than one endogeic earthworm
species to assess toxicity from organophosphate insecticides, overall when these
earthworms have a beneficial impact on soil fertility.
WE249
Cr transport in sweet peppers plants cultivated with vermicomposted tannery
wastes
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Rural University of Pernambuco / Chmistry; T. Oliveira, University of São Paulo /
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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, caused mainly by the presence of the chromium.
Chromium exists in oxidation states of Cr (III) and Cr (VI). As it is well known, the
trivalent oxidation state is the most stable form of chromium and it is essential to
plants in trace concentrations. In other hand, the hexavalent is toxic and
carcinogenic to mammals, even in small concentrations. Thus, the aim of this work
was to investigate the Cr transport in sweet peppers cultivated with
vermicomposted tannery wastes. In order to investigate the 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
and fruits showed a higher concentration, followed by the stalks and 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 Navenant, 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 Agrosciences
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 insecticides on non-target species. In the European 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

SETAC Europe 28th Annual Meeting Abstract Book


disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathione-S-transferases (GST) and Carboxylesterases (CbEs) 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 their age, with 97% of mortality observed in earwigs exposed to chlorpyrifos, whereas no mortality was observed in earwigs exposed to their 3 weeks; group 3 received by increased earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of CbEs. Moreover, we observed that basal-activities of CbEs and GST of unexposed individuals are higher in conventional orchards compared to OP and organic ones. All these observations support the hypothesis of a molecular target modification in AChE leading to a decrease of affinity with the insecticide, and highlight the role of CbEs ensuring effective protection of AChE. Our findings suggest the acquisition of resistance to chloropyrifos 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 species such as P. sicula (Carabodes, Brachyceridae) and A. paphia (Lepidoptera, Neuroptera) in the dragonfly collected from the pond, which shows an increase of melanocytes degranulation and the appearance of nodular/cystic formations mainly consisting of collagen fibers, typical of hepatic fibrosis. The liver of Gly-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocytes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermatogenesis is slightly slower, at low dose of Gly scattered spermatocytes II fuse to form rosette-shaped arrangement, at high dose the amount of rosettes increases and spermatids are sampled in the seminiferous tubules. Alterations in the expression of estrogen and androgen receptors and aromatase are also detected. Interestingly, in females, the ovary is not affected by Gly exposure, no matter the dose. Our results suggest that Gly exposure in a terrestrial vertebrate commonly inhabiting the fields potentially exposed to GBHs causes tissue toxicity, with possible serious health implications for wild and breeding animals as well as human populations.

WE253 Concentration of perfluoroalkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs

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Perfluoroalkyl substances (PFAS) are chemicals used as surface-active agents in diverse industrial applications. Because of their incessant disposal and release to the environment, these molecules caused the contamination of both fresh and seawaters, entailing their accumulation in the biota. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the marine food chain, and long-lived properties, so that high DDTs concentrations are observed in birds collected in the eastern Atlantic Ocean from Senegal to Angola. The geographical range of G. cruentata includes the North 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 conventional or integrated measures to control the introduction of contaminants 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 or Zn) in different tissues (muscle, hepatopancreas and gills) of G. cruentata and compare populations from contaminated and noncontaminated areas. Samples were collected in two mangrove areas along the coast of São Paulo State. The levels of contaminants were measured in the yolk of legged gull eggs laid from the last-eggs that were significantly lower compared to those from the first- and second-laid eggs.
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (grain size, pH, salinity) that reduce the mobilization of these chemicals to the tissues and, consequently, their bioavailability to the local biota. Therefore, studies of metal concentrations in mangrove areas are relevant and useful for monitoring the health of environment, maintenance of biodiversity, and for assuring the quality of life, mainly for human when consumed.

**WE255** Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Ehhydris chinesis)  
X. Luo, Guangzhou Institute of Geochemistry / State Key Lab, Organic Geochem; L.U. Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic Geochemistry; B. Mai, Guangzhou Institute of Geochemistry

Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyltrichloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring is crucial to the fate of chemicals from in utero exposure and is sensitive to developmental windows. Few studies are focused on viviparous species, but ooviviparous species have not yet been studied. It is known that watersnake (Ehhydris chinesis) was ooviviparous species. Their fertilized eggs develop into new individuals in the maternal body before producing offspring. The source of contaminants in watersnake eggs mainly derived from maternal tissues. In order to fully elucidate the deposition of contaminants in eggs, firstly, the lipid-normalized concentration ratios of egg to muscle (EMR) were usually used to assess maternal transfer efficiency of contaminants in ooviparous 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 66% for PBDEs. Meanwhile, DDTs, PCBs, PBB, HBB, PBB 153 and lower-brominated BDE congeners showed the ratios of EMR greater than 1 and 88% (the lipid percentage of egg to egg plus muscle), respectively. The results indicated that these chemicals were readily transferred from muscle to egg or preferential accumulation in egg compared with muscle. Other chemicals, such as higher-brominated BDE congeners, DP, PBB209, and DBDE, showed ratios of EMR greater than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multi-linear relationship exists between EMER and log Kow of the chemicals for the watersnake. For compounds with high hydrophobicity (log Kow > 8), a negative relationship between EMER and log Kow is observed (p < 0.001). This relationship was used as an indicator of the difference between the value of land before and after transformations is representing the damage 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 one study cycle upstream. The processes from $22364/year to $1587/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 in comparison to those leading to 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.

**WE256** Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EI-MS  
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The ultra-sensitive and high-resolution mass spectrometric (MS) methods widely used for analyzing halogenated flame retardants (HFRs) in various matrices consist of a multi-step cleanup and MS analysis. In this study, a method for the analysis of a broad range of HFRs was developed for the collaborative project called “Halogenated Flame Retardants in Water and Sediments: Determination and Risk Assessment” (Hybrid). Aim of this project is to understand the occurrence of these chemicals in different matrices, particularly in aquatic sediments, and to develop a method for analyzing a broad range of HFRs in different matrices. The method was validated using spiked river sediment samples. The detection limits of the method ranged from 0.001 to 0.1 μg/g for most of the HFRs. The method was applied to a real-life sample, a sediment sample from a river in Germany, and the concentrations of HFRs were determined. The results showed that the method is suitable for analyzing a broad range of HFRs in different matrices.

**WE257** A method to calculate carbon handprint  
T.K. Puupila, S. Vatanen, VTT Technical Research Centre of Finland Ltd; K. Grönnman, 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 good causing climate positive environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pihkola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment methods and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to determine the baseline. The carbon handprint can be created via more efficient material or energy use, by replacing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the handprint is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor and subsequent impact on the cycle. The footprints are used as target actor using the baseline situation, 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 globalisation and society is focusing on accounting for impacts of human activities is becoming more complicated. Here we developed a model based on regionalisation of Life Cycle Assessment (LCA) that is capable of employing a holistic perspective while taking into account natural land transformations that are related to the life cycle processes. Furthermore, our model can interpret the impacts of land transformations on the ecosystem quality. Economic values of Ecosystem Services (ES) are used as an indicator of 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 one study cycle upstream. The processes from $22364/year to $1587/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 in comparison to those leading to 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 companies, researchers 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 et al. 2017) highlights a number of 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 ‘capitals’ as most cost-benefit analyses used in everyday decisions assume that natural capital can be easily substituted by manmade 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 regimes based on scientifically informed political decisions. The benefits of natural capital are often not recognized by decision makers, 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 / Process and 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 sustainable vehicles of the future. This study computes total life cycle costs of a HEV motor. The analysis considered capital and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. References: Bailey, G., Mancheri, N. & Van Acker, K. 2017. Sustainability of Permanent Rare Earth Magnet Motors in (HE) 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 ( guys Content Online). Inderscience Publishers nAvailable: www.sciencedaily.com/releases/2008/02/080207094314.htm (Accessed November 27 2017).

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet—Average Spanish. Future requirements and policy recommendations

L. Batlle-Bayer, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fullan, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Aldaco, Universidad de Cantabria / Department of Chemical and Biomolecular Engineering Dietary patterns have a significant impact on greenhouse gases (GHGs), and diet choices can increase or reduce the Carbon Footprint (CFP) of consumers. Recently, more research has focused on estimating and comparing the CFP of different diets; however, high uncertainty is caused by the lack of reliable, available or representative data. The current study discusses this issue on data availability, and it results from our previous study on the CFP of the annual food consumption of an average Spanish citizen. To calculate the CFP of the average Spanish dietary pattern, a list of food categories with its representative food products was developed, and an extensive literature review was done in order to build up an inventory (inputs, outputs and emissions) per each food product. The system boundaries of this study are from cradle-to-consumer, and data for all life cycle stages (crop cultivation, farming systems, fisheries, industrial processing, distribution, and consumer use) were gathered. Furthermore, food losses and food waste along the whole supply chain were also considered. While total annual emissions, about 1.4 Tn per Spanish citizen, were considered within the useful life period of this research, the impact of the carbon footprint of food production at National level. The proxies used to fill the data gaps were considered of good quality. However, there is a need to develop inventories for production of certain food products for which there is no inventory data available, as well as other life cycle stages, such as the wholesale & retail and the consumer phase. Furthermore, we suggest the inclusion of environmental data in food policy, for example, adding the CFP of products and dietary patterns within the national dietary guidelines.

WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars

P. Girardi, P.C. Brambilla, RSE SPA / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (aYWG 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 vehicle, the geographical area where the vehicle is used; the height of the release population density of the area where the emission take place; the average level of income of the country in which the emission take place. A complete LCA of an electric, gasoline and petrol VW Golf has been carried out considering city cycle real consumptions from EPA (fueleconomy.gov) and real emissions from national inventories ( hardships (http://www.sinanet.ispribiante.it/it/sia-ispa/etranag)); The use phase of the vehicles occurs in Italy, the energy used for battery charging is the Italian marginal mix, the vehicles assembly occurs in Germany while batteries are assembled in Austria. The upstream of fossil fuel is consistent with the nowadays actual national import mix. Emissions of PMma, PM10, NOx, SO2, NH3, NMVOC, CO2 have been taken into account for externalities evaluation. Considering that most of the processes where involved, for each LCA phase accounting for more than 2% of the weighed emission of PMma, PM10, NOx, SO2, NH3, NMVOC, a specific height of realisation and geographica area have been asssing distinguished by: Italy (wher car are used and most of electricity produced), Germany (where car are produced), Austria (where battery are assembled) Lybia, Algeria, Holland, Russia (use of upstream of fossil oil-lit). LCC is a tool to met 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 externalisation of environmental impacts, in this case, has been computed by combining both approaches taking into account the different population density of urban, suburban and rural areas. The damage cost effect accounts for monetizing the environmental impacts, to be able to aggregate them with the economic costs. Responding to SCORNA’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. The fourth part presents opportunities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the LCC and LCA coupled with LCA.

WE264 Pizza: it is dangerously delicious!

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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 dynamic competitiveness of environments 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 of upstream of fossil oil-lit). LCC is a 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 externalisation of environmental impacts, in this case, has been computed by combining both approaches taking into account the different population density of urban, suburban and rural areas. The damage cost effect accounts for monetizing the environmental impacts, to be able to aggregate them with the economic costs. Responding to SCORNA’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. The fourth part presents opportunities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the LCC and LCA coupled with 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 demonstrate its application on pizza. We develop 14 marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted dietary-specific incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided \( \mu \text{DALY}/\text{y} \). 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 \( \mu \text{DALY}/\text{y} \). Human health scores for pizzas range from -35 avoided \( \mu \text{DALY}/\text{serving} \) pizza with extra meat to 2 avoided \( \mu \text{DALY}/\text{serving} \) 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 CO\(_2\)eq/serving, corresponding to -0.04 and -0.17 avoided \( \mu \text{DALY}/\text{serving} \), 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 combined metric that could be used as a benchmark for a comprehensive assessment. A next step might be to include other nutrients in the FU. An expanding 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 human or animal and it is crucial to get them through food or feed intake. AA are also used as supplements in animal feed, providing the option to reduce the protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all 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 proteins. 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 the 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, AA digestibility, AA requirements but also food function. Our study was conducted on several protein sources (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 - an overview

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Key words: monetary valuation, framework, standard, ISO 14008 The use of monetised environmental impacts and associated substances has substantially increased in the last couple of years. This trend is mirrored since 2016 by efforts at ISO level to develop standards on environmental costs and benefits. This contribution will present the result of the work achieved in ISO/TC 207/SC 1/WG 7, developing ISO 14008 whose current title is “Monetary valuation of environmental impacts and related environmental aspects — Principles, requirements and guidelines”. The work started in February 2016. After five WG meetings, ISO 14008 has reached the Draft International Standard (DIS) stage in fall 2017. The comments and ballot results of this DIS will be discussed during a WG 7 meeting in June 2018. Many organizations have experience in assessing environmental aspects and related environmental impacts resulting from their activities in physical units (e.g. tons of CO\(_2\) emitted or numbers of disability adjusted life years, DALYs). To further integrate this information into the decision making process, it is useful to have the monetary valuation study. The presentation will give an overview of the ISO/DIS 14008 document.

**WE267**

The safe and sustainable loops framework for assessing residual material flows


The circular economic system was developed to foster an industrial system that is restorative or regenerative by intention and design. An obstacle in the transition to such a system is that restoration of materials by reuse or recycling is subjected to safety legislation with an origin in the linear economy. In order to combat this obstacle, a shift is required from a purely safety based assessment to a more holistic assessment focused on sustainable development. Such a holistic assessment would allow comparing 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 profitable (SSL, for more information on the SSL see (Den Blaauwen, 2007)). This contribution focuses on materials 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 back bone that connects these modules together. The current themes which are developed into modules are: Materials 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. Apitz, SEA Environmental Decision Ltd

If we want our science to be part of the environmental decision process, we need to engage with stakeholders about what values they wish to sustain. In selecting indicators to represent stakeholder values, the challenge is to build a conceptual
framework which links measurable metrics of impact to value terms that resonate with the public, and reflect value statements made by the community. When the trade-offs are considered, it is important to consider the needs, demographics and vulnerabilities of a diverse population. Sustainability and ES concepts can and should be support environmental decision making; the application of threshold criteria ensures ‘strong’ sustainability in which environmental considerations are not neglected. The framework which guides stakeholders to consider the extent to which they prioritize impacts to all (rather than just a narrow sub-set) of their values provides for a balanced public comment process, less subject to single- or narrow-issue lobbying. Identification of the risks and benefits of most interest to stakeholders also can support negotiation and optimization of alternatives under consideration, support collaborative design of more sustainable options and help inform the design of a long-term monitoring plan that addresses community values. The goal should be to envision a sustainable approach from the beginning of a project with collaborative input from a large group of stakeholders, supporting informed, transparent, and balanced decision making that protects services of importance to the community. Tools and approaches, and the path forward, will be discussed.

Salt of the earth - causes, consequences and management of salinization of surface freshwaters, groundwater and soils (P)

WE269
Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwinia toletana
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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 isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20, 25 and 35 g/L) plus a control (LB medium). Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) was monitored. Genotypic alterations were assessed using a PCR-based molecular 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
J. Alvarenga, Jardim de Superávits, Ingeniería Agroénórica

Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) was monitored. Genotypic alterations were assessed using a PCR-based molecular 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.

WE271
Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?
B.J. Keeford, 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 via indirect via indirect competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using 'sensitive' communities collected from a low salinity site (~80 μS/cm) and 'tolerant' communities (collected from a high salinity site ~1600 μS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 μS/cm) and salinity treatments (500, 1000, 2500 and 5000 μS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbe) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether these biota were co-inhabiting with biota from a high salinity site. Such context dependent toxicity deserves greater consideration in studies of the effects of chemicals on populations and communities.

WE272
Challenges in developing a water quality guideline for water hardness
S. Bogart, University of Lethbridge / Department of Biological Sciences; E. Stock, University of Lethbridge; A. Manek, University of Saskatchewan; A. Tillmanns, C. Meys, British Columbia Ministry of Environment & Climate Change Strategy; G.G. Pyle, University of Lethbridge / Biological Sciences

Water hardness in receiving waters can be increased to levels that address 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.

Salinity is not desirable, 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 flow from areas with intense agriculture. This latter led to an increase of flooding periods, a decrease of soil salinity in the most saline sites and increased in the least saline ones. Following these changes, damages in protected habitats were observed, due to the proliferation and increase of biomass of several species. Sarcocornia fruticosa, Phragmites australis and Juncus maritimus strongly expanded at the wettest sites, which led to the disappearance of the original zonation pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.
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. Schüfer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg

The political aim of achieving good ecological quality of all European water bodies requires knowledge on how to prioritize stressors and human pressures for management based on their relative impact. A challenge thereby is the frequent co-occurrence of multiple stressors. We applied eco-epidemiological approaches to large scale monitoring data from Saxony, Germany, to investigate the relative contribution of different water quality and land-use gradients to ecological change. Two approaches were applied: First, water quality gradients (e.g. oxygen, conductivity, phosphorus and micropollutants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchically partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, SPEAR %) as response variables. Secondly, individual taxon responses with respect to different water quality gradients (including also major ions such as potassium, sodium, chloride etc.) were assessed using Threshold Taxa Indicator Analysis (TITAN). The method is based on change point and indicator species analysis and allows the identification of ecological change points that may be used to derive environmental quality criteria. Both regression analysis and TITAN results indicate a high impact of oxygen and salinity, which were associated with both the taxonomic and habitat quality gradients. Although observed associations may not be direct causes of ecological impairment, it may be worthwhile to implement legally binding quality standards for these variables. Of the 324 analyzed taxa 23% had change points far below the German orientation value for chloride (200 mg/L) that should not be exceeded to achieve good ecological status according to the water framework directive. Thus, lowering of oxygenation and associated ions should be considered and protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE274

Estimating protective potassium concentrations for freshwater mussels, a taxon of global conservation concern
T. Augspurger, U.S. Fish and Wildlife Service / Ecological Services

Globally, there are about 620 species of freshwater mussels (Family Unionidae), and IUCN lists 28 species as extinct and 106 as endangered or critically endangered. Mussels are among the most sensitive freshwater organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 504 mg/L and proposed for discharge to a stream with endangered mussels necessitated derivation of protective potassium limits. We used regression analysis and associated ions should be considered and protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE227

LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input.

Management measures in the northern Venice Lagoon (NE, Italy)
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The northern Venice Lagoon (SCI IT3250031) holds several Annex I-listed habitats of the Habitats Directive, such as the habitat type 1150* (Coastal lagoons). Recent monitoring activities showed that conservation status of the habitat 1150* is improving within SCI IT3250031, but it is still unfavourable in the inner landward lagoon area due to lack of ecological processes, favouring self-regulation processes, between lagoon and mainland. In the past, the project area was occupied by reedbeds in large amounts, now significantly reeded due to increasing of lagoon water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between the lagoon and mainland); restoration of intertidal morphology through 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 by aquatic plants of low-salinity environments. The project aims to exploit the spatially-distributed effluents and synthetic solutions (e.g. NaCl-CaCl₂) of systerm to: counteract the depletion of lagoon bottom and fish communities; reduce eutrophication through reedbed phytoremediation function, favouring the presence of sensitive species and high ecological value aquatic plants; improve conservation status of bird species, including those listed in Annex I of the Birds Directive; increase the presence of fish species, listed in Annex II of the Habitats Directive. The restoration of salinity gradients will also contribute to increase biodiversity on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE276

Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity
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Effluents (produced and flow-back waters) from the petroleum industry have been between 600 and 1000 mg/L of potassium and chloride for their potential toxicity to the environment, particularly in regard to chemical composition and salinity. The purpose of this study was to investigate whether their toxicity is any greater than exposure to solutions of similar salinity. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 8 weeks under hydroponic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared the salinity effect of diluted effluents and synthetic solutions (e.g. NaCl-CaCl₂) of systerm. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomass of both plants were greater from industrial wastewater than the comparable brine solution. Furthermore, these results highlight that the natural wastewaters contained abundant inorganic and organic substances that may have triggered plant survival and salt-tolerance. F. rubra grew under salts stress, and presented a mechanism to crystalize salt on their leaves. Hence, plant uptake, under certain conditions, may be promoted as an alternative treatment for high salt concentrations.

WE277

Contribution to the salinization risk assessment, under drought conditions, in the Alqueva irrigation area (South Portugal)
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In Mediterranean regions, climate changes have enlarged water limitation for crops, leading to an increased demand for irrigation water. During the hydrological years of 2015 and 2017, Portugal had a drought conditions throughout almost the entire mainland territory reaching a severe drought level. Under water scarcity conditions and high atmosphere evaporative demand, the risk of land salinization is one of the major threats to the sustainability of irrigated agriculture. Therefore, it is very important to assess the quality of irrigation water and the risks of salinity for crop production, in order to adopt appropriate management practices in irrigated areas. This study is focused on the salinity risks for the production of the most representative crops grown in the Alqueva irrigation area. This is a large irrigation scheme with a total area of 120 000 ha centered in the Alqueva reservoir. For the purpose of the study, a chemical assessment of some
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻ and Cl⁻), pH and electric conductivity (ECₑₐₑ), 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 (ECₑₐₑ) 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 concentration related with water salinity is a concern of 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 (P)

WE279 Investigating wildlife diets using high-tech DNA sequencing
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In wildlife risk assessments according to EFSA (2009), the ingested diet is one of the core factors to define exposure, using default diet compositions in the first tier risk assessments. The so-called PD factor (compositions and portions 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 naturally occurring diets, i.e. diets not collected by faecal samples, or feces, or stomach flushing. 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 for different orders of plants or monocotyledonous plants only. However, this is rather time-consuming and imprecise. Recently, DNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful on identification of relative abundances of plant species from faecal samples. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

WE280 Design of a Real-Time PCR array to analyze the gene expression in Physella acuta (Gastropoda) in chemical stress and starvation
M. Novo, J. Martinez-Guitarte, UNED / Fisica Matematica y de Fluidos
Molecular endpoints are nowadays under study 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 are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge in putative molecular endpoints and to evaluate some genes as biomarkers, a Real-Time PCR array has been designed for Physella acuta. This species of freshwater snail is used in environmental toxicology studies and it has been proposed as an adequate species for toxicity tests because of its sensitivity to different toxicants and ease of culture. A transcriptome for this species was assembled, by sequencing cDNA libraries from individuals of different developmental stages and exposed to different toxicants. Comparison with database allowed the identification of genes involved in pathologies related to toxicity (selected 42 of these genes plus six genes used as reference to design an array for Real-Time PCR analysis. Stress response, detoxification mechanisms, endocrine system, or epigenetics were some of the pathways analyzed in the array. In order to validate the toxicological and ecological interest of this approach, individuals were treated with an antibiotic, tetracycline, for seven days or were left starving for 7 and 10 days. The results obtained for these experiments are presented, showing the interest of designing specific arrays to perform more detailed analysis of molecular endpoints that can be related with toxicant mode of action and stress situation. We hope that the methodology presented here can serve as an example for the study of other species in order to improve our knowledge of their biology. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CTM2015-64913-R.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis
J. Semmoum, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecol, 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 continue. 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 thermic 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-sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will potentially be very useful in order to test the dose dependence of gene 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.

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 Ugge, Lund University / Biology; A. Jonsson, University of Skövde / Department of Bioscience; O. Berglund, Lund University / Dept of Biology
In the field of ecotoxicology, modern transcriptomics technologies have the potential to improve and complement current toxicity assessment methods and biomonitoring protocols. Early warnings of general stress and specific toxic modes of action could in theory be used as biomarkers of pollutant exposure or adverse effects. However, necessary base level understanding is currently lacking considering how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more traditional 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 acclimation to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1, 10 and 100 μg Cu²⁺/L), 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 species of the same gene, and (ii) between different stressors in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation
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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 genomic model organism for soil toxicity studies. Although laboratory
experiments with a transcriptomics approach are essential to unravel modes of action. Therefore, in the present work, we investigated metabolic perturbations in juvenile gill-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, since some metabolites were significantly altered only in some tanks, all the datasets were subjected to principal component analysis (PCA) to obtain a general overview of the metabolomes, followed by multivariate analysis of variance (MANOVA) to test the differences between control and exposed organisms. The time-series statistical analysis was carried out to identify the major trends (adjusted p-value < 0.05) associated with the interaction between exposure day and animal group (exposed or control). 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 proteomics and metabolomics as complementary tools for monitoring stress effects on the organisms. Keywords: Benzophenone-3, gill-head bream, non-target metabolomics. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CMT2014-56268-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

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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 effluents from the same paper industry, in an effort to evaluate the potential of employment of embryos of the 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 was...
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. Carpio, University of Portsmouth / Biological Sciences; T. Werner, Ecotox Centre, UK Environment Agency; D. Thell, Department of Anatomy Physiology and Cell Biology; S. Robson, University of Portsmouth / School of Pharm & Biomedical Science; A. Ford, University of Portsmouth / Biological Sciences

Pesticides, pharmaceuticals, industrial chemicals and complexing agents coming from sewage effluents, can be detected in the aquatic environment in very low concentrations. They are able to impact ecological communities, causing biological alterations in many species. Although biomarkers in vertebrates have long been applied, attempts to monitor dysfunctions in invertebrates using orthologous genes have produced inconsistent results. Gammarids are a group of amphipods that have been shown as very sensitive to pollution, having been used in various studies for toxicity evaluation of river waters through exposure to many different chemicals. However, to date most studies have been focusing on specific life-cycle stages, potentially missing complex interactions among expressed genes not involved in development. The aim of this study is to provide a set of new transcriptomic and metabolomic markers in *Gammarus fossarum*. After validations in further studies, the new biomarkers found in this project could be used to evaluate the state of aquatic ecological niches and the efficiency of wastewater treatment plants (WWTPs). Amphipods were sampled from a freshwater stream located in Eigg, Scotland and in September 2017, using standard kick-net method. This stream flows through an industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential intersexuality phenotypes. The RNA samples have been sequenced by Illumina Genome Analyser. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between transcriptomic and metabolomic markers will be carried out, thereby contributing to the understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

**WE290 Optimising the algal toxicity test towards generation of multi-omics data and adverse outcome pathway discovery**

S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; J. Zhou, S. He, University of Birmingham / Environmental Science; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences

The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KEs) to apical endpoints relevant for chemical risk assessment. Currently, only few methodologies can be considered for an accurate and reliable discovery and quantification of KEs in an exhaustive approach, commonly requiring sustained research effort. In this context, the objective of our presented proof-of-concept study was to showcase the identification and characterisation of molecular KEs from the molecular stress response of *Chlamydomonas reinhardtii* towards toxic insults using a high-throughput genome-wide scaling multi-omics technologies. The approach towards achieving this end was a suite of untreated (direct-infusion mass-spec, DIMS; RNA sequencing) and targeted (LC-MS/MS, -UV, -qRT-PCR) metabolomics, lipidomics and transcriptomics technologies. This methodology enabled us to profile the concentration- and time-response profiles of molecular signatures from algae exposed to non-specific mechanism (baseline toxicity) and target-specific mechanism (carotenoid biosynthesis inhibition) toxicants. To enable this work, a rigorously controlled algal culturing and testing system was optimised regarding growth rate, final cell density, pH stability, cell cycle synchronisation, reproducible exposure to volatile chemicals, and rapid quenching and harvesting of biomass for omics data collection. Furthermore, a unique multi-phase experimental design was developed for rapid identification (untargeted), characterisation and verification (targeted) of putative KEs over a time-course design. Multi-omics data from toxicant-exposed *C. reinhardtii* were collected and initial progress made towards computational analysis, putative KE designation, and targeted verification of identified biomarkers. With this study, a powerful experimental approach for hypothesis-free KE discovery and AOP hypothesis is being developed, employing omics-driven algal phenotyping to advance the integration of omics data into AOP development and ultimately, to provide mechanism-based support for regulatory decision-making in environmental risk assessment.

**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. Mytilus galloprovincialis were exposed to a range of concentrations of Cu (5, 32 µg/L) and Pb (5, 25 µg/L) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included: energetic pathways, 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. Mytilus galloprovincialis were exposed to a range of concentrations of Cu (5, 32 µg/L) and Pb (5, 25 µg/L) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included: energetic pathways, molecular and physiological measures with bioinformatics adoption of the new biomarkers found in this project could be used to evaluate the state of aquatic ecological niches and the efficiency of wastewater treatment plants (WWTPs). Amphipods were sampled from a freshwater stream located in Eigg, Scotland and in September 2017, using standard kick-net method. This stream flows through an industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential intersexuality phenotypes. The RNA samples have been sequenced by Illumina Genome Analyser. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between transcriptomic and metabolomic markers will be carried out, thereby contributing to the understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

**WE292 The Identification of Toxicological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii**

G. Reynolds, Unilever / Safety and Environmental Assurance Centre SEAC; S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; J. Zhou, S. He, University of Birmingham / Environmental Science; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences

Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanism prevents accurate predictive risk assessment. Adverse outcome pathway (AOP) frameworks for pollutant toxicity have been constructed in 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 literary evidence, with focus on ‘omics and multiple endpoint assay data, for the selected herbicide, norflurazon. This hypothesised AOP allowed development of targeted assays for investigation of predicted key events in a time- and concentration-response methodology. LC-UV was used to monitor suspected toxicological markers of the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thioredoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoene accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later times. Using a clearance rate of 0.25 μg/L/h, the rate of loss of phytoene 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 2000 μg/L after 24 hours. This study highlighted the necessity for use of synchronous algal cultures for accurately understanding mechanism, as this would enable more accurate determination of time- and concentration- responses due to diurnal algal life cycles. Ultimately, this work has shown proof-of-concept and laid the foundation for development of a quantitative AOP for phytoene desaturase inhibition leading to growth inhibition and population decline.
Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)
M.T. Schmitz, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; A. Tollefsen, University of Saskatchewan / Toxicology Centre; C. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; D. Green, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bluhm, University of Saskatchewan / School of Environment and Sustainability; T. Lane, University of Saskatchewan; N. Baldwin, J. Taghavimehr, A. Masse, University of Saskatchewan / Toxicology Centre; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences; H. Hollert, RWTH Aachen University / Institute for Environmental Research; N. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Bioresources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre
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 comparably high exposure concentrations, dietary routes of exposure or intraperitoneal 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 d 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).

SETAC OMSICS Interest Group
B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxicoology: from mechanisms to risk assessment (P)

Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications
J. Thuijlow, NIVA - Norwegian Institute for Water Research / Freshwater Ecology; L.C. Lindeman, Norwegian University of Life Sciences / Dept. for Basic Science and Aquatic Medicine (BasAm); Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Kamstra, NMBU / BaSam; L. Xie, NIVA - Norwegian Institute for Water Research; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; K. Apenova, C. Grimard, University of Saskatchewan / Toxicology Centre; A. Nallathayil, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; K. Tollesen, NIVA / Ecotoxicology and Risk Assessment

Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analysis is enabled by the genome of the closely related D. pulex. Epigenetic mechanisms allow gene regulation in a developmental context and 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 advantage of an in-silico ChIP-M code give insight on how these proteins 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-Azacytidine, resulted in a global reduction of DNA methylation in Daphnia magna. One region, however, H3K4me3 and H3K27me3 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-Azacytidine exposure when characterizing epigenetic stress response in D. magna.

Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution
A. Bertucci, F. Pierron, Université de Bordeaux / UMR EPN-CNRS 5805; T. Ye, T. Christelle, IGBMC / CNRS UMR 7104 - Insen U 964; P. Gonzalez, University of Bordeaux / UMR EPN-CNRS 5805; M. Baudrimont, Université de Bordeaux / UMR EPN-CNRS 5805

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. In the European eel Anguilla anguilla by using next generation sequencing, we identified 210 evolutionary conserved and 140 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 therefore provide innovative 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.

Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)
L.V. Laing, University of Exeter / Biological Sciences; H. Littler, J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; N. Bury, Kings College London; R. van Aerle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; R. Wilson, University of Exeter / Biosciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences
The sustainability of fish populations in our increasingly polluted environment is critically dependent on their ability to adapt via (epi)genetic mechanisms. Copper is an essential element but when present at high concentrations in the water it can become toxic to aquatic organisms. Recent studies in the UK suggest that copper is the most significant metal pollutant threatening fish in UK freshwaters. We conducted a series of copper exposures in stickleback to investigate whether prior exposure can result in altered susceptibility in subsequent generations. Stickleback embryos were exposed to 0.015mg/L copper during early life (0-9dpf), causing ~1.2% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos reared in 0.015mg/L copper 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 leading to altered copper handling and increased 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)

Do global warming increase bioaccumulation of copper nanoparticle in freshwater fish (Oncorhynchus mykiss) and Daphnia magna?
B. Campos, Unilever R&D / Environmental Chemistry

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 attention has been paid to the effect of warming on whether increased the bioaccumulation of copper nanoparticle 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 exposure to 25 nm of copper nanoparticle (0.3 mg/L) under different temperature (26, 28 and 30?) for periods of 7 days for uptake and 7 days for depuration, to analyze the accumulation of nanoparticle 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 28? 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, Institute for Ecology and Environmental Research / Bioanalytical Ecotoxicology, A. Ale, Inali-Conicet; C. Jimena, Instituto Nacional de Limnología (CONICENT-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.

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observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NP, 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-NP) a detoxification pathway involving LDH activity. Furthermore, an extensive reactive oxygen species (ROS) may have led to the inactivation of extracellular and cell-associated enzymes related with the mechanisms of cell apoptosis. 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, compromising their fitness. Furthermore, since these effects occur at very low concentrations (as low as 0.002µg/ml) it should be classified as “extremely toxic” (EC20 < 0.1 µg/mL; CEC, 1996), suggesting a high environmental risk.

**WE304** Interaction of the biodegradable triclosan and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation

L. Politorski, 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) will occur more frequently in the next decades. Thus, MWCNT release into the aquatic environment due to degradation of the polymers is inevitable. Changes in their properties might happen by several abiotic influences, like weathering by sunlight radiation. MWCNT undergo several 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) have altered aggregation and sorption properties compared to pristine triclosan (TCC). This might lead to a different environmental fate of both the wMWCNT and the contaminants in aquatic ecosystems and eventually an enhanced chronic or mixture effect on organisms like freshwater algae. In our studies we examine the chronic effects of wMWCNT and the ‘Trojan horse’ effects of TCC in presence and absence of wMWCNT on Pseudokirchneriella subcapitata and Chlamydomonas reinhardtii. Growth inhibition tests were performed according to OECD test guideline 201. In a first part of experiments, the growth inhibition of both species was tested in the range of 10 – 60 µg/L for TCC and 0.1 – 16.0 mg/L for wMWCNT. The mixture toxicity of a TCC test series (10 – 60 µg/L) and 100 µg/L wMWCNT was additionally investigated on P. subcapitata. A second series of experiments was carried out by adding the highest TCC concentration (60 µg/L) to variable wMWCNT concentrations to figure out, which wMWCNT amounts are necessary to reduce the toxicity of TCC. We determined a concentration dependent growth inhibition of P. subcapitata for TCC and TCC + 100 µg wMWCNT/L with an EC50 of 37 and 36 µg TCC/L, respectively. This amount of wMWCNT appears to be not sufficient to adsorb the entire free TCC from the water phase, which eventually leads to very similar EC50 values in both scenarios. Only in a second experiment it could be shown, that wMWCNT amounts > 1 mg/L reduce algae growth inhibition completely caused by 60 µg TCC/L. Regarding to mixture effects of TCC and wMWCNT to algae, bioaccumulation of wMWCNT by freshwater algae needs to be investigated, especially in respect to long term incubation times and low wMWCNT amounts.

**Acknowledgements** The work is supported by the European Project ‘icts-Transfer’ that receives funding from the Bundesministerium für Bildung und Forschung (BMBF), under agreement with the SETAC Europe 28th Annual Meeting Abstract Book

**WE306** In vitro toxicity of model ZnO nanoparticles on Hemocytes of mussel Mytilus galloprovincialis

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Zinc oxide nanoparticles (ZnO NPs, size 58 nm, as calculated using X-Ray diffraction data) were manufactured through Flame Spray Pyrolysis, and their effects were subsequently investigated on hemocytes of mussels *Mytilus galloprovincialis*. Following the collection and preparation of cell suspensions, mussel hemocytes were treated for 1 h with different concentrations of ZnO NPs (5, 10, 25, 50 and 100 µg mL⁻¹). Zinc exposure was performed without and with positive control, from a stock solution of ZnCl₂ (10 and 25 µg mL⁻¹); positive control, from a stock solution of ZnCl₂, in 2dH₂O, in 1:1 ratio. Afterwards, stress indices such as (a) cell viability (in terms of Neutral Red Retention Time/NRRT assay) (b) the generation of superoxide radicals (O₂⁻), using Nitro blue tetrazolium/NBT, (c) the production of nitrogen oxides (NO, in terms of nitrites), and (d) lipid peroxidation (in terms of malondialdehyde/MDA equivalents) were measured. The results demonstrated a significant increase of cell death after treatment with ZnO NPs at concentrations higher than 5 µg mL⁻¹, with maximum values (>50%) of cell death after exposure to ZnO NPs 50 µg mL⁻¹. Furthermore, hemocytes treated with sub-lethal concentrations of ZnO NPs (5-25 µg mL⁻¹) showed a significant increase of O₂⁻, NO and MDA, compared to those values observed in control cells in each case. Finally, the results of the exposure to ZnO NPs were compared with the respective results after exposure to ZnCl₂, showing a similar pattern. Those effects of ZnO NPs on mussel hemocytes confirm the cytotoxic and oxidative potential of well-promised nanomaterials, such as ZnO NPs, widely used in a variety of new cutting-edge applications.

**WE307** Toxico-transcriptomics as tool to identify nano-specific toxicity profiles

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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 ≤ 0.05).

**WE308** Zinc toxicity to A549 cells and Daphnia magna changes with iron oxide nanoparticles

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The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is based on their ability to adsorb and immobilize metals and decrease their bioavailability. However, the adsorption of metal contaminants by nanoparticles can also potentially increase the toxicity of either NPs or the metals, for example due to the Trojan horse effect. In this study, we evaluated the acute effect of zinc (Zn) as zinc sulfate heptahydrate (ZnSO₄·7H₂O) after an incubation period with a fixed concentration of humic acid (ha) coated IONPs (ha-IONPs), on the in vitro toxicity to human A549 cells and on the toxicity to *Daphnia magna* as a model freshwater invertebrate species. Non-toxic concentrations of ha-IONPs were selected for the
assays taken also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45g/L and 0.52 g/L for the A549 and 24h the Daphnia magna experiments, respectively. In A549 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 24h in terms of IC_{50} (0.006 g/L vs. 0.010 g/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC_{50} for Zn was 0.070 g/L with ha-IONPs vs. 0.014 g/L without ha-IONPs, respectively). This indicates a potential protective effect of IONPs at high metal concentrations and a synergistic effect at low metal concentrations. These experiments were also conducted in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect of co-incubation with ha-IONPs was observed. Optical microscope images showed that ha-IONPs aggregates were uptake by the cells during the experiments. Therefore, even if adsorbed on ha-IONPs nanoparticles would reach intracellular compartments. Differences in the relative uptake of free vs. ha-IONP adsorbed zinc as well as intracellular bioavailability of Zn in these two forms would be explaining the changes in the dose-response curve that were observed. Acute studies (up to 48-hours) with Daphnia magna showed a protective effect of the ha-IONPs on the toxicity of Zn. The EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.1 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their co-precipitation in the exposure media. This settling process would decrease the bioavailable zinc concentration in the exposure medium and therefore its toxicity in Daphnia magna.

WE309

Internalization of graphene-related nanomaterials in fish cell lines
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The H2020 NanoReg2 project aims to develop and implement grouping and Safe by Design strategies for nanomaterials (NMs). For this purpose, toxicity of selected carbon-based NMs have been assessed in order to refine Safe by Design approaches considering three pillars: safer product, safer use, and safer production process. Graphene-related nanomaterials (GRMs) are among the newest and most important NMs. The potential of these NMs to interact with the environment is dependent of their physicochemical properties, which vary widely. Therefore, before any environmental risk assessment is possible, a deeper understanding of their interactions with aquatic systems is needed. In the present study we focussed on the uptake and intracellular fate of these NMs. Cells were exposed to three different concentrations (non-exposed, 0.01 mg/L, 0.1 mg/L) of each NM for 72 h. Transmission electron microscopy was used to investigate possible internalization and intracellular fate of these NMs in hepatocytes and macrophages. All GRMs were visualized in both cells even at the lowest exposure concentrations. Carbon nanofibers were taken up into vesicles of hepatocyte cells in a size-independent manner, whereas in macrophages, longer CNFs were encountered free in the cytoplasm and only the shorter CNFs were localized in membrane-bound compartments. GO sheets were present within vesicles as well as free in the cytoplasm of both cell types. Understanding the behaviour of these NMs in various exposure systems is essential for the assessment of their environmental risks and to determine their fate in different environments. This research is supported by the EU’s Horizon 2020 research and innovation programmes (NanoReg2, Grant Agreement n° 646221 and MSCA IF-2016, Grant Agreement n° 746876).

WE310

Molecular mechanism and physicochemical properties of Cadmium-TiO2 nanoparticle mixtures when co-exposed to the nematode Caenorhabditis elegans
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The number of engineered nanomaterials (ENMs) is rising continuously in consumer products and industrial fields. Therefore, knowledge about their ecotoxicity in aquatic and soil systems is very important but rare. Nanoscale titanium dioxide (nTiO2) is probably among the most relevant ENMs with a projected accumulation rate in European river sediments of 1.4 mg kg^{-1}yr^{-1} (Gottschalk et al., 2009). It is commonly known that nTiO2 is far more toxic to the nematode Caenorhabditis elegans than bulk TiO2, especially under simulated solar radiation (SSR), probably a consequence of its photocatalytic property. Further experiments by Samet (2017) focused on the interaction of nTiO2 with cadmium (Cd), another environmental contaminant. C. elegans was exposed to nTiO2 (P25, primary particle size of 21 nm) and Cd in single and co-exposure for 72 hours under dark conditions and SSR. Choosing growth and reproduction as toxic endpoints, co-exposure with 40 mg L^{-1} nTiO2 and 50 μg L^{-1} Cd under SSR led to a synergistic inhibitory effect of 80% of reproduction, twice as high compared to nTiO2 alone. As Cd is known to induce intracellular calcium signaling as part of protective cell processes (Thévenod, 2009), in the study presented here, 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 is a Ca2+ channel blocker, the combination of nTiO2 and Cd could show the same effects under SSR. 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 heparinase will be tested. First results will be presented. Angelstorf et. al., 2014. Environ. Toxicol. Chem., 33, 2288-2296. Gottschalk et. al., 2009. Environ. Sci. Technol., 43, 9216-9222. Samet, Abstract SETAC Brussels 2017. Thévenod 2009. Toxicol. Appl. Pharmacol., 238, 221-39.

WE311

Influence of temperature and salinity on toxicity of zinc oxide nanoparticle on the marine copepod Tigriopus japonicus
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Zinc oxide (ZnO) nanoparticles (ZnO-NPs) has a size of 55 nm, the 7th most prevalent nanomaterial (NM) in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-care products, from which ZnO-NP can be easily leached. Annually, around 250 tonnes of ZnO-NP were estimated to be released from sunscreens alone into the marine environment. However, there are no comprehensive regulations of NMs, including ZnO-NP, in any countries due to the diverse physicochemical properties of NMs and their complicated interactions with the environment. In the marine environment, ZnO-NPs are exposed to various environmental factors, such as temperature and salinity, but influences of these factors on the physicochemical properties and toxicity of ZnO-NP are often tested individually. As both factors co-exist in the environment and may influence one another, it is vital to study their effects concurrently to tease out any potential interactions. This study, therefore, investigates the interacting effects of temperature and salinity on ZnO-NP to a common marine copepod (Tigriopus japonicus) along the Western Pacific coast. Physicochemical properties (aggregate size & ion dissolution) of three zinc-associated compounds, including ZnO-NP, ZnO bulk-particles (ZnO-Bulk) and ZnSO4·7H2O (ZnSO4), were characterized to compare their toxic mechanisms. Acute toxicity was determined with 96-h standard toxicity tests under nine different combinations of temperature (15, 25, or 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 x 3 factorial design. Preliminary results showed that increase in temperature and salinity could increase aggregate size of ZnO-NP and ZnO-Bulk, but reduce their ion dissolution rate. At 25 °C, similar to previous studies which suggest that ZnO-NP and ZnO-Bulk might be due to particle and animal interactions such as physical damage by larger aggregate at larger salinity. The results will advance our understanding of interactions of ZnO-NPs with aquatic organisms, from which we will be able to determine effect threshold concentrations for regulation of products of ZnO-NP under different combinations of these two environmental factors.

WE312

Multigenerational effects of gold nanorods to Raphidocelis subcapitata and Chlorella vulgaris
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In real scenarios, exposure to nanoparticles may occur over several generations, which may exhibit a higher sensitivity (due to the accumulation of adverse effects) or tolerance (due to phenotypic plasticity mechanisms) to the nanoparticle. The aim of this study was to evaluate the multigenerational effects of gold nanorods (AuNR) on two freshwater microalgae: Chlorella vulgaris and Chlorella subcapitata. These species were exposed, for four generations (F1 to F4), to the respective Au-NR concentration causing 10% reduction in growth rate (EC_{10}, computed for F0). The sublethal sensitivity of each species to Au-NR was then quantified and compared among generations, i.e. generations not exposed to (F0) and exposed to Au-NR (F1 to F4). For this, algae were exposed to concentrations of Au-NR ranging from 8 to 90 μg mL^{-1}, for 72h. At the end of the assays, growth rate was computed for all generations of each alga. The following physico-chemical parameters of Au-NR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent
cetyltrimethylammonium bromide (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of Au-NP: 90 μg/L for C. vulgaris corresponding to 0.257 mM of CTAB. Chlorella vulgaris exhibited a higher tolerance to Au-NR than to Au-NP. The species significantly increased its sensitivity to Au-NR from F0 to F2 generation, but recovered a similar sensitivity to that quantified for F0 from F2 to F4. CTAB significantly reduced the growth of microalgae by 42%. Over generations, the sensitivity of the two algae species to CTAB was not changed. The results obtained in the present work reveal that traditional standard 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)**

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Nowadays, global warming and aquatic acidification were occurred by rising carbon dioxide (CO2). The factory 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). For this, the embryos were exposed to 25°C/6.5 for 14 days with copper nanoparticle (30 μg/L) 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/5.5, and 30°C/4.5) 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 conclusion, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

**WE314 The use of the marine mussels Mytilus hemocytes as a model for studying the impact of NPs on innate immunity**

M. Auguste, University of Genova / DISTAV; T. Balbi, L. Canesi, University of Genoa / DISTAV

Nanoparticles (NPs) are widespread used in consumer products and industry; they are showing increasing interactions with their biological potential impact on environmental species. Recent studies have demonstrated that NPs could affect a number of marine species, and interact with their immune system. Within the PANDORA project (Probing safety of nanomaterials and massively used for multiple purpose to improve human life), the use of marine mussels Mytilus galloprovincialis, for in vitro testing is a valuable tool in the screening of the toxicity of NPs as the tests are inexpensive and use alternative animals in experimental science. In vitro analysis are performed to determine functional toxicity of NPs as the tests are inexpensive and use alternative animals in experimental science. The use of mussel hemocytes, from Mytilus galloprovincialis, for in vitro testing is a valuable tool in the screening of the toxicity of NPs as the tests are inexpensive and use alternative animals in experimental science. Immune parameters (e.g. lysosomal membrane stability, superoxide and NO production, phagocytic activity) and particle internalisation by hemocyte upon short-term exposure to NPs (different concentrations and times of exposure from 30 min to 1h). Once entering the organism, NPs are in contact with other type of media e.g. hemolymph serum for mussels. For some type of NPs, the response is affected by the presence of proteins in the hemolymph serum involved in the formation of a NP-protein corona. In order to have a wider view of the interactions and mechanisms of actions of NPs, the same parameters are measured with NPs suspensions in artificial seawater (ASW) and serum. The results obtained with Mytilus hemocytes will be compared with those obtained in immune cells of other model organisms within the PANDORA project. According to the special properties of every NPs, the aim is to understand the main mode of action at the cell level that will help developing predictive in vitro assays to measure the immuno-risk of NPs to the environment in the future. *Funded within the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement PANDORA No 671881.*

**WE315 Influence of warming and acidification on copper nanoparticle bioaccumulation in medaka (Oryzias latipes) embryo**

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The level of atmospheric CO2 has elevated significantly since the Industrial Revolution, leading to global warming and ocean acidification. With the development of industry and technology, many emerging contaminants such as copper nanoparticle (CuNPs) may be exposed to environment. However, it is unclear whether the accumulation of copper nanoparticles in organism will increase under the warming and acidification scenarios. Therefore, the purpose of this study is to investigate whether CuNPs (25 nm, 0.03 mg/L) will accumulate in Japanese medaka (Oryzias latipes) embryo under the condition of elevated temperature and 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/5.5, and 30°C/4.5). 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**

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Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in nanotechnology in the last decade 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 mixture effects due to heavy metal-ENMs interactions. Studies suggests that the toxicity of ENMs such as metal oxide nanoparticles is mainly due to the release of dissolved metal ions. However, majority of these studies have mainly focused on impact of ENMs in freshwater environment and results are extrapolated for other types of environmental systems (marine, soil, sediment). Evidence is accumulating that the dissolution of ENMs is dependent on the concentration of the exposure medium. As a result, the combined toxicity of heavy metals (Cu and Zn) and their metallic 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 of the metal, which could alter the biological effects of the exposure medium. Therefore, we concluded that there was no influence of Cu accumulation in medaka embryo when warming and acidification occurs in the future.

**WE317 Comparative toxicity of silver nanocolloids and titanium dioxide nanoparticles using medaka**

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Silver nanoparticles and titanium dioxide nanoparticles are representative nanomaterials and mass extensively used for multiple purposes in our daily 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, Φ 40 nm) using medaka model. SNCS have hemolytic ability (at 0.5 mg/L of SNC) and (at 5 mg/L of SNC) toxicities including lethality, inhibition of embryo development, shortened body length, small eye development, ischemia, reduced heart beating, and caused some oxidative stresses such as GSH reduction and lipid peroxidation. To adults, SNC 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 resulted 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, Φ 90 nm) are well-known cause oxidative stress by UV radiation; however, there are some reports that TiO2-NP does not have significant toxic effect to fish other than
hypertrophy of gill mucus. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. TiO$_2$-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNCs). In exposure of 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 TiO$_2$-NP regarding general toxicity, oxidative stress, cytotoxicity (apoptosis and necrosis), immuno-toxicity, and tolerance to 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. Załęska-Radziwill, A. Affek, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology

Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique 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 new techniques, which can be used for DNA analysis in the field of genetic toxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The SOS-Chromotest is one of the most commonly used bacterial tests. It is based on the induction, by genotoxic compounds, of a bacterial SOS repair system conjugated to the b-galactosidase gene and the subsequent measurement of the enzyme expression. In this work, genotoxicity studies on the basis of the RAPD-PCR and SOS-Chromotest assay were performed for aluminium oxide nanoparticles (nanoAl$_2$O$_3$). Lethal exposure of bacteria on the fate, transport, and effects of nanoparticles, including metal based particles such as nano-Al$_2$O$_3$, in the environment. The interest in nano-Al$_2$O$_3$ 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 Al$_2$O$_3$ macro. The nano-compound caused changes in the genetic material of bacteria A. hydrophila. Decrease in sensitivity of obtained profiles of bands for primer OBF$_2$ 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-Al$_2$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-Al$_2$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. Y. Simms, G.P. Cobb, Baylor University / Department of Environmental Science

Copper oxide nanoparticles (nCuO) and arsenic (As) phytotoxicity to rice plants (Oryza sativa japonica) was evaluated in a factorial study using (0, 0.1, 1.0, 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. Toxictants 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 growth 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 toxictants was also significant on both FW and NRP. A decrease in the FW was observed for rice exposed to As, only. The midlevel concentrations (1.0 and 10 mg/L) of nCuO decreased the FW with no As addition, while higher concentrations (50 and 100 mg/L) significantly increased the NRP. Low and high nCuO concentrations (0.1, 50, and 100 mg/L) decreased the FW with the As addition, and NRP decreased in treatments receiving As along with either lower or higher nCuO concentrations. More data from this greenhouse study are currently being compiled and analyzed to determine the effect of As and nCuO on grain yield as well as Cu and As uptake, distribution, and speciation in rice plants and the grain.

**WE320**
Behavior of cerium oxide nanoparticles in presence of pharmaceuticals

G. AMARIEL, Universidad de Alcala; K. Boltes, Universidad de Alcala / Chemical Engineering; P. Letón, Universidad de Alcala Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in a wide range of services and industries. Subsequently, they can be released into the environment and potentially end up in water bodies. That may cause a potential risk to aquatic environment, exerting toxic effects at the level of cells/tissues or the whole organisms.\^3 The general study, evaluate the toxicity behavior of cerium oxide nanoparticles (CeO$_2$NPs) on three aquatic specimens- algae Selenastrum capricornutum, bacteria Vibrio fischeri, and activated sludge, by exploring concentration-dependent effect and changes induced due to the presence of Ibuoprofen (Ibu) or Levofloxacin (Levo). 72h algae growth-inhibition, marine bacteria-hemolysis reduction and 24h sludge enzymatic activity and oxidative stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mg L$^{-1}$. The particle size and the ζ-potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of 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 hemolucence intensity in marine bacteria. The presence of both, Ibu or Levo, reduced the negative effects of single nanoparticles in Vibrio fischeri. Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity. The presence of pharmaceuticals compounds did not produce significant changes on nanoparticles behavior. In the following n-TiO$_2$ (at 10 mg/L) spiked with a concentration of 0.625 mg L$^{-1}$ n-TiO$_2$ (corresponding to the EC$_{50}$ for D. longispina), ii) food (microalgae) spiked with nano-TiO$_2$ (after being exposed for 3 days to a concentration of 0.615 mg L$^{-1}$ n-TiO$_2$), and iii) water and food spiked with n-TiO$_2$. The effects of the nanoparticle were monitored on the feeding rate (after a 24h exposure period), somatic growth rate (after a 10-day exposure) and in reproduction (after 21-day of exposure). For D. longispina we observed a significant effect of n-TiO$_2$ on the growth rate, while from daphnids were exposed to n-TiO$_2$, simultaneously through the water and food items. In this same treatment a significant increase in the somatic growth rate was observed relatively to the control. No significant effects were observed for time to release the first brood and for length of females at first brood. However, neonates from females exposed to the nanoparticle through dietary were smaller (2.52±0.32 mm) than the ones in the control (3.04±0.11 mm) and the total number of neonates released per female was significantly higher for females exposed to n-TiO$_2$; both in dietary and waterborne (6.1 ± 1.37 neonates/female versus 3.8 ± 1.619 in the control). The obtained results report higher effect on somatic growth and reproduction of n-TiO$_2$ when exposure occurs via the two routes: waterborne and dietary. However, the tested concentrations seemed to increase the fitness of D. longispina, which could be due to hormesis effects.

**WE322**
Dynamics of Cu accumulation in charophyte cell compartments after its exposure to nCuO

Manaspradhan, NatureResearchCentre / Institute of Botany, Laboratory of AquaticEcotoxicology; B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany

In plant and bacterial cells, prior to be internalized, NPs have to pass semipermeable cell wall and plasma membrane barrier. Metal nanoparticles may interact with the cell directly or induce toxicity through the release of metal ions. Intracellular localization of cerium orange alga poses features such as big size, and separation of the main cell compartments, which enable mechanical separation of the compartments, namely cell wall, cytoplasm and vacuole. In this study, fractionation procedure was verified by cyttoplasm and vacuole specific biomarkers.
maltase dehydrogenase and o Mannosidase, respectively. A high-purity vacuolar (99.5%) and cytoplast (86.7%) fractions of the cells of *Nelilopsis obtusa* were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplast and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytoplast. The data on Cu accumulation dynamics within the compartments after cell exposure to rCu2O suspensions will be presented and the role of the cell wall in the accumulation process will be discussed.

**WE323 Are graphene nanomaterials "Trojan horse" carriers for oil compounds in mussel hemocytes in vitro?**

G. Nicolussi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU), Basque Country, Spain; A. Katsumi, M.P. Cajaraville, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE

In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are 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" carrier能力和 the potential toxicity of graphene nanoplatelets with and without adsorbed oil compounds. This work was funded by the EU H2020 GRACE project (grant 679266), Spanish MINECO (project NACE, CTM2016-8130-R), Basque Government (consolidated research group ITS10-13) and University of the Basque Country (UIF 11/37).

**WE324 Multigenerational effects of titanium dioxide and silver nanoparticles on Daphnia magna: gene expression and morphological changes in vitro**

L.A. Eliq, The University of Birmingham / GEES, E. Valsami-Jones, University of Birmingham / School of Geography Earth and Environmental Sciences; I. Lynch, University of Birmingham / Geograph Earth Environmental Science

Recent studies have investigated nanoparticle (NP) physicochemical 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 pathophysiological pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO2) nanoparticle (NPs). Particles were either pristine or aged, uncoated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular defects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in morphological changes and expression levels such as natural organic matter changes the pathways and/or severity of changes observed; (3) if the ageing of particles make them more or less toxic; (4) if long-term low dose exposure (25 days, EC20 concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F0 generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F1-F3 generations. We also observed differences in gene expression compared the control populations, supporting that AgNP and TiO2 do have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of consequent histological accumulation of the TiO2 and AgNPs supported the assumption that NPs manifest themselves as particulates. We were also able to see some recovery in the F3 generations that had their subsequent parent generations removed from exposure. The influence of biomolecules secreted by the organisms in response to the presence of NPs, and the influence of humic acid containing medium 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 identify relationships between dissolved oxygen and temperature signals and PAH concentrations. This study was performed to determine significant effects of measured environmental parameters. The most important environmental variables affecting the concentrations of the measured compounds were those describing the characteristics of the aquatic sediments. The percent moisture of the sediment was the most important environmental parameter, significantly affecting eight of the ten organic pollutants and all three toxicity indicators. Percent organic matter of the sediments was the second most significant parameter, accounting for the variability in concentration for five of the measured pollutants. Temperature was significant for three of the PAHs and TEQ, and in every instance it had a negative effect on concentration. Dissolved oxygen of the water column was a significant variable on the concentration a single organic compound. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physicochemical 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 concentration and measurements at each sampling location should be incorporated into monitoring study design in order to more completely interpret the sediment burden of organic pollutants in aquatic sediments.

**WE326 Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events.**

F. Romero, S. Sabater, ICRA Catalan Institute for Water Research; O. Pereda, University of the Basque Country; 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-desired 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 regressive design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biofilm) exposed to a dilution of a WWTP effluent. We found that desiccation and wastewater effluent significantly affected bacterial community and key biofilm processes such as photosynthesis, denitrification and methanogenesis. After the desiccation event, the biofilm associated to coarse sediment showed a stimulatory effect even at low dilution factors, which was not observed under control (i.e. no desiccation) conditions. Our results seem to indicate a simplification of the biofilm community after the desiccation event and a subsequent co-tolerance phenomenon. We argue that the acute desiccation event
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stressors 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 disproportionately greater fitness costs than mean increase in temperature. Additionally, water contaminants are currently a major source of human induced stress likely to produce fitness costs. Global change models forecast an increase in these two human-induced stressors. Yet, in spite 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 life-history fitness costs when associated with increase variability in temperature. Although fluoxetine and variability in temperature are extensively studied as separate stressors, their combined effect and the potential costs to natural populations are not well understood. Here, we compare fitness costs of mussels (Mytilus galloprovincialis) exposed to warming conditions (21 ºC) and control temperature (17 ºC), after which mussels were exposed for the same period at 17 ºC in the absence or presence of Hg (17 ºC; 17 ºC Hg), and exposed to predator cues and copper (20 µg Cu L⁻¹) in the absence or presence of Hg (17 ºC; 17 ºC Hg; copper), and exposed to high concentrations of fluoxetine (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). The results indicate that both exposure to fluoxetine and variability in temperature remain important stressors for the mussels, with warming and increased variability acting additively and uniquely on the fitness costs to mussels exposed to high copper concentrations and to both stressors. As such, our study highlights the importance of using a multi-seasonal approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE328 Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination E. Coppola, Department of Biology & CESAM - University of Aveiro / Biology; B.M. Henriquez, CESAM - University of Aveiro and CIMAR University of Porto / Department of Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; E. Figueira, University of Aveiro / Biology CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry

Several studies already described the impacts caused by metals in estuarine species, including mussels, but very scarce information is available regarding their effects in a global warming context. It is known that increased temperature can negatively affect the response of organisms but their capacity to recover from pollution events. In this way, the present study aimed to understand the impact of warming in the capacity of Mytilus galloprovincialis to recover their biochemical performance after being pre-exposed to Hg. For this, mussels were exposed during 14 days at 17 ºC in the absence or presence of Hg (17 ºC; 17 ºC Hg), after which mussels were exposed during 24 days at 21 ºC in the absence or presence of Hg (21 ºC; 21 ºC Hg) or kept for the same period at 17 ºC in the absence or presence of Hg (17 ºC; 17 ºC Hg), and biomarkers related to mussels’ metabolic and oxidative stress status were evaluated as well as Hg bioconcentration. 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 ºC) and control temperature (17 ºC), with a tendency to reach control values (observed in mussels exposed the entire experiment to 17 ºC in the absence of Hg).

WE329 Impacts of ocean warming and BDE-209 contamination on the energy budget of juvenile white sea bream (Diplodus sargus) P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seafood Upgrading; C. Figueiredo, M. Baptista, MARE - Marine and Ocean Sciences and Technologies; A. Marque, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading: C. Camacho, IPMA, LP.; M. Santos, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Upgrading; P. Pousão-Ferreira, Portuguese Institute for the Sea and Atmosphere; L. Valente, Interdisciplinary Centre of Marine and Environmental Research; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Upgrading; R. Rosa, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences and Technologies.

Climate change and chemical contamination are global environmental threats of growing concern for the scientific community and regulatory authorities. Yet, the impacts and interactions of both stressors (particularly ocean warming and emerging chemical contaminants) on the physiological responses of marine organisms remain unclear and require further research. In this context, our main goal was to study, for the first time, the effects of warming (+5 ºC, i.e. 24 ºC) and accumulation of a polybrominated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.5 ± 0.2 g total body), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faecal, F and nitrogenous losses, U) and food consumption (C) were calculated to obtain the energy budget. The results demonstrated that the energy proportion spent for growth dominated the mode of the energy allocation of juvenile white sea bream (50.0-67.8%), including even under the synergistic effect of warming and BDE-209 exposure. On the other hand, energy loss via faeces was significantly higher under control temperature and BDE-209 exposure (16.0%). In all treatments, the energy channelled for metabolism was around 26% and a smaller percentage was channelled for excretion (faeces: 4.3-16.0% and ammonia: 2.3-3.3%). In general, the parameters were significantly affected by increased temperature and exposure to the flame retardant, with higher levels found under warming conditions (for wet weight, relative growth rate, protein and ash contents), BDE-209 exposure (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). On the other hand, lower viscoseromatic index (VSI) was observed under warming and lower fat content was observed under both stressors. Overall, with such extreme and expected conditions of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness costs when associated with increase variability in temperature. Although fluoxetine and variability in temperature are extensively studied as separate stressors, their combined effect and the potential costs to natural populations are not well understood. Here, we compare fitness costs of mussels exposed to high copper concentrations and to both stressors. As such, our study highlights the importance of using a multigenerational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE331 1 + 1 = 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper T. Håkoni, Department of Biosciences; A. M. T. T. Titelman, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; K. Boga, Department of Biosciences, University of Oslo / Department of Biosciences

This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, threezenie stickleback) and copper (20 µg Cu L⁻¹) on the marine copepod Tisbe brevicaudata. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent synergi

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WE330 Transformational effects of pesticide on vector mosquito Culex pipiens under global warming T. Tran, L. Janssens, K.U.Leuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology

Recent transgenerational studies have showed that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4°C increase) and the pesticide chloryphyrin on life history traits and antipredator behaviors of the vector mosquito Culex pipiens using a bi-factorial transgenerational experiment to understand the combined impact of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness costs when associated with increase variability in temperature. Although fluoxetine and variability in temperature are extensively studied as separate stressors, their combined effect and the potential costs to natural populations are not well understood. Here, we compare fitness costs of mussels exposed to high copper concentrations and to both stressors. As such, our study highlights the importance of using a multigenerational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.
2-parametric non-linear mixed effect model was used to describe nauplii development over time ($Instar = K / (K + (1 - e)^x \cdot (exp (log (mu) / age ) )$), where $K$ is the asymptotic development stage and $mu$ is the average stage transition rate. Effects of treatment and pedigree on the two model parameters were examined by comparison of models with likelihood ratio tests and Akaike's Information Criterion (AIC). This analysis finds that treatment influenced development stage at the end of the experiment, while pedigree affected the time to reach it. Developmental effects were found in the late stage of three development stages of surviving individuals. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kainorone + copper were significantly delayed compared to all other treatments. Effects on individuals in the combined treatment were greater than expected based on the two factors alone. A combined adverse effect on development was already evident at the time of the first emerging copepodites (138 hours). These results indicate a synergistic relationship between risk of predation and copper by increased age at maturity in developing individuals of $T. brevicornis$. The results also show the significant role of pedigree in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.

WE332

Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain

J. Alvarez-Rogel, A. Peláñez Alcalá, M. Tercero Gómez, H. Consuegra Alcaraz, O. Maldonado, O. Escuela de Ingeniería Técnica Superior de Aragón, Universidad Politécnica de Cartagena / Ciencia y Tecnología Agraria; F. Jiménez-Cárceles, BIOCYMA, Consulting in Environment and Quality, S.L. Murcia, Spain.; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; M. González-Alcaraz, Departamento de Biología & CESAM - Universidade de Aveiro / Bioecology & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation succession were studied in an abandoned mining area (La Chapera, Spain). The study environments were: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Pinus halepensis trees (2-5) ≤≈2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees >3≈4 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>4≈5 m high and shrubs and herbs under the canopy (DP+MS)); 5. Polluted forest with P. halepensis trees >5≈6 m high and shrubs and herbs under the canopy (CF); 6. Control mature forest not contaminated with P. halepensis trees >5 high and shrubs and herbs under the canopy (CF). Ecological indexes of vegetation were evaluated and soils analyzed for physical, chemical, and biological parameters. Soil temperature, feeding activity of invertebrates and decomposition were measured in situ. P+MS, DP+MS and PF showed the highest diversity of plant species and P the lowest. The organic C/N ratio was ≈20 in P+MS, DP+MS, PF and CF and ≈13 in S and P, which was in accordance with larger accumulation of litter in the first four environments. Cation exchange capacity (CEC), an indicator of the buffer capacity of the soil and the stability of the organic matter, was largely higher in CF (≈32) followed by PF (≈20), P+MS and DP+MS (≈12) and finally P and S (≈5). Water soluble metals concentrations in P+MS and PF showed the highest concentration of metals in P+MS, which is attributed to the different dissipat

WE333

Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

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Neonicotinoids are a group of insecticides that are used worldwide in agriculture production to treat piercing-sucking and chewing insect pests. These insecticides are considered contaminants of emerging concern due to their high toxicity to nontarget aquatic invertebrates and their potential to cause multiple stressor effects in aquatic organisms. The objective of the present study was to study the combined effect of low-dose γ-radiation (13.2, 20.3 and 47.1 mGy/h) and UVR (UVB 0.5 mW/m2) in the aquatic plant duckweeds (Lemma minor) using a combination of genomic, functional and adverse toxicity endpoints. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (Fv/Fm) and oxidative phosphorylation (OXPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PI operating efficiency (Fv'/Fm'), content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h). Mammalian fibroblast cell cultures were used to identify the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combine study with radiations and chemicals are currently on going.

WE335

Natural organic matter determines the potential of titanium dioxide nanofluids to mitigate pesticide toxicity in presence of UV light

S. Lüderwald, Universitat Koblenz-Landau / Institute for Environmental Sciences; V. Gerstle, F. Meyer, R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment

Nanofluid-based technology has evolved to a global industry with a tremendous economic potential. Since 2006, the investment in nanotechnology increased from estimated $11.8 billion to more than $2.5 trillion in 2015. Among all manufactured nanoparticles (NPs), titanium dioxide NPs (nTiO2) belong to the most frequently produced and applied NPs. As a consequence of their incremental use, nTiO2 will end up in our water bodies and air. Radiation, especially UV light, triggers the photocatalytic potential of nTiO2 to form reactive oxygen species (ROS). ROS have the ability to reduce the toxicity of co-occurring pesticides on aquatic invertebrates. The role of ubiquitous natural organic matter (NOM) for this interaction is, however, not well understood. Therefore, this study systematically assessed the influence of ambient UV-A radiation (0.00, 0.40-0.60, 1.00-1.40, and 2.20-2.60 mW/m²) and 0.00 mg/L of dissolved organic carbon (DOC) on the potential of nTiO2 (P25, 0.00 or 0.05 mg/L) to reduce the acute toxicity (96-h) of three selected pesticides (Aoxystrobin, Dimethoate, and Pirimicarb) towards the waterflea Daphnia magna. Aoxystrobin toxicity was up to 1.6-fold reduced in the presence of nTiO2 with increasing UV intensity (0.00 vs. 2.20-2.60 W/m²). The combination of nTiO2 and NOM enhanced the toxicity of Aoxystrobin 2-fold (0.00 vs. 1.00-1.40 W/m²). Dimethoate toxicity was 3-fold decreased with increasing UV (0.00 vs. 2.20-2.60 W/m²). NOM generally decreased the toxicity of Dimethoate by a factor of ~3, whereas the combination of nTiO2 and NOM revealed the highest toxicity reduction with increasing UV (4-fold, 0.00 vs. 2.20-2.60 W/m²). The
toxicity of Primicarb was reduced 1.7-fold with increasing UV (0.00 vs. 2.20-2.60 W/m²). In presence of NOM, Primicarb toxicity was generally decreased (up to 2.3-fold, e.g. 0.00 W UV/m²). Depending on pesticide type and factor combinations we observed both positive and negative effects of UV radiation on the toxicity of the selected pesticides. A general prediction on the combined effects of nTiO₂, NOM, and UV on the toxicity of pesticides seems currently difficult. Rather, physiochemical properties like pesticide structure, solubility, adsorbability 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.

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Between 4.000 and 6.0000 tons of sunscreens annually are washed from the skin by swimming, showering, and driving released into the ocean waters, 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 into mimic commercial available sunscreen formulations. Two Symbiodinium phyotypes, 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 formulations show no 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 biodegradation, constituting a major risk to marine organisms. Corals rely on the photosynthetic provided by the endosymbiotic algae for their nutrition, and the production of excess ROS by Symbiodinium cells as a consequence of heat stress, is considered to be a trigger of coral bleaching (the loss of Symbiodinium from the coral host). The significant decrease of maximum photosynthetic activity at 32°C coupled with the algal growth decline, and direct release of oil from the water, poses a potential threat to coral reef ecosystems. The increased ROS production following sunscreen exposure, in addition to the reduction of photosynthetic activity, provide evidence that exposure to these types of sunscreens may exacerbate bleaching response in corals and pose a risk to coral reef ecosystems in a changing ocean.

WE337
Metallothioneins as an indicator of metal exposure in a naturally mineral enriched aquatic environment

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The Marico River in the North West province of South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations – mainly from natural sources – occasionally exceed environmental quality guidelines or toxic concentrations. Macroinvertebrates are capable to react to these metals through processes such as the induction of metallothioneins (MTs). The aims of this study were to determine whether the induction of MTs can be used as indicator of natural metal exposure in anthropogenically impacted systems and whether there are relationships between metal concentrations in water, sediment and macroinvertebrates and concomitant MT levels. This was done by sampling macroinvertebrates, water and sediment from eight sites in the Marico River and tributaries. Water and sediment samples were prepared and analysed with an ICP for the determination of 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 sediment and macroinvertebrates, while there were no correlations between metal concentrations in water and macroinvertebrates. Even in freshwater river systems with a relatively low human impact and no mining activities, a positive correlation existed between trace metal bioaccumulation (e.g. Ni, Pb, Zn) in macroinvertebrates and the induction of MTs. There were, however, no correlations between MTs and bioaccumulation of earth metals (e.g. Al, Fe, Mn, Ti). These data clearly demonstrate the application value of MTs as biomarkers for metal exposure in freshwater systems.

WE338
Mollusks as indicators of environmental pollution (case studies in marine mussel Mytilus galloprovincialis Lam. and terrestrial snail Bradybaena fruticum Mull.)

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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 biodiagnostics a 3-4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz’minka, Issaiovsky Park) with respective and annual average and maximum allowable concentrations. Pairwise comparison was done based on cardiac activity monitoring in mentioned groups of snails under thermal treatment (20-50 min, 50±0.5°C). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazovo, Kuz’minnyk) differed in lower thermostress from those of the reference site and Issaiovsky Park demonstrated in dynamics of HRs. The correlation between HR and the pollution level of mussel beds, 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

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Cypermethrin is an insecticide which European Parliament of the Council has classified as a priority substance in Directive 2013/39/EU in the field of Water Policy. The Annex II of the Water Policy sets the environmental quality standards (EQS) for the priority substances. Cypermethrin’s annual average and maximum allowable concentration in inland surface waters are 0.08 ng/L and 0.6 ng/L, respectively, and annual average and maximum allowable concentrations of other surface waters are 0.008 ng/L and 0.06 ng/L respectively, one of the lowest annual average and maximum allowable concentrations in environmental quality standard. The abiotic stressor like the temperature can have an effect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48-hour half maximal concentration (EC50) and median effective time (ET50) values were tested with crustacean 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 ET50 value at 10°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10°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 SETAC Europe 28th Annual Meeting Abstract Book
ecotoxicity data has been accumulated. The most informative tests performed for the ecological effects of toxicants are mesocosm studies: controlled experiments where the effects of toxicants on model communities are studied for extended periods of time. Mesocosm studies are cost- and labor-intensive but offer a unique insight into realistic ecological effects of toxicants: they address not only direct effects on sensitive species, but also indirect effects resulting from ecological interactions (e.g., competition, predation) between sensitive and less sensitive species. Typically, the effects occurring in mesocosm studies are however complex and difficult to interpret. A study has been set up to investigate whether food web modelling 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 technique, multiple patterns of interaction 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 Rudippitius philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Contaminant/shell weight index
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Rudippitius philippinarum (Adams & Reeve, 1850) is a soft-bottom dweller bivalve commonly used in biomonitoring programs, especially in bioaccumulation assessment, owing to its high tolerance to toxic compounds. However, bioavailability and accumulation of contaminants in the soft tissue of molluscs could be affected by abiotic factors, such as food availability, pH and temperature, and also by biotic factors, such as the seasonal changes of flesh weight in molluscs. In this context, some issues could arise especially when comparing different sites in a long-term monitoring with data obtained from different periods of the year. In this study, bioaccumulation of metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Butyltins (BTs) in Manila clams was monitored twice a year, from November 2010 to June 2015, in order to assess impact of human activities on R. philippinarum population from the Vallona Lagoon, a transitional area located in the delta of the Po River (NE, ITALY) which is the largest and most important Italian watercourse and one of the main sources of contaminants to Adriatic environments. Although levels were quite consistent with those reported from other geographical areas with low to medium pollution, seasonal trends were shown for each contaminant with higher concentrations on autumn rather than on spring surveys. The physiological condition of clams was also examined through two indices (condition index and survival in air) and they both exhibited seasonal variations. Some contaminants (e.g., cadmium) showed a strong correlation with certain chemical parameters of water (temperature, pH, salinity and dissolved oxygen) and also considered. To ensure that bioavailability assessment was not affected by seasonal variation of soft tissues of molluscs, Contaminant/shell weight indices, which consist of normalization achieved multiplying each contaminant concentration by the condition index, were applied. Accordingly, the normalization enabled us to highlight the contaminant uptake from clams in some particular periods and to compare different sites in a long-term monitoring with data obtained from different periods of the year. Indeed, some contaminations showed quite a steady state all over the monitoring period and at the different sites, whilst others, such as Arsenic, Chrome, Nickel, Lead, Copper, Zinc and BTs, showed different patterns of bioaccumulation with some periods presenting enhanced concentrations probably related to anthropogenic activities.

WE342 Biomonitoring of Singapore mangroves using biomarker expression and contaminant burden in caged green mussels, Perna viridis.
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Mangroves are fragile coastal ecosystems whose ecological and socioeconomic importance for adjacent ecosystems and local populations is being clearly recognized nowadays. Mangroves are one of the most threatened tropical environments and our understanding of the impact of chemical pollution on these ecosystems is still at its infancy. In this study, nine mangroves sites were selected around Singapore coastline to cover various contamination profiles, and green mussels, Perna viridis were used as bioindicators. Bivalves were deployed in cages at each of the nine mangrove patches for 28 days on two consecutive years (one year during the monsoon period and the other year during a dry-weather period), and collected for subsequent analysis. A series of biochemical and cellular biomarkers were developed and measured using various organs. Metallothioneins (MTs), Glutathione-S-Transferase (GST), Ethoxyresoruﬁn O-deethylase activity (EROD), Vitellogenin-like protein (Vil) inhibition of Acetylhypoxanthine (AChE) were measured in the bivalves’ soft tissues. Mussel’s haemolymph was also used to evaluate various biological parameters (Total Haemocyte counts, phagocytosis and lysozyme levels) and the level of haemocytes’ DNA damage, using the Comet assay. Results of this study revealed different patterns of biomarker expression between the various sites. Most notably, metallothionein induction was observed at some of the sites, indicating potential exposure to heavy metals while higher levels of DNA damage and EROD were also recorded at some of the mangrove patches pointing towards possible exposure to organic contaminants. Some biomarkers appeared to be subject to seasonal variations while others were very stable. Possible correlation between biomarker expression and the level of various contaminants (metals, PAHs, pharmaceuticals, endocrine disruptive chemicals, personal care products) in caged mussels were also studied. Using an Integrated Biomarker response index, the various mangrove sites were eventually ranked amongst each other. Our findings ultimately indicated a clear segregation of mangrove sites, indicating that some mangrove patches were potentially more at risk than others towards chemical contamination.

WE343 Impacts of climate change on mercury bioaccumulation in large ocean predators
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Many marine ecosystems are being affected by climate driven changes in freshwater discharge, circulation, productivity and seawater temperature. Large ocean predators such as tunas account for a large proportion of methylmercury exposure in many countries. However, about 40% of the world’s tuna production originates from the Mariana Islands, which are located in an arid region of the north Pacific. In this region, methylmercury concentrations in marine food webs are typically high due to exposure to historical mercury contamination by historical artisanal mercury mining activities. The marine food web is also vulnerable to modern anthropogenic sources of mercury, including emissions from the burning of coal. Methylation of inorganic mercury is a complex and poorly understood process, but is thought to be driven by a variety of factors, including the methylation potential of the food web. A study has been conducted to investigate the potential impact of climate change on the marine food web in the Mariana Islands. The study used a combination of numerical modeling with data from a long-term monitoring program to investigate the potential impact of climate change on mercury bioaccumulation in large ocean predators, with a focus on the potential impact of ocean acidification. The model was able to predict the potential impact of climate change on mercury bioaccumulation in large ocean predators, with a focus on the potential impact of ocean acidification. The model predicted that climate change is likely to result in an increase in mercury bioaccumulation in large ocean predators, with a potential increase of up to 50% in the next century. This prediction is consistent with the observed increase in methylmercury concentrations in marine food webs in the Mariana Islands. The study also identified potential mitigation strategies for reducing the impact of climate change on mercury bioaccumulation in large ocean predators, with a focus on the potential impact of ocean acidification. The study recommended the implementation of strategies to reduce mercury emissions from anthropogenic sources, such as the burning of coal, and to improve the methylation potential of the food web, with a focus on the potential impact of ocean acidification. The study concluded that climate change is likely to result in an increase in mercury bioaccumulation in large ocean predators, with a potential increase of up to 50% in the next century.
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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Population growth and human activity are contributing to habitat deterioration in Patagonian rivers with the consequent threat to water quality and biodiversity. The bivalve Diplodon chilenis is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantation of caged D. chilenis to different sites in the Chimehuin river (reference site (S1), downstream from an aquaculture facility (S2), and downstream from an open dump and from the sewage treatment plant (S3)) after 3, 6, 9, and 12 months of exposure. We combined the antioxidant response, oxidative damage, ROS production and energetic status, with water quality parameters and sediment analysis (physic-chemical and biological variables, and organic matter content). Physic-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total coliform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In D. chilenis, gill SOD and GST activity was higher in both S2 and S3 than in S1 by the end of the exposure time. During the last month of exposure (month 12), GSH levels dropped dramatically and lipid peroxidation levels increased in individuals from S2 and S3 sites. Digestive gland factor (DGF) and energy values in digestive gland were increased at sites S2 and S3, from 6 to 9 months of exposure. Our results indicate that despite the large flow rate of Chimehuin river water quality is deteriorated in areas impacted by anthropogenic activities (aquaculture, solid waste disposal and sewage). This effect is reflected by a physiological response of D. chilenis, which is especially significant during period of their highest metabolic activity (autral fall/ winter).

WE346
The influence of selected seasonal and anthropogenic phenomena on a perennial river in South Africa.
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The quality of surface waters worldwide is declining fast. This is due to anthropogenic activity, 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 seasons. 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 highest concentrations of metals in the water column were obtained during the low flow seasons, when compared to the high flow seasons. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pieu’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P>0.05). The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa collected in large numbers during both seasons were tolerant to highly tolerant.

WE347
Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat Wave and Drought
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Extreme climatic events such as heat waves and droughts are predicted to increase in frequency and severity in many regions under future climate scenarios, and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on Hordeum vulgare under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in photosynthesis 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 that from single heat wave treatment as revealed by higher level of malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthesis processes in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by heat wave treatment compared to water deficit treatment and revealed an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE348
Does elevated CO2 protects plants against heat waves damage?
J. Zaltauskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetoviene, I. Januskaite, A. Diksaityte, D. Miškelytė, G. Kacienė, G. Juozapaitienė, R. Juknys, Vytautas Magnus University

The frequency and severity of heat waves is increasing as a result of climate change. There is a great need to understand the impacts of these extreme events on crops, weeds, and crops and weeds to heat waves and CO2 may also cause shifts in their competitive interactions. The aim of the study was to examine the influence of extreme events (heat wave plus drought) and CO2 on the growth of spring barley (Hordeum vulgare) and wild mustard (Sinapis arvensis). Barley and wild mustard, growing together in the microcosms at the combination 21/B, were subjected to short-term and permanent drought treatments. Microcosm were exposed to 20°C and 28°C without desiccation, and 28°C with +10 °C heat wave treatment. The decreases in water deficit treatments (Control, Low and High Concentration) in each environmental scenario. For barley, the highest values were found with regard to suspended solids and total organic material, whereas a substantial increase occurred during the high-flow seasons. 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 solids or a decrease in the concentration of dissolved metals. The highest concentrations of metals in the water column were obtained during the low flow seasons, when compared to the high flow seasons. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pieu’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P>0.05). The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa collected in large numbers during both seasons were tolerant to highly tolerant.
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. Zaltauskaitė, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetoavienė, A. Dikašaitė, J. Januskaitė, G. Kaciūnienė, G. Juozapaitienė, D. Miškelętė, Vytautas Magnus University; S. Sakalauskienė, J. Miliūšiūnienė, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknas, Vytautas Magnus University Climate change is a major concern for agriculture and 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 co-evolution of insect herbivores. 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 (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms at the 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 response 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. Bordalou, University of Aveiro; O. Golovko, O. Koba, University of South Bohemia in Ceske Budejovice; A. Terradillos Benito, AEM-Research Center of Aquaculture and Biodiversity of Hydrogenoses; 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, there may be a development 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 (Cp) and thiamethoxam (Tm) are neonicotinoids that have been applied to fruit orchards 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 boltonii. A full factorial design tested the effects of the CAP (0 or 2 µL/L), presence/absence of the predator C. boltonii and of the two insecticides (Cp and Tm) on leaf loss as well as on leaf community composition 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 chironomids 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 Lethobalans catesbeianus T. In levels and metabolites expression (dio2, dio3, thi3, tra, trb and klf9) were mostly upregulated in these groups, showing disruptive effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on L. catesbeianus and its effects were also pronounced at high temperatures. Native tadpoles of Rhinella schneideri and Euphémis nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone and sulfentrazone. Sulfentrazone impaired allantoic fluid pH and nitrogen metabolism in R. schneideri tadpoles and its effects can be pronounced at higher temperatures. These findings imply that the effects of abiotic factors should be taken into account to evaluate the real risks of exposure of amphibians to commonly used pesticides, mainly in tropical areas.

WE353 Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Bahri, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / Lancaster Environment Centre; E. Leu, Akvaplan-niva AS; L. Nizzetto, NIVA Freshwater ecosystems are subject to natural and anthropogenic disturbances such as climate change, landscape management, natural resources overexploitation and also pollution. Chronic background contamination by pesticides applied in agriculture poses a selective pressure on natural phytoplankton communities, favouring species and strains that can handle herbicide exposure better than others. Under such conditions, there may be a development of herbicide tolerance towards a specific substance over time. It can be expected, however, that the community resulting from the historic exposure to the stressors is not uniformly well optimized to utilize available resources in the best possible way. The hypothesis behind this study is drawn from the following concept: The history of community exposure to chemical pollution in the environment influences the sensitivity of responses to contemporary stressors. Herbicides may persist for several physiological time periods, depending on whether it is underpinned by purely ecological or evolutionary processes and on the ability of the ecosystem of recruiting diversity and the structure necessary to cope with new environmental conditions. In order to assess these hypotheses we have studied the effect of long-term adaptation vs. acclimation in a two phase community level experiment with natural phytoplankton communities from a pristine and an agricultural catchment. Using a controlled experimental setup, phytoplankton communities were germinated from sediments with and without herbicide exposure (Isoproturon, nominal concentration – 12 µg/L) in phase 1. Afterwards (Phase 2), we subjected the resulting communities to a stress experiment where we applied 4 different concentrations of the same herbicide (Isoproturon). Effects were recorded on growth and metabolic rates, gene expression, and changes in algae community composition and biomass development. The results indicate that the ability of the ecosystem to recruit diversity and the structure necessary to cope with new environmental conditions is influenced by the experience towards herbicide exposure. The strategy of the community towards herbicide exposure is a key to understand the risk assessment of pollution scenarios.

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. Malby, The University of Sheffield / Dpt. of Animal & Plant Sciences; S. Beulke, Envisresearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology Maclean Building Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
pesticide ingredients. Temperature, rainfall, soil parameters, pest ranges and cropping patterns are all expected to alter under climate change conditions, and all of these parameters could affect pesticide use and environmental exposure patterns which will alter the risk that these compounds pose to the environment. Here, we report the results of a study to evaluate the impacts of climate change on the exposure of aquatic systems in the UK. Concentrations of a number of case study pesticides covering a range of physico-chemical properties and uses, were modelled in streams 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 micropollutants in effluent by exposure indices evaluated via suspect/nontarget screening
L. Minguez, L. Xue, Z. Zhu, A. Agatz, J. Lee, A. Seifert, C. Smit, M. Mayer, P. Naree, Changwon National University / Environmental Engineering; c. youngjun, 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 efficient monitoring programs have been conducted for limited, but prioritized pollutants. In general, the prioritization has been mainly based on effect/toxicity information rather than exposure relevancies. Thus, the costly 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 efficient 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-MS/MS (QExactive+ Orbitrap). Within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high rankers, about 20 micropollutants were orthogonal confirmed and roughly quantified. The prioritized micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatoried (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antimistastis (diphenhydramine, fexofenadine), antihypertensive agent (ibrersartan, valsartan), antipsychotic (amisulpride, haloperidol, clozapine), appetite suppressants (mefenamic acid, fexofenadine), anticonvulsant (carbamazepine-epoxide, oxcarbazepine), and antitussis (diphenhydramine, fexofenadine). The concentrations for the top ranker, acetaminophen detected in all 7 samples, was ranged up to 1.300 ng/L. The 2nd ranking pollutant was caffeine and followed by cimetidine> mefenamic acid>fexofenadine>carbamazepine>ibrersartan>fluconazole>diphenhydramine> 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 exposable 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 congeneric copepods Tigrionop sp.
J. Hug, 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), glucuronate-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 Tigrionop japonicus and the Antarctic copepod Tigrionop 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 96 h and 72 h tests of 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 breathing on zooplankton physiology and fitness driven by food 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. Nejezgina, Leibniz Institute of Freshwater Ecology and Inland Fisheries / Dept. Experimental Limnology; M.O. Gessner, Leibniz Institute of Freshwater Ecology and Inland Fisheries

ECotoxicological assays using Daphnia species are generally performed under optimal food and light conditions. However, results of such assays may not adequately reflect stress responses in the wild, since the ability of organisms to cope with adverse conditions critically depends on the amount of available energy. One type of potential stressors is dissolved organic carbon (DOC) that causes browning of lakes and streams, but long-term effects of DOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term DOC 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 sexost characteristics and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water (B) showed higher fecundity (and physiological and biochemical traits) than daphnids kept in clear water (A). This unexpected outcome is explained by higher sexost quantity and quality in enclosures receiving tDOC, related to a higher abundance and biomass of nutritious food algae. Moreover, transplantation of daphnids from A to B enclosure water and vice versa revealed considerable plasticity, as the daphnids were capable of rapidly adjusting their metabolism to a similar level as that observed in the specimens coming from the natural environment. Thus, our study points to the importance of accounting for exposure duration and food quality and quantity when assessing Daphnia responses to environmental stressors such as tDOC.

WE358 Interactive effects of multiple stressors on estuarine processes
A. O’Brien, The University of Melbourne; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre; A. Charron, Macquarie University / Molecular Ecology and Toxicology

Natural systems are threatened by a variety of different anthropogenic stressors. These are often considered in isolation, but in reality most are found in combination and have the potential to interact with different outcomes. Urban systems such as estuaries and harbours are commonly exposed to chemical (e.g. contaminants), physical (e.g. built infrastructure) and biological (e.g. invasive species) stressors. It is in clear water (A). This unexpected outcome is explained by higher sexost quantity and quality in enclosures receiving tDOC, related to a higher abundance and biomass of nutritious food algae. Moreover, transplantation of daphnids from A to B enclosure water and vice versa revealed considerable plasticity, as the daphnids were capable of rapidly adjusting their metabolism to a similar level as that observed in the specimens coming from the natural environment. Thus, our study points to the importance of accounting for exposure duration and food quality and quantity when assessing Daphnia responses to environmental stressors such as tDOC.

WE359 Ecology or reproducibility crisis? - Lessons from a laboratory scale tri-trophic test system
V. Riedl, Environment Department, University of York / Environment Department; A. Agatzi, IBACON GmbH / Environment Department; R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; R. Ashauer, University of York / Environment

In recent years, concerns have been raised regarding a lack of reproducibility in scientific research. There is indeed evidence that a number of research findings are not reproducible by others or even within the original laboratories. Yet, while the reproducibility of results might often be difficult, it is essential in the context of regulatory decision making. In the environmental risk assessment of pesticides, for example, replication, standardization and reproducibility are of great importance to ensure the reliability and validity of test findings. For this reason, rapid single-species tests that only allow for the assessment of direct pesticide impacts are still more frequently used than multi-species systems. Although they are ecologically more relevant, micro-mesocosms often yield lower statistical power due to higher complexity, difficulty of standardization, resource demand and variability among replicates. However, growing evidence suggests that direct effects measured at the individual level do not proportionally translate to impacts at the population and community level. The use of testing procedures that are ecologically more realistic but ideally comply with regulatory needs should thus be a priority to risk assessors and regulators. The tri-trophic aquatic test system
TriCosm (P. subcapitata, Ceriodaphnia, Hydra) was developed as an intermediate link between single species tests and complex multi-species systems, to detect small stressor-induced alterations in ecological interactions. The achievement of standardization, replication and reproducibility was given close attention during the development of the system, yet, the TriCosm was found to be compliant in terms of repeatability and reproducibility only in the short term. Here, we present experiments designed to discern effects of variation due to ecologically 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
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Rotifers are widely used as bio-indicators and models for ecotoxicology due to characteristics such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural and chemical stressors in life by inducing acute toxic effect biosassays and 48h chronic toxicity biosassays 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 biosassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25 ppm as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. The results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an 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 these great advances and assess if their maintenance can be achieved through several generations.

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem
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Owing to their ecological importance, freshwaters provide important services such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural and chemical stressors in life by inducing acute toxic effect biosassays and 48h chronic toxicity biosassays 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 biosassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25 ppm as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. The results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an 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 these great advances and assess if their maintenance can be achieved through several generations.

WE362 Improving the Quality of Ecotoxicological Testing and Assessment (P)

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 MOA classifications. Log Kow-QSRs were developed using linear regressions of log acute toxicity and log Kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad; 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ion/osmoregulatory/circulatory impairment, and reactivity. Forty-eight of the 50 MOA-based models were statistically significant (p < 0.05; most p < 0.001), but r² values were generally less than 0.5, particularly for non-narcosis MOAs. The results showed that MOA-based 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

Aproaching the availability of a wide range of compounds, standard lower-tier risk assessments on aquatic organisms also provide valuable additional information for higher-tier testing strategies for risk assessments for plant protection products. While typically only the standard endpoint (e.g. 96-hour LC₅₀) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of toxicity response, log Kow magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.

WE365 Comparison of models and tools for derivation of species sensitivity distributions (SSDs) for use in pesticide risk assessment
L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; G. Schmidt, BASF SE

EFSA’s guidance document for the risk assessment of edge-of-field aquatic ecosystems (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. While typically only the standard endpoint (e.g., 96-hour LC₅₀) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of toxicity response, log Kow magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.
WE366 Effects on NTA communities: HCx 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 HCx, approach where ECi, 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 taxa were 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 HCx-study consistent dose-response curves were obtained within 4 major arthropod taxa (63 out of 776; 8%) and SSD’s could be constructed for each of them. Due to full overlap of curves the classes could be combined, resulting in narrow confidence intervals. In the NOEC-study 66 from 596 (11%) taxa were valid for univariate analysis, representing all major taxa. The protocol developed for the classification of results yielded an informative evaluation and allowed results to be classified as inconclusive or conclusive on a confidence scale of 1-4. Both study designs were fit for dose-response analysis and were statistically valid. Where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE367 a-Dominance versus β-Prominence
F.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
The NOEC of an equivalent regulatory set ECi, value are key endpoints to assess safety of pesticides and therefore challenged and reassessed biologically and statistically valid results. Where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE368 Defining simple toxicity values (EC, BMD) is not so simple
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Effective Concentrations (ECx) have now largely supplanted No Observed Effect Concentrations (NOEC), after decades of statistical criticisms towards the latter. ECx has a simple definition which sounds unambiguous. However, depending on the concentration-response pattern, its derivation is not trivial and should be paid attention 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. Based on our results, sigmoidal concentration-response shape was the more 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 does make sense only provided an asymptotic response level is observed at high exposure concentrations and, in the case of non-monotonic trends, requires the definition of a maximal amplitude of the response. Alternatively to EC, the Benchmark Dose (BMD) has been proposed in the field of toxicology for setting toxicity values. The BMD approach as mentioned in EFSA guidance proposes two options. The first one considers a x-fold change of the control response which seems 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. Friedmuth, Bayer AG Crop Science Division; T. Preuss, Bayer Ag / Environmental Safety
ECx and LC50 are most frequently used endpoints for deriving Predicted No-Effect Concentration (PNEC) or Regulatory Accepted Concentration (RAC). ECx is defined as the concentration that shows x% effect compared to the control and LC50 is the concentration at which 50% mortality was observed. These definitions inherently assume the adverse effect at control is 0%. For example, in terms of mortality, the mortality at control should be 0% and when there is background mortality, Abbot’s correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of dose-response models in toxicity testing 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 procedure. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to the control as how it is defined. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE370 Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Friedmuth, Bayer AG Crop Science Division; T. Preuss, Bayer Ag / Environmental Safety
Low effect 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 assay power to detect NOECs is high. However, use of dose-response models in toxicity testing can be very low due to high variability and small sample size. However, the concept and the limitations behind the various dose-response models have not been systematically addressed. There are ambiguities in the methodologies used such as linear and nonlinear dose-response models. When to use which model is not clear to practitioners. Practical difficulties in the implementation of the methodology lead to questions like what to do when there are no monotonic dose-response relationships, when ECx is superior to NOEC and when NOEC is more appropriate, why the confidence intervals are very broad in the range of low effect levels, and so on. In this study, we provide an in-depth review of the various dose-response models and associated assumptions and indications to answer these questions. Challenges in which certain dose response model is more appropriate than others were described and illustrated using both real and simulated data examples. We show that the type of data, quantal, count or continuous are important to determine the error structure in the statistical model and the data characteristics provide inherently hints in the choice of dose-response model. The shared parameterizations and curve shapes between the so-called linear and non-linear model are clarified and the most appropriate analyses are emphasized. We also identify a few common mistakes in practice due to wrong interpretation of dose-response analysis or wrong understanding of the software implementations. Potential improvements over the decision tree approaches proposed in the EFSA Guidance are discussed. The knowledge gaps related to non-monotonic dose-response relationships are also tackled. The connection between the multiple comparison procedure to derive NOEC and the model-based dose response analysis are presented and hybrid approaches are discussed.
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 potential for 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 default conservative and evidence shows that when combined lead to a phenomenon termed “compounded 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 ability to incorporate and evaluate data and information that is associated with a 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 protective nature of a chemical’s DNEL. This work will demonstrate how PRA is used to calculate DNELs using trichloroethylene (TCE) as an example. The situation 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. Eschenbich, Eurofins Regulatory AG

First exposure of pests 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 partially 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 complicacy 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 ecotoxicity 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 exposure scenarios. The critical question to consider is that 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 relevant exposure risk assessment (ERA) and assessment of environmental fate. More refined exposure 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. Gonser, Eurofins Agrosciences Ecotox GmbH; U. Mennemert, G. Eck, E. Eschenbich, Eurofins Regulatory AG; C. Hafner, Eurofins Agrosciences Ecotox GmbH / Aquatic Ecotoxicology

Higher-tier exposure testing comprises challenges on both, the exposure as well as the filial fish was fine and in line with the quality criteria set by the 90-day testing. Critical aspects of higher-tier laboratory exposure testing with aquatic test organisms. This option of risk refinement is also reflected in the recent FOCUS guidance document for aquatic risk assessments for plant protection products. It offers scope for risk refinement by defining ecotoxicologically relevant concentrations that might be less conservative than constant exposure scenarios realised in standard effect studies or to justify time-weighted average concentrations in context with chronic risk assessments. Higher-tier exposure testing comprises challenges on both, the exposure as well as the filial fish was fine and in line with the quality criteria set by the 90-day testing.

WE375 Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!

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Repeated pulsed exposure can be used to transfer more realism into standardised exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulsed exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, P0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by placing fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquarium 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 sensitive endpoints such as handling of the fish was visually 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) calculated with the FOCUS tools. The analysis of the AUC as well as of the DT50 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filial fish was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

WE376 Pulsed exposure of fish at sensitive life stages: The ‘worst case’ challenge.

408 SETAC Europe 28th Annual Meeting Abstract Book
Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Interlcalibration exercises towards standardized procedure

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Refined exposure tests have become part of the regulation framework for plant protection products in the EU (EFSA Aquatic Guidance Document 2013). A pulse dose test can be used to address areas of risk that cannot be satisfied with the standard suite of aquatic toxicity tests. A pulse dose considers situations where the expected exposure event in the field is significantly shorter than in the standard laboratory test. However, the challenge is often to cover exposure events from multiple scenarios within one test. Therefore, the maximum exposure (peak) concentration, the number of peaks, the duration of the peaks, and the interval between peaks are considered to simulate a realistic profile covering a large number of scenarios. In this study, three different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to two concentrations of the test chemical. To set these pulses as sharp as possible, the fishes were transferred from treatment vessels to untreated vessels at each time of pulse application. All vessels, including controls, were kept under flow through conditions. The concentrations of the test chemical were measured at start and end of each pulse event. Fertilised eggs, newly hatched fry and juveniles, already swimming up, were exposed. Glass aquaria with a total volume of 30 L were used. The evaluation of biological effects was based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the ‘worst case’ when a typical laboratory exposure is unrealistic.

Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.

T. Lanchier, C. Dupuy, A. Fouand, Groupe SGS France; J. 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 HOCNF guideline, for example. The embryo and larvae stage mortality of turbot (Scophthalmus maximus) and the test substance (Labrax lacustris) reference substances were evaluated. To this purpose, within 72 hours post-fertilisation, the blastula stage eggs were exposed to reference substances separately. The effects of the toxicants on embryos and larvae were observed daily on a 10-days exposure period. For each reference substance and species, EC50 and mortality rate were calculated. To avoid vertebrate testing, results of this study were compared to published data. Several reference substances had a significant impact on survival of eggs and/or embryonic development. The sensitivity of the organisms is significantly different according to reference substances. Moreover, this test was used to evaluate toxicity of waste seawater samples in multi-trophic level bioassays (i.e. combination with single-species on algae, copepod and 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.

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

S. Pawlowski, M. Damann, S. Champ, BASF SE; M. Mathis, Port, Fort, Environmental Labs, Inc.

The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay - AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (1969) stages 41 - Xenopus laevis larvae to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hind limb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid axis disruption. Recently, the relevance 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 AMA hindlimb length and body weight was observed in 6 of the 8 studies, with the correlation coefficient between hindlimb stage development (r²=0.347-0.156, 0.429, 0.564). For the censored studies, comparison 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 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.

Optimisation of a chronic toxicity flow-through set up to investigate the adverse effects of chemicals to Daphnia magna

C. Beyer, IES Ltd; A. Peiter, Innovative Environmental Services IES Ltd; S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Zbinden, University of Appl. Sc. Northwestern Switzerland / Institute of Ecopreneurship; P. Corvini, University of Applied Sciences Northwestern Switzerland

Daphnids are playing an important role as representative or indicator species for aquatic invertebrates in the environmental risk assessment for plant protection products, chemicals and pharmaceuticals. To investigate chronic toxicity, semi-static Daphnia magna reproduction tests following Test Guideline OECD 211 have to be performed. So far this test design was also used for highly degrading substances, despite the fact that by using semi-static test design the exposure concentration of the parent test compound is decreasing and metabolic products are accumulated during the renewal intervals of 2-3 days. To ensure a steady exposure level of unwashed eggs, eggs were exposed to different concentrations of the test substance and 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.
but also standard test organisms for the RA for pharmaceuticals and chemicals.

Photosynthetically ac...ecotoxicological test.

Increasing complexity of ecotoxicological tests and the methodical challenges during the testing of difficult substances, this presentation also intends to underline the importance of a continuous improvement of the technical setup for a successful performance of ecotoxicological test.

WE383 Difficult Substances as Challenge for the Algol 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. Photoautotrophically 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 testing” with different test species and test designs to 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, adsorption, storage condition). In this presentation several examples for the testing of difficult substances are shown and the advantages of this dosing system are discussed as well.

WE384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes

P. Mack, A. Appeltauer, J. Ilig, Eurofins Agroscience Services Ecotom GmbH; S. Knaebe, EAS Ecotom GmbH / Ecotop Field Soil micro-arthropod field studies are carried out as part of the risk assessment of plant protection products. Those studies followed the proposed study design for soil organisms by Römbke et al. (2009). Soil cores are taken in the field and afterwards soil organisms are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of collembolans. Especially in long periods with high temperatures and low precipitation, a high number of collembolans might mitigate in deeper soil layers as included in the standard sampling scenario of 5 - 10 cm soil cores. Therefore it might be useful to cover also deeper soil layers, which contain potentially more specimens at the sampling time. One activity based trapping method for soil microarthropods would be the slide traps which were presented at SETAC 2016 by Dehelen et al. 2016. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling and will present first results from the comparison of soil core and slide trap catches.


Stefan-Bogdan Dehelen et al., 2016 Stratification of soil arthropods in topsoil layers, SETAC Europe 26th Annual Meeting, Nantes, France

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 / DÉTI IEETA Copepods play an important ecological role on marine ecosystems and may act as a sentinel of environmental degradation resulting from direct or indirect human impacts. The copepod Acartia tonsa is a calanoid species with a worldwide distribution and relatively easy to maintain for several generations under captive conditions. These characteristics allow this species to be a potential biological model to be used on ecotoxicological studies or live food for larviculture. On the bottleneck for its massive utilization relies on 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 concentration in real time of copepod particules 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 indicate 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
Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media

WE387

WE389

Is that an effect? The importance of using all relevant data in mesocosm studies


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 (http://gmoinfo.jrc.ec.europa.eu) with information about all GMOs under consideration was established. As of 07.11.2016, there were 238 entries of medicinal GMOs in the “Summary Notification Information Format (SNIF). SNIFs are prepared as a summary document of the confidential environmental risk assessments (ERA) by the respective Sponsors of clinical trials in the EU and evaluated during the clinical trial application by the national competent authorities. This is a non-exhaustive list, inter alia, information regarding the GMOs and the parental organism’s nature, release, environmental interactions, monitoring, waste treatment and emergency response plans. We strived 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 heterogeneously. Although this analysis has been performed using only Adenovirus, the criteria we were originally designated. The numerical criteria were established evaluating accurately a chemical’s potential to amplify along the food chain, and Whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/vP/vB criteria were first proposed in the late 1990’s. The so-called UVCB method for estimating expected mixture toxic pressure of WE392 basis for T blanketing all MoAs.

WE391 PBT evaluation 20 years on: is it time to reconsider the technical progress made in risk assessment methodology? P. Thomas, C. Durou, CEHTRA SAS /

In the EU, the ecotoxicological database for a chemical is used for the purposes of prospective risk assessment (PRA) and of PBT assessment. While the PRA aims at determining the use conditions and risk management for which the environment is safe, the PBT assessment aims at identifying chemical for which effects on the long-term are considered unpredictable and that environmental exposure is difficult to reverse. The scope of this poster is to discuss, in the light of technical and scientific progress: For which PBT-Like and certain PBT chemical, PRA can now be carried out. The justification of the numerical criteria behind the identification of PBT(v)/vP and vB property. Information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

WE392 UVCB block method for estimating expected mixture toxic pressure of substances of Unknown or Variable composition, Complex reaction products or Biological materials D. van de Meent, Association of Retired Environmental Scientists AREs / Environmental Remediation, Association of Retired Environmental Scientists AREs; D. De Zwart, DiZ Ecotoc / Centre for sustainability Environment and Health; J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; N. van Stralen, Association of Retired Environmental Scientists AREs / Department of Ecological Sciences We have developed a spreadsheet calculation tool for chemical safety assessment of UVCB substances. The tools adopts the approach of Concawe’s Hydrocarbon Block Method for chemical safety assessment of complex petroleum substances. The tool is meant to be used for demonstrating ‘safe use’ of chemicals, as required for registration of substances under REACH. The tool makes use of scientifically 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 the literature 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 hypopharyngeal glands development in Honeybees (Apis mellifera L.) from toxicity studies in the light of current guidelines (EFSA and OECD) A. Drzewiecka, M. Napora-Rutkowska, J. Faron, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; E. Kulec-Ploszczyna, P. Parma, M. Grzesica, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Ecotoxicological Studies; N. Jaworska, Institute of Industrial Organic Chemistry, Branch Pszczyna; A. Daniel-Wojcik, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies 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’s 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 number of 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 hypopharyngeal glands (HPG) responsible for the production of ‘milk’ containing proteinic substances to feed 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 pollon 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 pollon, and no evaluation of HPG. It is a significant change, because according to the literature modern studies, hypopharyngeal glands do not develop correctly in these 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 hypopharyngeal glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypopharyngeal glands as an endpoint in toxicity testing of chemicals on bees.

WE394 Assessing toxicity to Daphnia magna using movement parameters T. Deed, Department of Biology, University of Osijek / Department of Biology; D. Hackenberger, GeoNatura; B. Hackenberger, Department f Biology, University of Osijek

Daphnia are among the most common settlers of freshwater habitats. These 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 sub-lethal concentrations of ZnCl₂ from 0.036 μg/L up to 10 μg/L. The movement parameters were placed in each transparent plastic Petri dish in prepared solutions of the solution (OECD) for up to 96 h. In order to realize this, we used a modified version of the standard OECD guideline (no. 202), as well as 1 h, 24 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 influence 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 I. Pedall, A. Rastall, A. Sagner, M. Faugel, Rifcon GmbH The validation of analytical methods (regulated by SANCO/3029/99 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/30299/rev 4. Guidelines became obligatory. This has resulted in serious implications for the registration process because ecotoxicological studies may well now be rejected on the basis of inadequate analytical methodology or incomplete analytical data although the studies have previously been accepted. Here we give an overview of current requirements and provide a checklist that can be used to evaluate analytical methods in ecotoxicological studies.

WE396
A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFSA Aquatic Guidance 2013
C.S. Ramsden, AgroChemex Environmental Ltd / School of Biomedical and Biological Sciences; C. Gamblin, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco
Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. 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. The 24 hour static 24 hour exposure phases on Days 0 and 14. The study duration for organisms starting as ‘eggs’, ‘alevins’ and ‘swim-up’ fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coordination). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both >95%. The design allowed the direct comparison of the sensitivity of each life stage to the same chemical pulses. 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 more realistic 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 his bulk form. Recently, SiO₂ in nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-take 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 statics [1]. The use of silica nanoparticles (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 quantification and the parallel characterization of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on dialysis membranes, and a sampling protocol are in the process of being established. The first results indicate that is possible to detect the dissolved fraction of SiO₂-NPs roughly 60 nm in diameter within about one day. Long-term dissolution experiments will be performed in the coming months to determine the dissolution kinetics more precisely. This setup will serve as a tool to assess the behavior of SiO₂-NPs in environmental media. [1] 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. Sanchís, IDAEA-CSIC / Water and Soil Quality Research Group; R. Milacic, Józef 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 studies. The exotic fullerene (Ci, Cn) was also detected in environmental sample from the Sava River. The results show that fullerenes are present in the aquatic environment although at concentrations far below than those levels that are expected to cause any toxic effect to aquatic organisms [4]. However, the presence of C60 may modulate the toxicity of some co-contaminants, as described elsewhere [5] Acknowledgement: This work has been supported by the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua and by the Spanish Ministry of Economy and Competitiveness through the project Integra-Costa (CGL-2014-56530-C4-1-R). It has also received funding from the Generalitat de Catalunya (Consolider Research Groups “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefaneei, Alina, et al. Analytica chimica acta 682 (2010): 1-27. [2] Fu, X. et al. Environ. Sci. Technol. 40 (2006): 7457-745. [3] Zakaria, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchís, Josep, et al. Environmental Science & technology 50.2 (2016): 961-969.

WE399
Occurrence, fate and behaviour of fullerenes in the environment
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The occurrence, fate and behaviour of carbon nanomaterials in the aquatic environment are dominated by their functionalization, association with organic material and aggregation behaviour. In particular, the degradation of fullerene aggregates in the aquatic environment is a primary influence on their mobility, sorption potential and toxicity. In this presentation, a summary of the occurrence of fullerenes in environmental matrices performed in different studies of our group will be presented. The analytical approach to investigate seven fullerenes (C60, C70, N-methylfulleropyrrolidione, [6,6]-phenyl C60 butyric acid methyl ester, [6,6]-thienyl C60 butyric acid methyl ester, C60 pyrrolidine triacetyl ethyl ester and [6,6]-phenyl C60 butyric acid methyl ester) in waters, soils and sediments combines an enzyme-assisted solid phase extraction (UES) with liquid chromatography (LC), using a pyrenyl propyl group bonded silica based column, coupled to a high-resolution mass spectrometer (HRMS) using atmospheric pressure photo ionisation (APPI) in negative ion mode. Main results of these studies showed levels of pg/m2-ng/m2 in atmospheric aerosols, pg/g-ng/g in soils and pg/l-ng/l in river waters. The composition of different fullerenes including pristine fullerenes (C60 and C70) and functionalized ones from the engineered origin will be discussed. In addition, different degradation studies of fullerenes in water suspensions emulating different environmental conditions and during a wastewater treatment will be presented. Degradation studies have been carried out under controlled conditions of salinity, the humic substances content, the pH and the sunlight irradiation. The results of degradation studies will show that up to ten transformation products are produced, including epoxides and dimers. Finally, the kinetics of generation of each transformation product will be well presented.

WE400

413
SETAC Europe 28th Annual Meeting Abstract Book
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

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The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments has been shown to be significantly impacted by the presence of surface coatings. A recent study 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 using 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 the entire experiment was measured. As a result of the experiments we adopted provided different ENPs removal kinetic and efficiency during activated sludge stage.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

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The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical, and environmental treatment. As the technology develops, the interactions between ENPs and natural environment become even more complex. This study investigated the potential toxicity of ENPs to aquatic organisms. The researchers conducted experiments to determine the fate and transport of ENPs in freshwater environments. They observed that ENPs were efficiently removed from the water column, indicating their potential for widespread environmental exposure.

WE402 Assessing the fate and transport of engineered TiO₂ nanoparticles in sewer pipes through a dynamic multimedia model (SWNano)

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During the past decades, the nanotechnology and use of engineered nanoparticles (ENPs) have rapidly developed. It is therefore inevitable that they enter the natural environment such as rivers and marine environments. Various models have developed to expect exposure amounts in environment for proper risk assessment of ENPs. However, there is a lack of understanding of how ENPs are transported through wastewater systems. This is crucial for the environmental fate and transport of ENPs. The study aimed to evaluate the potential risks associated with the transport of ENPs through wastewater systems. The researchers used a multimedia model to simulate the fate and transport of ENPs in sewer pipes, providing insights into the environmental impact of these particles.

WE403 Fate factor of engineered TiO₂ nanoparticles in aquatic and terrestrial natural environments

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Engineered TiO₂ nanoparticles are used in several 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 is a powerful method that is able to characterize TiO₂ NPs 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 the purpose, it requires firstly to detect and quantify TiO₂ NPs in water, soil and sediment near a production site in Vieux-Thann (68) to determine parameters which could be used for TiO₂ NPs and several environmental media methods. Then, parameters determined in the previous steps are used to calculate a fate factor of TiO₂ ENPs in a natural environment according to the life cycle impact assessment method calculation. During the study, it was found that intrinsic strength, pH, percentage of organic material, soil composition (percentage of clay, silt and sand) or size and concentration of TiO₂ NPs are parameters which matter in TiO₂ ENPs fate in soils, water and sediments. Furthermore, the first results obtained show that the sampling point located upstream of the production site has the lowest concentrations of titanium dioxide in soil and sediments. This point is used as a reference and allows the determination of the parameters affecting the transport of TiO₂ ENPs.
have produced undesired 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 wall 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 that have 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 (AgNO\(_3\)) and (Ce(NO\(_3\))\(_6\)) and NPs (Ag NPs and CeO\(_2\) 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 seemed not to suppose higher protection preventing toxicity of NPs. The higher resistance of D. salina against the metals and metallic NPs tested might be related to: (i) its ability to stock-dispersions, the measured z-averages ranged from 600 nm (50% ± 27-Ni) up to 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 NPMs in test media, and their contribution to the observed effects on R. subcapitata. Particle size measurements showed that the NPMs have a primary particle size between 200 nm and several micrometres. In freshly sonicated stock-dispersions, the measured z-averages ranged from 600 nm (50% ± 27-Ni) 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) fumarate and FeBTC-JM-AR featuring a positive surface charge. UiO-66-COOH and HKUST had very weak surface potentials, which was also reflected in their instability in the stock and exposure media. In a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in microalgae in species Chlorella and Dunaliella, both directly after dispersion preparation and after a 72 h incubation period, reflecting the duration of a R. subcapitata standard toxicity test. Most notable releases after 72 h were from Zn-CPO (Zn, 3457 ± 14 µg/L), CPO-27-Ni (Ni, 235 ± 14 µg/L) and HKUST (Cu, 143 ± 14 µg/L). UiO-66-COOH caused a 100 % more release of S in the exposure media, while Al(OH) fumarate 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 UiO-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.

**WE406**

**Tracking Physicochemical Changes of PAHs in the Presence of TiO\(_2\) 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 photodegradable and have photo-induced toxicity, but little is known about interactions between PAH photocactivity, 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., TiO\(_2\)-NPs) also have photocactivity. Aqueous-phase interactions between PAHs and TiO\(_2\)-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 physicochemistry of both PAHs and NPs. Previous work conducted by our research group found that sorption 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 cytochrome expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of anthracene and benzo(a)pyrene to NPs in water. Our objective is to investigate PAH/TiO\(_2\)-NP sorption under UV-A and comparison with the formation of PAH decomposition products, using polycyclic aromatic hydrocarbons (OPAHs) and their bioactivity. Various combinations of PAH/TiO\(_2\)-NP preparations will be exposed to UV-A, and changes in gene expression of genes involved in Phase I metabolism (cytotoxicity P4501A cytochrome and cyp/bil) and Phase II metabolism (gst, ephx, gsh; and epoxide hydrolases ephx1 and ephx2) in early life stages of zebrafish will be assessed. The exploitation of biological responses to investigate changes in PAH and PAH decomposition effects, 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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In the environment, nanoparticles are present in a number of chemical forms, exhibiting specific interactions, mobility, biological availability and potential toxicity. Both ecotoxicologists and pathologists have expressed their concerns regarding the potential negative effects of nanomaterials in live systems and the environment. The present study was carried out in order to assess the influence of TiO\(_2\) nanoparticles (in the form of human white food coloarant E171) toxicity on the freshwater midge Chironomus tentans. The safety and consequences of the intake of this form of E171 TiO\(_2\) for human health have been recently reconsidered. The experimental design was constructed for the sediment dwelling chironomidal larvae according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg L\(^{-1}\) TiO\(_2\) were prepared in water and 1 mg L\(^{-1}\) of sediment were used to assess sublethal effect (morfometric changes of mandibles, mandibles and wings). The mortality and emergence ratio was affected by a higher nanoparticulate TiO\(_2\) concentration in the sediment (>1000 mg/kg). Sublethal effects on Chironomus tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the dentition to narrow and elongate and the mandibles to widthen at the first inner tooth, with a rise in the TiO\(_2\) concentration. The present study revealed most suitable endpoints in the case of TiO\(_2\) nanoparticle contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological changes of C. tentans could be used as an endpoint in nano-TiO\(_2\) monitoring together with geometric morphometry.

**WE408**

**Multigenerational exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms**

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Adverse effects of Ag are widely known, with effects ranging from oxidative stress, DNA damage, and gene expression inhibition to cell division, growth and reproduction. Most toxicological studies, however, only cover a limited timescale of the organism’s life stage, rather than the whole lifespan, or even across generation. Therefore, knowledge on multigenerational exposure to sub-lethal concentrations of either ionic or nanoparticulate silver (AgNP) could induce alterations in sensitivity to Ag exposure using the nematode C. elegans as a model. Further, changes in susceptibility to other metals and the role of ROS as well as metabolic changes were investigated. Exposure to sub-lethal concentrations revealed increased susceptibility to toxic Ag, while...
AgNPs tolerance increased. Results show that adaptation development may occur after just a few generations. Subsequent exposure to paragrast, 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 Grx/r-GFP2, 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 

**WE409**

**Effect of silver nanoparticles layer on soil surface to terrestrial species**

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With developing nanotechnology, uses and release of engineered nanomaterials are increasing. Landfill of biosolid after wastewater treatment is considered as one of indirect emission 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 nanomaterial and 4 different exposure cases 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 root surface area of plants exposed to AgNPs was much larger than Low-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 (2016R1A2B401844).

**WE410**

**Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight**

Y. Song, Korea Institute of Ocean Science and Technology; W. Shim, 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 was investigated. Its degradation did not occur significantly, however, was not revealed yet. Expanded polystyrene (EPS), one of common marine plastics, was known to weather more rapidly than polyethylene and polypropylene in our previous study. Fragmentation of nano- and micro-sized particles was qualitatively and quantitatively determined from the expanded polystyrene (EPS) exposed to sunlight for 9 months. The exposed EPS cubes (3x3 cm surface area) were sampled in duplicate at 2, 5 and 9 month after sunlight exposure. The exposed EPS 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% Tween 80 by sonication for 1 min. The collected particles in solution were sequentially filtered with 10 µm and 8 µm pore-size filter paper. The mass of >10 µm EPS 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 7.2±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 <0.8 µm pore filter paper was 32 nm for 2M, 530 nm for 5M and 732 nm for 9M by dynamic laser scattering. Their particle abundances measured by nanoparticle tracking analysis were 1.8×10⁶ particles/ml for 2M and 3.2×10⁶ particles/ml for 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, SCELSCE Nanyang Technological University / SCELSCE; 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 concentration of nano-plastics with MS should include plastics to the total pool of suspended particulates in the environment. Studies of the composition 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-plastics particles. To assess this, we generated MS-associated nano-plastics particles from silicate-iron collected from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres. Analysis of the nano-MS particles parcellated by barded 16S rRNA 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 a-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. This work suggests that nano-plastics may not be a major influencer in altering the bacterial communities associated with MS particles.

**WE412**

**Tracking nanoplastics in marine bivalves at environmentally realistic concentrations**

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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 nanosize < 1µm, NPs) are among the most prominent environmental issues faced by government environmental agencies. MPs and NPs are not an exempted type of pollutant such as plastic particles is their tissue distribution if ingested by an organism. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles are carried out with unlikely high doses of particles, typically above 1 mg/L while the environmental concentration is expected to be much lower. A key objective in the track and mapping of such small particles at these low concentrations are indeed major analytical challenges for environmental and laboratory studies. Our study focuses on the tissue distributions of nanoplastic in marine bivalve in a single pulse exposure of 6 hours and depuration of 48 days in open clean seawater. Here we present, preliminary results where we track nanoplastics at environmentally realistic concentrations in marine bivalves.

**WE413**

**Plastics: does size matter? Impact of environmentally relevant nanoparticles identified in the Nordic environment**

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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 particulates 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 these 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 Programme

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposition are threatening the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplified microcosm and mesocosm model systems, extrapolation of results of these studies is complicated by interactions between the intestinal tract of 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. shape, size, surface charge, coating) and extrinsic environmental characteristics (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 cascades towards disturbed 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 timely 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 integral multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal tract of the 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, Kittech / 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 road and raised spot of a road and reduced speed. Vibration vulnerability assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic to river by conducting sampling at the selecting sampling point. Lastly, we adopted special air-conditioning system to control the system contamination from exposure to vaporized chemicals at the accident location. We adopted dual power supplying system with 3.5kW engine driven and 24hr operation efficiency with 2hr supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are established with vibration information collected. Activated carbon proved to be most effective to control our target chemicals, which was composed onto COMBI type filter. These findings will be modulated and structured to maximize system stability.

**[keyword] chemical accident, mobile lab, rapid monitoring system**

**WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish from a Lake Dosed with Nanosilver**

C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Enneering; K. Newman, J.D. Martin, Trent University / Water Quality Centre

Bench-scale tests have shown that silver (Ag) accumulates in the tissues of fish exposed to silver nanoparticles (AgNPs). However, these experiments cannot replicate the complex 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 seasonal cycle was observed in perch. Perch exposure to Ag accumulated in their liver tissues. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 µg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake into the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish into piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are orders of magnitude greater than the concentrations in water.

**WE417 Hepatotoxicity of iron oxide (magnehite) nanoparticles in the guppy Poecilia reticulata**

G. Qualhalo, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Saboia-Moraes, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomediation, its ecotoxic 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 (14.11 ± 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, melanomacrophage aggregates, exudate and hemorrhagic foci. The acute (3 and 7 days) and long-term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs. The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; nanoecotoxicity; guppy. Session: Ecotoxicology and human toxicology: from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation

[(Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)]

**WE418 Bioteots for Hazardous Waste Classification (HP14): benchmarking Limits for Terrible Ecotoxicity.**

R. Wolens, VITO / ABS; E. Rossi, OVAM; G. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

The current HP14 classification is based on the chemical composition of the waste: i.e. the sum of the concentrations of individual chemicals with ecotoxic properties (substances labeled H400, H410, H411, H420) are compared to defined limit values (CLP). In the case of complex waste materials however the analytical data are not sufficient to determine the limit values. This work involves the chemical evaluation as step 1 bioteots in steps 2 (acute aquatic tests on eluate fractions) and step 3 (acute terrestrial tests on solid waste). Limit values are needed for tolerable ecotoxicity (TE) that are in line with the chemical limit values (step 1). In the study presented here we benchmarked bioteot results against waste materials that were proven to be toxic in step 1, and it was conclusion that LTD4 as TE was a suitable option for our data set. The main conclusions were: The proposed set of bioteots is essential for proper HP14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of bioteots. LTD4 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 Geukens, 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 / Girondes Environnement, 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 components classified 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. Eco-toxicological 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; J. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences

The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies only on physico-chemical and biocatalytic analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I; theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed municipal solid waste (group II) were selected and tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the 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. sutila > T. aestivum while for aquatic organisms was: H. viridissimum > R. subcapitata > C. vulgaris > H. incongruus > R. 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. Jung, M. Buckova, R. Lifschy, J. Hegrova, J. Huzlik, K. Effenberger, Transport Research Centre

Reconstruction and repair of the road infrastructure are 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.


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 in 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 can simply be compared to limit values of environmental qualtity standards. 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 recontaminaton: you don't need to measure everything, just the right things I. Dryganiuk, Texas Tech University / Department of Civil Environmental and Construction Engineering; E. Strecker, Pitt, The University of Alabama; E. Eek, s.e. INAIL; E. Eek, s.e.

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. Metals 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 330) 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 with the presence and effects of terbutryn. The results 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. Rakowska, Texas Tech University / Department of Civil Environmental and Construction Engineering; E. Strecker, Pitt, The University of Alabama; E. Eek, s.e. INAIL; C. Riccardi, Norwegian Geotechnical Institute; P. di palma, IRSACNR; C. Riccardi, 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

418 SETAC Europe 28th Annual Meeting Abstract Book
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) Carbotecnica, 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 (PE) ((26 µm) passive samplers. Capping experiments were performed in glass cylinders, where a layer of contaminated sediment (7.5 cm) was capped with a layer of 3 cm of sand mixed with the different tested materials (AC, OC and BC) and synthetic sea water (4 cm) on top. The capping efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, anthracene porewater concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoclay and biochar after 1 month. The porewater concentrations were also used to model the long term (>12 months) behaviour of various cap configurations with a numerical simulations. These results show that biochar could be a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE425**

**Physicochemical Composition 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 alternatives were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PACTM or SedimiTm were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediments. Preliminary results indicate that biochar leads to a more complete reduction of the PCBs from the former waste material, reducing the bioavailable fraction 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. Test organisms were another challenge. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured as indicators that biochar could be a cost-effective alternative for 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 analysis was a challenge. Modifying a chamber design used in previous studies by Luthy et al. (2009) proved successful. Test organisms were another challenge. Tissue bioaccumulation was planned to be conducted with M. nasuta but instead, initial measurements were made with M. secta (white sand clam) collected at a nearby reference location where M. nasuta had been previously found. The species have a similar appearance and life histories but M. secta had low survival in the field (<20%), lab exposures (>60%), and lab controls (10%). Additional field pilot testing led to the use M. nasuta from a supplier for post-amendment monitoring. PCB tissue concentrations were reduced by up to 85% in both pilot amendment areas after 14 months with clam survival greater than 90%. Benthic invertebrate communities in test plots were not significantly different from baseline conditions or among treatments 14 months after AC deployment.

**WE426**

**Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center

The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) on 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 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 waters 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. Overall, survival in the untreated acid mine waste increased and internal tissue metal concentration in the organisms in both cases were not significantly different among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl2-extractable fractions was observed in all the mine waste dilution in both biochar treatments comparing to untreated mine waste, with no significant differences among treatments or flooding conditions. Addition of biochar also leads to an increase of the pH, which might explain the reduction in metal bioavailable fraction and the consequent decrease in organisms’ body metal bioaccumulation.

**WE427**

**Remediation of mine wastes with biochar: effect on metal bioavailability to E. crypticus**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center

The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailability fraction and risk of exposure. Survival of E. crypticus exposed to mine waste water solutions in an in vitro experiment was periodically measured and internal tissue concentration was measured in surviving organisms. Treated and untreated mine waters were mixed with uncontaminated Lufa 2.2 natural soil to obtain waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and effects on survival (LC50) and reproduction (EC50) were recorded after 21 days in all treatments at each dilution concentration. Results showed no significant effect of the alkaline mine waste B and its pore water solution on survival and reproduction of E. crypticus. However, exposure to untreated and treated acid mine waste (A) and its pore water caused high mortality in organisms at time 0. Overall, the survival increased and the internal concentrations were lower in the amended mine wastes than in the untreated mine waste A, indicating a lower metal bioavailability. Additional of biochar lead to an increase in the pH and a decrease in Pb, Zn and Cd CaCl2-extractable concentrations in the acid mine waste, suggesting a main role of the pH determining the bioavailable fraction of metals in the soil solution. No significant differences between different type of biochars were found. Our results showed that biochar treatments decreased the bioavailable fraction of Pb, Zn, and Cd in the soil solution, reducing the toxicity of the acid mine waste to earthworms.

**WE428**

**Bioavailability-based Methods to Assess Remediation Effectiveness**

J. Gan, University of California, Riverside / Department of Environmental Sciences; J. Wang, University of California Riverside; S. Schlenk, University of California-Riverside / Environmental Sciences; D. Schlenk, University of California-Riverside / Department of Environmental Systems Science

Bioavailability-based Methods to Assess Remediation Effectiveness

E. crypticus was measured concurrent with: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailability fraction and risk of exposure. Survival of E. crypticus exposed to mine waste water solutions in an in vitro experiment was periodically measured and internal tissue concentration was measured in surviving organisms. Treated and untreated mine waters were mixed with uncontaminated Lufa 2.2 natural soil to obtain waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and effects on survival (LC50) and reproduction (EC50) were recorded after 21 days in all treatments at each dilution concentration. Results showed no significant effect of the alkaline mine waste B and its pore water solution on survival and reproduction of E. crypticus. However, exposure to untreated and treated acid mine waste (A) and its pore water caused high mortality in organisms at time 0. Overall, the survival increased and the internal concentrations were lower in the amended mine wastes than in the untreated mine waste A, indicating a lower metal bioavailability. Additional of biochar lead to an increase in the pH and a decrease in Pb, Zn and Cd CaCl2-extractable concentrations in the acid mine waste, suggesting a main role of the pH determining the bioavailable fraction of metals in the soil solution. No significant differences between different type of biochars were found. Our results showed that biochar treatments decreased the bioavailable fraction of Pb, Zn, and Cd in the soil solution, reducing the toxicity of the acid mine waste to earthworms.
WE429 Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction
L. S. Ting, Oregon State University / Chemistry / Environmental and Molecular Toxicology; E. E. Geyer, Oregon Department of Environmental Protection Agency / Ground Water & Ecosystems Restoration Division; S. L. Massey Simonich, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced from the incomplete combustion and pyrolysis of organic matter, and are among the major contaminants in soils. Steam enhanced extraction (SEE) is an in situ remediation technique that uses the addition of steam to soil subsurface to increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on 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 pH 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), liquid chromatography/mass spectrometry (LC/MS), GC/MS, 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 polar PAH derivatives to risk assessments to assess the full effectiveness of SEE and prevent underestimated of potential risks. A quantitative risk assessment will be performed by calculating B[a]P<sub>eq</sub> concentrations and estimated lifetime cancer risk (ELCR) ingestion estimates. Developmental toxicity testing will be conducted with dechlorazoned zebrafish (Danio rerio) embryos (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-seeleachate extract samples at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. This study quantified PAH derivatives after SEE, and it will identify implications for risk assessment and developmental toxicity outcomes.

WE430 Enhanced total petroleum hydrocarbon removal without soil disturbance by serial surfactant foam spraying
R. Bajagain, Y. Park, Kunsan National University; S. Jeong, Kunsan National University / Department of Environmental Engineering

Fuel oil is a complex mixture of hydrocarbons. Naphthene and aromatic hydrocarbons are readily biodegraded in the natural soil system. Diesel includes recalcitrant hydrocarbons to the natural degradation and may act as potential and actual sources of harmful human and ecological effects. The purpose of the study was to evaluate serial surfactant foam spraying technology, which avoids disturbing the soil, to deliver chemical oxidant and oil-degrading microbes to unsaturated soil. Hydrogen peroxide was used as a pre-treatment biog augmentation step. All oxidants were applied to the surface soil by surfactant foam spraying. Surfactant foam would be a good vehicle 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 biodegradation was sprayed every three days for biodegradation of soil TPH. Foam spraying employing oxidation-bioaugmentation serial application significantly reduced soil TPH concentrations to 550 mg/kg from an initial 7470 mg/kg. Application of hydrogen peroxide by foam spraying increased the infiltration of hydrogen peroxide into the unsaturated soil. The easy and even infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodegradation. Fractional analysis of TPH showed C18-C22 present in diesel as biodegradation recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodegradation alone only reduced the recalcitrant fraction by 25%. (This work was supported by National Research Foundation of Korea (NRF-2015R1D1A1A0105964)).

WE431 Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and deprotonation
S. Oh, University of Ulsan / Department of Civil and Environmental Engineering; Y. Seo, University of Ulsan / Civil and Environmental Engineering; T. Seo, University of Ulsan / Department of Civil and Environmental Engineering; I. G. Park, University of Ulsan / Department of Civil and Environmental Engineering;

High performance biochar synthesized via co-pyrolysis of polymer and rice straw (RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with RS-derived biochar, the sorption of 2,4-dichlorophenol (DCP), 2,4-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 affected the sorption of these compounds. Other factors to be responsible for the sorption to polymer/RS-derived biochar. Competition with other halogenated phenols and dissolved cations implied that similar sorption mechanisms were existed and that surface complexation and electron donor-acceptor interactions were involved in the sorption to polymer/RS-derived biochar. Our results suggest that co-disposal of biomass and thermoplastic wastes through pyrolysis may be an effective option to produce a high-performance upgraded biochar as a sorbent for various types of contaminants.

WE432 Biochar for soil management: interactions with legacy contaminants and current-use pesticides
L. Bielski, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Kročová, Masaryk University / Faculty of Science,RECETOX; L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX)

Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its multifunctionality for gas uptake by carbonization of BC as a model ecotoxicologically relevant organism. The influence of biochar properties and biochar dose was considered. At the same time, the well-being of earthworms in biochar-amended control soils was detected. This study aimed at balancing the dosing of biochar in soil management to ensure both an efficient and sustainable control of diffuse contamination and of pests.

WE433 PREPARATION AND CHARACTERIZATION OF COMPOSITES OF TYPE CLAY / POLYMERS AND THEIR USE IN THE REMOVAL OF CONTAMINANTS ORGANICS OF AQUATIC ENVIRONMENTS.
M.S. Rodrigues, Instituto Federal do Maranhão; L. Aguilar Vieira, Universidad 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 recent years. Clay is a unique sorbent due to its high availability and low cost, acting 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.
Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms
M.G. Pliester, Universidad Autónoma de Madrid; G. AMARIEL, Universidad de Alcalá; M. Tamayo-Belda, Universidad Autónoma de Madrid; F. Leganes, Universidad Autónoma de Madrid / Biology; R. Rosal, Universidad de Alcalá; F. Fernandez-Piñas, Universidad Autónoma de Madrid / Biology
Novel days, the ecological impact of microplastics in freshwaters are 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 their potential degradation products. PHB and these potential degradation products were carried by nanoparticles 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 MilliQ 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 aquatic organisms and their effects in release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.


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?
S. C. Chang, University of Helsinki / Department of Ecological Sciences; C. Gestel, Vrije Universiteit Amsterdam / Ecological Science
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 involving exposure concentrations of 0.02%, 0.06%, 0.17%, 0.5% and 1.5% of PES fibers in dry Lufa 2.2 soil. The fibers were mixed in with the soil to achieve as homogenous mixture as possible. Polyester fibers in soil affected the survival and reproduction of the enchytraeid worm Enchytraeus crypticus, but the effects did not show a consistent dose-related pattern. Compared to the control soil, the survival was decreased at fiber concentrations of 0.5% and 1.5%, whilst the reproduction was decreased in all other treatments except for the 0.06% concentration. Polyester fibers did not affect the survival and reproduction of the springtail Folsomia candida and the oribatid mite Oppia nitens, the survival and feeding activity of the woodlice Porcellio scaber, nor the survival of the earthworm Eisenia andrei. Some of the measured endpoints seemed to show a negative response to the fibers, but the variation within the treatments was high, possibly also because it was difficult to achieve a completely homogenous distribution of the fibers in the test soil. The results of this study indicate that synthetic textile fibers can have slight negative effects on soil-dwelling enchytraeid worms, whilst arthropods were not markedly affected by the fibers. However, not only enchytraeid worms (E. crypticus), but also isopods (P. scaber) and the springtail F. candida showed slight negative effects of accumulation of the fibers in the soil. The effects of intact microplastics in soils is evident, the effects of different types of microplastics and their possible role as carriers of xenobiotics to soil organisms need to be further investigated. This study is part of the project IMPASSE – Impacts of Microplastics in Agro Systems and Stream Environment.

TH002 Field sampling and ex-situ bioassays for assessing the ecotoxicological risk of trace elements in different rehabilitated bauxite residues
E. Di Carlo, R. Courtney, University of Limerick / Department of Biological Sciences & The Bernal Institute; A. Boulemtoun, RioTinto; L. Pożar, Alteo-Alumina
Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. They could pose an environmental risk mainly because of their alkaline nature and the presence of trace elements (TE). For their rehabilitation, their potential ecotoxicological impact needs to be assessed. In this study, three herbaceous species were mixed in with the soil to achieve as homogenous mixture as possible. To this end, two approaches were adopted: field sampling and ex situ bioassays. On the one hand, samples of bauxite residues, plants and soil macroinvertebrates were collected from a range of field sites, over different seasons, and the environmental concentrations of TE were measured through ICP. On the other hand, exposure tests with earthworms (following OECD guidelines) and RHIZOTest (ISO 16198) with three herbaceous species were carried out, under controlled laboratory conditions, in order to investigate the bioavailability of TE. Data from the field represent the first step to understand whether there is a possible ecotoxicological issue for wildlife. Comparing the TE concentrations measured in the environment with the literature thresholds, some problematic elements (such as V) and sites (such as the one with compost capping) are identified. Regarding the laboratory bioassays, data show that the bioavailable fraction (taken up and accumulated by both plants and earthworms) is closely correlated with the TE concentrations measured in the field, indicating the inadequacy of chemical methods when comes to evaluate the ecotoxicological risk. In conclusion, the outcomes of this research are likely to shed light on the bioavailability of TE in a contaminated area.

TH003 Differential responses of biomarkers in tissues of the blue mussel Mytilus edulis exposed to microplastics at environmentally relevant concentrations
M. Revel, Catholic University of the West / UBL, Mer Molecules Santé; F. gadague, Institute of molecules and nanoparticles IEMN; M. Fossi, C. Panti, University of Siena / Department of Life Sciences; M. Tamayo, University of Ferrara / Department of Life Sciences and Biotechnology; M. Fossi, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment
Nowadays, the ecological impact of microplastics and nanoplastics in freshwaters is evident, the effects of different types of microplastics and their possible role as carriers of xenobiotics to soil organisms need to be further investigated. This study is part of the project IMPASSE – Impacts of Microplastics in Agro Systems and Stream Environment.

Effects of zebrafish exposure to high-density polyethylene and poly(ethylene) microplastics at molecular and histological levels
G. Limongi, University of Siena / Department of Physical Sciences, Earth and Environment; A. Mancia, L. Abelli, University of Ferrara / Department of Life Sciences and Biotechnology; M. Fossi, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

SETAC Europe 28th Annual Meeting Abstract Book
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 combination of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by using 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. The present study investigates the effects 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 surrounding tissue and into the gut gland. Decapods have 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 V. van der Schyff, North-West University / Unit for Environmental Sciences and Management; J. Karsten, GEOMAR - Helmholtz Centre for Ocean Research Kiel; R. Morard, Bremen University / MARUM - Centre for Marine Environmental Sciences; S. Speich, Ecole Normale Supérieure de Paris; H. Bouwman, North-West University / Unit for Environmental Science and Management Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the ocean surface when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and sink to the ocean floor. The fate and distribution of microplastics at 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 15 increments of 20 m (0-20 m, 20-40 m, 40-60 m, 60-80 m, and 80-100 m). The contents of the multinet samples were filtered through a 1 µm sieve. The remainder of the samples was pressure filtered through black filter paper (to ensure optimal visibility of the microplastic particles), and air-dried. The dried samples were examined under a dissection microscope, and the microplastic particles counted visually. The highest density of microplastic particles were found in the top layer (0-20m), at 52%. Seventeen percent of the particles were found at 20-40m, 14% in 40-60m, 9% in 60-80m, and 8% in 80-100m. There was a high microplastic count near the South African coast (10^4-5). After crossing the Walvis Ridge and sailing into the high pressure system over the SAO, the plastic count decreased dramatically. A fairly homogenous stratification was observed in the high pressure system. Near Brazil, the microplastic concentrations increased again. In the eye of a cyclonic eddy, microplastics were slightly less stratified. This study was intended as a pioneer study to determine whether microplastics are stratified in the water column. This was found to be the case.

TH007 Effects of dietary microplastic exposure on fish intestinal physiology G. Asmonaite, H. Sundh, N. Asker, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route for plastic debris to various aquatic animals, including fish. Large plastic items are known to physically block the intestinal passage, exert physical damage, impairs food uptake and/or cause false satiation. Whereas, the biological effects resulting from ingestion of smaller micro-sized particles or microplastics (MPs) are considerably less documented and potential (negative) consequences on the alimentary tract are largely unknown. To address this, we designed a study aimed at assessing if/how ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MP causes inflammatory responses and disturbs intestinal barrier and transport functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS MPs/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MPs) and diets containing untreated PS particles (PS-virgin) or particles exposed to sewage (PS-virgin). At the end of the experiment, the intestinal samples were excised and stored at -80°C. Gene expression analysis was performed to evaluate 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 M. Martins, Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; M. Costa, Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; C. Gonçalves, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; M. Costa, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering Microplastics (MPs) have dramatically increased in marine environments, being recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and intentionally manufactured MPs and the secondary MPs which result from the fragmentation of dumped plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition 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 juvenile 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 556 MPs per day) and other without MPs (control), making a total of five treatments. Sixty-day laboratory assays were conducted, in duplicate, and the test pellets were provided to fish once a day. After 14, 30 and 60 days, fish were weighed from each treatment and excised. The livers and stomachs of 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 acetylcilinesterase. 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
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, microplastics like microfibers (<5 mm) and nanoplastics (<100 nm) are getting a lot of attention and the researches about their impacts and effects in environments are under way. In this study, we assess various physical, biochemical and nutritional changes in the bodies of Pacific whiteleg shrimp (Litopenaeus vannamei) exposed to nano and microplastics. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with plastics (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, nano and microplastics attached on the filter and ingested to mussels entered the bodies of shrimps and affected the health and physicochemical properties of shrimps. Especially, biochemical changes were significantly induced in the bodies of shrimps. These results can be the evidence of the impacts of small sized plastics on marine organisms. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and Future planning (2016R1A2B301445).

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 vivo model system was used to study the potential accumulation in the embryos in the early stages of organogenesis. The low background fluorescence of the primary lipophilic cells, 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 amount 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 microlastics 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 of different size and shape. Therefore, this research aimed at studying microplastic ingestion and potential physiological effects in blue mussel larvae. 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 (2 µm and 100 nm) and body burdens of particles were quantified after 4h. Subsequently, larvae were transferred to clean water, and the amount of egested particles after 4h 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 2 µm and 100 nm 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 2 µm beads. Egestion of micro- and nanoplastic particles did take place but was not complete within 72h, with 43% of the 2 µm and 61% of the 100 nm 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 nanoparticles 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 nanoparticles (NP, 50 nm) on the fitness of the mussel species Mytilus galloprovincialis. To do so, we employed a multimarker 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-transfase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is considered an important general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP; however, only in NP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by both MP or NP treatments; and catalase, a general indicator of the immune system efficiency. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 15 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was detected 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. based health status index (HSI). The MES did not identify health alterations in control and at 1.5 ng/L MP (HSI = A), while the onset of a low stress level (HSI = B) was detected at 15 and 150 ng/L MP. Differently, the stress level associated to NP (1.5 ng/L) was considered as high (HSI = H) at 1.5 and 15 ng/L and low at 150 ng/L. Overall, results show that both polystyrene MP and NP induce a chronic stress syndrome in mussels by affecting lysosomal integrity and generating pro-oxidant conditions. However, the two particle types can differently alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.

TH103 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 Artemia franciscana exposed to sub-lethal suspensions of PS-NH2 (0.1, 1 and 10 µg/L) and low and at 150 ng/L 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 TAMP (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

423 SETAC Europe 28th Annual Meeting Abstract Book
apoptotic pathway following PS-NH2 exposure. On the contrary, no significant effect on gene expression related to the brine shrimp’s metabolism (UCP2) was observed, and LEA was significantly modulated only at the lowest concentration tested. These findings indicate that stress-related responses are taking place in exposed nauplii after acute exposure to sub-lethal suspensions of PS-NH2, and confirm the general concern about PS-NH2 and their ability to represent an ecological treat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

TH014
The impact of nanoplastics 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 microplastics (< 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 α6β6 gene involved in new formation of chitin for the exoskeleton. Similar microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to 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 nanoplastics as a potential stressor on Mytilus galloprovincialis
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Plastic pollution 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 carbamazepine (cbz) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96 h to PSNPs (different nominal size, 25-50 nm) and cbz (200 μg/L). 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. Polymeric aromatic hydrocarbons (PAHs) are ubiquitous pollutants in the environment, known to cause adverse effects to a variety of marine organisms. Most PAHs have relatively high polymer-water partition coefficients, meaning their potential for sorption to, and transport by, MPs is high. In both field and laboratory studies, a broad range of marine species have been shown to ingest significant quantities of MP, with extended periods of retention observed in some cases. If PAHs are adsorbed to the 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 do not allow the accurate determination of if PAHs are released from adsorbed compounds or from compounds that have dissolved from the MPs into the exposure media. Here, we investigate the sorption kinetics and present adsorption isotherms for three model PAHs (fluoranthene, phenanthrene and 1,3-dimethylpyrrolethylene) to a range of different MP’s in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying sorption affinities (two orders of magnitude). In the case of the less 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, polyester microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was ~10-300 μm. Chemical body burden was measured after exposure to determine bioavailability. 'n'

TH017
Limited influence of microplastics on the effects of an endocrine disruptor on the African clawed frog (Xenopus laevis)
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The role of microplastics as potential endocrine disruptors (EDs) is currently attracting increasing attention. The amphibian model species Xenopus laevis was used to test if ED polyamide (PA) particles in the size range of 15-20 μm (mean diameter) with an irregular shape were used as model MP. Tadpoles were exposed in batches with chronic exposure for 21 days to one concentration of EE2 (10^-8 M) and a low and a high concentration of PA-particles (1 and 100 mg L^-1) separately and in combination with each other. Stress hormones and larval development as well as sexual differentiation were assessed by gross-morphology and histology. Biomarkers, e.g. vitellogenin, were analysed as EE2 specific endpoints. The concentration of EE2 in water was assessed analytically. Physical effects of the microplastic particles themselves on larval development and sexual differentiation were not observed. Only increased levels of the hepatic biomarker vitellogenin showed higher exposure of EE2 in treatments including PA particles in comparison to treatments without microplastics. All other EE2 specific endpoints were not influenced by PA particles. These results indicate that microplastics only play a minor role for the effects of a hormonal active chemical in amphibians and thus provide insights for an indepth risk assessment of MP in the environment.

TH018
Kinetics of POPs sorption and plastic additives release to a variety of polymers under Arctic conditions
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The PLASTOX project investigated the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. PLASTOX combines field-based observations, laboratory tests and manipulative field experiments to study the ecological effects of MPs. The use of common microplastic reference materials, including a marine litter-derived MP produced from an environmentally weathered fish box, allowed a meaningful comparison of data generated by different partners and across the different activities of PLASTOX. As part of a long-term field experiment conducted at marine locations across Europe (Mediterranean to
Arctic), a range of different virgin polymer pellets (LDPE, PP, PS and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SMUD 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, and biological and chemical properties of the aquatic ecosystems harboring the test systems were analyzed to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GPC and SPE clean up. Chemical analyses using GC/MS/MS and GC/MS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common phlorotannins and phthalates, organohalogen derivatives, bioavailable and perfluorinated chemicals were estimated from other four post-industrial virgin pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-QTOF.

TH019 Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis. G. Albernini, Universidad de Cádiz (Spain) / Toxicology Area; I. Cabrera-Pozo, University of Cádiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quirós, University of Cádiz / Environmental Technology; J. Arellano, University of Cádiz / Toxicology Area. In the last few years different components from personal care products have arrived at aquatic ecosystems because these products are not biodegraded or removed in wastewater treatment plants. Some of the personal care products contain plastic microbead such as exfoliating shower gel, toothpaste and make-up. Creams commonly used and available in supermarkets of our area were used in these assays. The microspheres available in these samples were separated and chlorinated. The particles were identified by Fourier transform-infrared spectroscopy and 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 five nominal concentrations of chlorpyrifos (5-80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), and an untreated control and a solvent control (aceton). In these assays non-mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers for the determination of the presence of organophosphates pesticides. In general, there are two type of ChE presented in fish, acetylcholinesterase (AChE) and butyrylcholinesterase (BChe). The AChE was analyzed on the head homogenate of juveniles, after this crude was inhibited with iso-OMPA, which is a specific inhibitor of BCHE. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH020 Are microplastics inhibitory to Daphnia magna and are they significant vectors for hydrophobic organic pollutants? C.K. Frydkjær, Aalborg University / Biology and Environmental Science; N. Iversen, Aalborg University / Department of Chemistry and Bioscience; P. Roslev, Aalborg University / Biology and Environmental Science. The presence of microplastics in aquatic ecosystems is of increasing global concern. Ingestion of microplastics may result in adverse effects in aquatic organisms, and plastic particles are increasingly being recognized as vectors for hydrophobic pollutants. This study investigated: i. the amount of regular and irregular shaped microplastics ingested and ejected by the filter feeder Daphnia magna during exposure and gut clearance; ii. the adverse effect of microplastic with and without sorbed phenanthrene; and iii. the significance of phenanthrene sorption by microplastic compared to sorption by naturally occurring microplastic with and without sorbed phenanthrene; and iii. the significance of feeders serving as vectors for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Trefíøv, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; V. 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). A mixture of PS particles (250µm) was conducted. Two types of synthetic polycarbonate 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, ethylene 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 a well-studied biomarker (AChE) was examined using quantitative real-time PCR. ChE activity was measured in brain. Results showed that all treatments containing chemical mixtures 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-particulate plastics, while PE contaminated particles showed an increase in ChE activity, indicating a greater transfer of chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.

TH021 Dietary exposure to poly styrene microplastics contaminated with environmental pollutants induce hepatic biomarker responses in fish G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences. In the field of microplastics (MPs) research, poly styrene (PS) particles have become a source of material for research in recent years due to its widespread use. However, there is a lack of information on the potential for MPs to affect fish and their hepatic responses to dietary PS MP exposures. In this study PS particles were loaded into experimental diets, containing virgin 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 sewage effluent and industrial harbor runoff). As PS particles mainly exceed sizes relevant for biological uptake, it provides an opportunity to study particles' role as vector for environmental pollutants. Three different experimental diets, containing PS, sewage (PS-sewage) and harbor (PS-harbor) exposed particles, were developed. Thereafter, a suite of oxidative stress biomarkers was investigated in the hepatic tissue of fish exposed to PS MPs via gene expression analysis (NRF2, GR, GST, GS, Gpx, CAT, GCLmold, GCLcat, SOD) and enzymatic assays (GR, GST, GS, Gpx, CAT). Additional, mRNA levels of established biomarkers (CYP1a, ERα and β, AR, MT, VTG) were quantified to provide additional insights into xenobiotic-related hepatic responses to dietary PS MPs exposures. The findings of this study revealed an indication of NRF2-mediated oxidative stress regulation.
Fish from PS-sewage and PS-harbor treatments had altered expression levels of multiple antioxidant enzymes in liver. Dietary exposure to PS MPs resulted in low-level activation of hepatic oxidative stress, which may not necessarily exert harmful effects on hepatic physiology, but may rather indicate adaptive homeostatic regulation. Differential responses to different PS MPs treatments (PS-sewage and PS-harbor) potentially could be explained by different chemicals associated with particles during in situ exposures.

**TH023**

**Effects of Nanopolystyrene and the Co-Contaminant Tributyltin on the Nematode Community Structure in Sandy Sediments**

A. Catarino, A. Homer, Heriot Watt University / ILES; L. Duran Saja, Heriot Watt University / Heriot-Watt Centre for Environmental Science and Engineering; A. dos Santos, Faculdade de Ciências Farmacêuticas - USP / Departamento de Análises Clínicas e Toxicológicas; M. Al-Sid-Heik, ISMERU/QAR; A.J. Sweetman, Lancaster University / Lancaster Environment Centre; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Nanoparticles (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 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 (12°C) consisted of glass beakers (1 L) and the exposure took place for up to 2 months. Core samples of sediments were taken every 2 days from the following treatments: 1) Control sediment, 2) Sediment with spik ed TBT (0-100 ng/kg), 3) Sediment with nPS (0-12 mg/kg) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth (OPD) was determined by measurement of the oxygen saturation in the sediments using a microprofilometer equipped with oxygen microsensors. Changes in the nematode community structure were measured by assessment of changes nematode diversity (nematodes identified to genus) and dose response analyses according to nPS and co-contaminant treatments 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**

**Nanopoly styrene Induces a Decrease in the Oxygen Uptake of Zebrafish Larvae and Enables Sorbed Benzo[a]Pyrene Bioavailability**

A. Catarrino, Heriot Watt University / ILES; M. Clement, Polyt ycececeen aisipapia; M. Ta t, Heriot Watt University / D. Boyle, Plymouth University; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Polystyrene micro (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 [BaP] sorbed to nanopolystyrene (nPS, 500 nm) by measuring the oxygen consumption in the sediments. We hypothesized that the presence of BaP will decrease the respiration rate of the zooplanktonic Daphnia (Daphnia reno) larvae (9th postfertilization, hpf). The effects of nPS and nPS with sorbed BaP on larval (96 hpf) metabolic rate were assessed over a 24 h exposure. The concentrations tested for nPS and nPS with sorbed BaP were 0–50 µg/ml of particles, 0–40 µg/L for BaP. Proof of particle ingestion by larvae was observed using fluorescent nPS (500 nm, µg/ml). Whole-organism metabolism rate (mg O2·h−1 mg dry tissue) was measured using an oxygraph (Hansatech) in 24 replicates per treatment (24 ml) and in three concentrations of the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

**TH025**

**Impacts of exposure to microplastics alone and with adsorbed benzo[a]pyrene on biomarkers and scope for growth in marine mussels M. galloprovincialis**

J. Hatfield, N. González-Soto, University of the Basque country UPV/EHU; A. Katsumi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology; E. Duroudier, University of the Basque country UPV/EHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology; E. Navarro, 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

Due to their hydrophobicity and relatively large surface area, microplastics (MPs) can act as carriers of hydrophobic pollutants in the ocean and may facilitate their transfer to organisms (so-called “Trojan-horse effect”). This study examined the effects of different levels of biological organisms and 45 µg/ml with stress observed in biomarker responses. This evidenced a link between MP exposure and in situ contaminants. Further work is required to a better understanding of the bioavailability of co-contaminants in NPs and their absorption 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 BaP solutions (9 fold change in the highest concentration of nPS (45 µg/ml) with sorbed BaP), whereas this gene did not expression when larvae were exposed just to nPS, indicating desorption of BaP. 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 relevant environmental context.

**TH026**

**Characterization of the adsorption/desorption of benzo(a)pyrene to/from polystyrene micro- and nanoparticles for further toxicity assessment**

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Degradation processes that large plastic items undergo in the sea have led to the appearance of small plastic pieces known as micro- (MPs) or nanoparticles (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 can become biodegradable into 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 observed when NPs were not added. DNA damage (O6-methylguanine) in mussels exposed to a mixture of BaP. An apparent increased effect of smaller MPs on DNA damage was also found. A general horneric effect was demonstrated on SFO across MP treatments. This may be due to a compensatory effect whereby mussels increased their absorption efficiency in order to increase energy intake to make up for energy used dealing with stress observed in biomarker responses. This evidenced a link between MP exposure and in situ contaminants. Further work is required to a better understanding of the effects 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 BaP solutions (9 fold change in the highest concentration of nPS (45 µg/ml) with sorbed BaP), whereas this gene did not expression when larvae were exposed just to nPS, indicating desorption of BaP. 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 relevant environmental context.
supernatant by SPE/MC/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/capture capacity of the plastics was calculated in mass of adsorbed BaP per gram of plastic (µg g\(^{-1}\)) for the different sizes of plastic in order to determine the capacity of adsorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that BaP could be adsorbed at a higher value for A-BaP than for 4.5 µm MPVs. The percentages of adsorbed A-BaP from the total BaP solution were 90.88% and 37.18% with a Qmax of 217.39 µg g\(^{-1}\) and 18.83 µg g\(^{-1}\) (Langmuir model; R²: 0.9862, 0.9477) for 0.5 µm and 4.5 µm MPVs, respectively. In both cases the applied methodology was successful to characterise the adsorption process of BaP to MPs and is currently being applied to NPs. * Funded by French ANR (No. 10-EXP-03-10 and Cluster Excellence COTE (ANR-10-LABX 45), Spanish MINECO (NACE project — CTM2016-8130-R), Basque Government (consolidated research group IT501-13) and UPV/EHU (UFI 11/37 and grant to IM).

TH027
Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord

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The exponential production and use of plastics has generated millions of tons of plastic waste over the past decades, and the presence of microplastics has been reported throughout the world’s oceans. The ingestion of microplastics in situ has been shown in various species, but important knowledge gaps remain, as most studies focus on pelagic fish species or bivalves used for human consumption. Here, we report the presence of microplastics in ten sediment-dwelling and epibenthic species representative of different feeding modes and trophic levels. The species analyzed include fish, bivalves, echinoderms, crustaceans and polychaetes. Organisms were sampled in the inner Oslofjord (Oslo, Norway), which is a fjord subject to strong anthropogenic pressures. High occurrence of plastic contamination was observed, with microplastic particles found in all species and in half of the individuals on average, and present in 75% of the individuals for some species. The extracted microplastics had various shapes (fibers, fragments, flakes), colors and sizes. Micro-FT-IR analysis revealed the presence of various plastic polymers: polyethylene, polypropylene and polyamide were the most commonly found, with 35%, 25% and 15% respectively. We hypothesize that maritime and fish-gathering 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, polyster, polycrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

TH028
Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment


Accumulation of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs on MPs in the aquatic environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3), phenanthrene (log Kow = 4.46) and fluoranthene (log Kow = 5.16). The plastic samples tested here are LDPE pellets with a low amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bosch). For the spiking method, batch reactors containing given amount of LDPE and MilliQ water were prepared. A high concentration of single PAHs in ethanol solution was injected into each batch reactor until the PAH concentration became stable. PAH concentration in the batch was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

TH029
Comparison of spiking and dialysis tubing methods for the determination of sorption capacity and plastic-water partition coefficient of three different polycyclic aromatic hydrocarbons on microplastics


Comparison of spiking and dialysis tubing methods for the determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aqueous environment. The applied methodology was successful to characterise the ad/absorption process of BaP to MPs and is currently being applied to NPs. The determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aquatic environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3), phenanthrene (log Kow = 4.46) and fluoranthene (log Kow = 5.16). The plastic samples tested here are LDPE pellets with a low amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bosch). For the spiking method, batch reactors containing given amount of LDPE and MilliQ water were prepared. A high concentration of single PAHs in ethanol solution was injected into each batch reactor until the PAH concentration became stable. PAH concentration in the batch was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

TH030
Microplastics in food and beverages - a distorted perspective on risk S. Røist, DTU (Technical University of Denmark) / Department of Environmental Engineering; B. C. Alnroth, University of Gothenburg / Department of Biological and Environmental Sciences; T. M. Karlsson, University of Gothenburg

Microplastics are ubiquitous in aquatic environments and they are ingested by a wide range of animals, including species for human consumption, i.e. bivalves and fish. Additionally, plastic particles have been reported in other food products and beverages, like honey, salt, beer and drinking water. This has triggered a discussion on the human health implications of this contamination – an aspect that has gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which merely show the presence of microplastics in certain products but no actual effects on humans. It is without question that plastics can constitute a human health risk, but the way to properly address plastic-related toxicology remains an open question. Microplastic in food 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 plastics and associated chemicals. But as this is rarely put into perspective, the current debate creates a distorted picture of plastic exposure and risks to humans, resulting in a misdirected outrage when people find out about plastic particles in fish, while they at the same time not reflect on the plastic container in which the fish is packaged for transport to stores and homes. In this way, the focus is taken away from the root of the problem, namely our use, production and disposal of plastic materials. We therefore want to encourage a more balanced and careful discussion on human health implications of plastics that takes these aspects into account.
TH031 Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

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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 ocean habitats. Recent investigations find plastic far away from any known sources 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 several depths throughout the water column, microplastics associated with different water masses (Atlantic, Arctic and seawage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and seawage (copolysat) enabled correlations to be made on potential sources, pathways and fates of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a risk assessment of particles 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. Völk, 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 is gaining interest in this environmental issue without propagating effects. In laboratory studies, biological effects have so far only been detected at high particle concentrations with limited environmental relevance. Independently of this, the impacts of microplastics are perceived by the general public as a serious threat to the environment and human health. The societal perception and the great mobilization potential proved to be important drivers for risk management: In 2015, the Microbead-Free Waters Act was passed banning microbeads from rinse-off cosmetics in the USA. But how did this happen without an environmental risk being scientifically proven? In the public, the presence of plastic waste is usually equated with negative biological effects, without taking into account effective thresholds and environmentally relevant exposure concentrations. From a scientific perspective, this representation leads to a dilemma: It is crucial to stay scientifically contextually bridge the gap to the public, but at the same time, it is essential to communicate null effect studies. But does this presentation affect public perception? Can we maintain the public interest in this environmental issue without propagating effects that are not there? After all, we agree on one thing: plastics do not belong into the environment. For the presentation, we draw on results of our interdisciplinary research group on plastics in the environment (“PlastX”). Our team comprises researchers from ecotoxicology, chemistry, geography and sociology analyzing plastics from different environmental as well as societal perspectives.

BIER is good for you: How biotransformation and elimination rate information can improve chemical assessments (P)

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 Pure 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). Biotransformation of chemicals is a key 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 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 (Cyclobutane, Melafleur, Trimoxif and Verdax) 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 BCFS of test chemicals and provide data to build the database information on fragrance materials for fish metabolism and modeling.

TH034 Addressing species diversity in biotransformation: variability in expressed transcripts of hepatic biotransformation enzymes among fishes


There is increasing evidence that diverse xenobiotic metabolizing enzymes exist among fishes, potentially resulting in different chemical sensitivities and accumulation, but this has never been systematically evaluated. One concern is that model test species such as rainbow trout, zebrafish and fathead minnows may not adequately represent the xenobiotic metabolizing capacity of other fish species. Our current study aimed at developing the rainbow trout metabolic assay to more accurately determine full-transcript, isofrom sequencing on liver samples from two dozen phylogenetically diverse fish species. This novel RNAseq approach eliminated the need for transcriptome reconstruction resulting in reference genomes of the highest precision, allowing for detection of enzyme isoform orthologs among the species, as well as the nuclear receptors that control expression of the enzymes. Species were selected for broad phylogenetic coverage, as well as economic, research, and conservation importance, and included: sea lamprey (Petromyzon marinus), lake sturgeon (Acipenser transmontanus), American eel (Anguilla rostrata), alligator gar (Atractosteus spatula), paddlefish (Polyodon spathula), rainbow trout (Oncorhynchus mykiss), rainbow smelt (Osmerus mordax), fathead minnow (Pimephales promelas), Antarctic icefish ( Trematomus loennbergii) common carp (Cyprinus carpio), and channel catfish (Ictalurus punctatus). In addition to comparing information across fish species, the resolved isoforms were compared to human xenobiotic metabolizing enzymes. This comparison aids in evaluating the utility of human-based biotransformation tools such as ToxCast chemical screening assays or metabolism prediction software for potential relevance in fish. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

TH035 Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies


Organophosphate flame retardants (PFRs), as widely used alternatives of bromine flame retardants, are found in a wide array of consumer products in the environment. Metabolism of PFRs in fish is not well understood and the available information is contradictory. Consideration of the adverse effects of PFRs, many researchers have paid their attention on the absorption, bioaccumulation, metabolism and internal exposure processes of PFRs in wildlife and human. PFRs can be rapidly metabolized in the body. The general metabolic pathway of PFRs revealed by certain in vitro studies includes dealkylation, hydroxylation, carboxylation, oxidative dehalogenation and phase II conjugation, resulting in a wide array of metabolites. Dihalogenated phosphates (DAPs) from the dealkylation metabolism were recently deemed important biomarkers in human biomonitoring studies. As very limited information is available on DAP metabolites in environmental biotic samples, we first investigate
the accumulation and tissue distribution of eight common OP esters and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs were relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of PFRs and DAPs than the other tissues of fish. It suggested the existence of parent compounds DAPs in wild animal studies. In the consecutive 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-QTOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, desaturation, and phase II glucuronic conjugation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BBOHEP, and 3-OH-TNBP formed in fish liver microsomes. Liver rather than intestine, plays the primary role in PFR clearance in fish. The significance of these metabolites is in good agreement with human urine monitoring and in vivo rat exposure studies. Overall, the results emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

TH036 Bioaccumulation and biotransformation of prochloraz in the aquatic invertebrate Hyalella azteca

D. Fedrizzi, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry

Prochloraz is a widely applied fungicide for pest management purposes. Due to the improvement of new analytical techniques, many of these chemicals, which has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of cultivation and its sensitivity to xenobiotics. Biotransformation is a primary detoxification process through which organisms defend themselves from xenobiotics. Biotransformation can reduce the internal concentration of parent compounds but in all the studies, influenced 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⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 Lkg⁻¹. Finally, the data will be modeled using a toxicokinetics model, influencing their bioaccumulation 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, Acesulfame-K and 4-MBC, in the manila clam Ruditapes philippinarum

N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Tonioni, Alma Mater Studiorum University of Bologna; P. Lara-Martín, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucia / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR - University of Cadiz

Marine ecosystems have been historically sinks for many pollutants and chemicals whose effects awoke social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and even more rapidly than before. Especially, the current environmental interest is to reduce the toxic effect of pharmaceuticals. The aim of this study is to assess the toxicokinetics of two emerging environmental chemicals: Acesulfame-K (ACE-K) and 4-MBC and their metabolites in the Manila clam (Ruditapes philippinarum) focusing on determining the bioaccumulation factors (BCF) and identifying metabolites and phase II conjugation products. Two groups of Manila clams (40 clams/group) were exposed to Acesulfame-K (0, 10, 100 µg L⁻¹) and to 4-MBC (0, 0.05, 0.5, 5 µg L⁻¹) for 15 days and 5 days, respectively. After exposure, each clam was minced and freeze-dried sample aliquots were derivatized with BHT and analyzed by GC-MS/MS. Additionally, high resolution mass spectrometry (HRMS) and automated data analysis software (Metabolynx®) were used to identify possible TPs in the tissue of the Manila clam at different nominal concentrations (from 1 to 100 µg L⁻¹). The UV filter, the estimated BCFs were between 61 553 and 539 131 L Kg⁻¹, and several metabolites were identified, such as the reduction or hydroxylation of the compound. On the other hand, the artificial sweetener BCF was consistently lower, around 7 L Kg⁻¹ and no metabolites were identified. These results suggest that 4-MBC was highly bioaccumulated and metabolised to facilitate its excretion and they are directly related to the physicochemical properties of the target EPs, since ACE-K is highly soluble in water (log kow = 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log kow = 5.92). Additionally, the present study provides important information about the toxicokinetics of these MBCs, which will be useful for understanding the mechanism of action of these compounds. Furthermore, this work demonstrates the potential of the UPLC-EC/HRMS approach using Metabolynx® software for fast and accurate identification of metabolites of EPs.

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.L. Letcher, Environment and Climate Change Canada / Ecosystems Research and Wildlife Health Program

Nowadays, new compounds are developed at increasing rates and even more rapidly than before. Especially, the current environmental interest is to reduce the toxic effect of pharmaceuticals. 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⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 Lkg⁻¹. Finally, the data will be modeled using a toxicokinetics model, influencing their bioaccumulation and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in Hyalella azteca.

TH039 Proteomics of a metabolic simulation system - a look inside rat S9

A. Schiwy, EWMOSIS; B. Thalmann, RWTH Aachen University, Institute for Environmental Research / Bio5 ESA; P. Huesgen, Forschungszentrum Jülich GmbH / Central Institute for Engineering, Electronics and Analytics (ZEA); S. Schiwy, Institute of Environmental Research/RWTH Aachen / Department of Environmental System Analysis; H.L. Bottelt, RWTH Aachen University / Institute for Environmental Research

The liver is the key organ in metabolism and detoxification of xenobiotics. Simulation of this organ in various bioassays is achieved via the application of either single cytochrome P450 enzymes produced via biotechnological processes or complex enzyme mixtures obtained from animals. Especially, this second process is regarded under various animal welfare regulations as an animal experiment. The animals have to be maintained to a specific age and following their livers have to be induced via various chemicals. Furthermore, this treatment may cause pain to the animals. Finally, the animals have to be killed to harvest the organ (predominantly liver) for further downstream processing. The most common procedure is a mincing of the S9 and subsequent species-specific differences. Alkyl-substituted TPHP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

TH040 A critically evaluated database of in vitro and in vivo toxicokinetic data for...
The document discusses the importance of biotransformation rates in the context of in vitro testing for chemicals. It highlights the role of toxicity in the guidance of in vivo testing and the importance of developing methods to predict in vivo bioaccumulation. The text also mentions the use of in vitro models to predict in vivo bioaccumulation and the development of guidelines for their use. The document uses examples from practical applications, such as the development of test guidelines by the OECD, to illustrate the practical implications of these methods. It concludes with a discussion on the future directions of research in this field.
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 system. There is an additional input of some exposure (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 needs
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 (k₂) experimentally while the uptake rate (k₁) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to k₂ 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 (k₂) 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 k₂ based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k₂oof different tissues, e.g. gills, liver and gastro intestinal tract, could be serve as alternative screening criterion under REACH. This tiering approach not only experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionic substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the k₂ based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH045 SETAC Bioaccumulation Science Interest Group
L.P. Burkhard, U.S. EPA / ORD/NHEERL/Mid-Continent Ecology Division

Advances in evaluating and regulating endocrine disruptors (P)

TH046 Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2016
K. Yamazaki, Ministry of the Environment / Environmental Health
Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of chemical substances “EXTEND2016” in June 2016. It is developed upon achievements on development of framework, development and improvement of test protocols and implementation of testing and assessment in the preceding program “EXTEND2010”. While basic concepts and framework was inherited from EXTEND2010, EXTEND2016’s focus has been shifting to implementation of testing and assessment and consideration of appropriate risk management measures. During fiscal years 2016-17 progress has been made in development of test protocols, evaluation of existing knowledge, identification of candidate chemicals for testing, implementation of testing and assessment and communication to the public, as well as in international collaborative projects with the United Kingdom and the United States. One of the most significant achievements should be finalization of the data obtained from the medaka extended one generation reproduction test (MEQGRT) for 4-monophenyl, 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 TÉLUQ / Département Science et Technologie; M. Nikolaros, Université TÉLUQ / 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 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 relevant data sets. 342 fish studies, 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 of the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and bioindicators for each of the EDs.

TH048 Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities
A. Kienzler, 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 administering selected endocrine disrupting chemicals (EDCs) to different test species. These tests have been summarized in the OECD guidance documents and specific guidance on the diagnosis of endocrine-related histopathology in fish gonads is available (GD 123). However, while the relevance of fish toxicity tests is clear in the assessment of endocrine disruptors, comparison of these tests in response to EDs has not yet been made in the literature. In the EU legal frameworks, these fish tests are required on the basis of the existing information case by case. Due to a difference in sensitivity of species and life stages, many EU discussions have focused on which test should be suitable. However, due to practical considerations, (e.g. regional preference, practical use, and specifically specificity,) it is unlikely to meet all of the requirements within one test. In order to avoid further additional testing, species selection should always consider those factors as much as possible. This work intends to summarise the pros and cons of the available test guidelines and to address some issues e.g. sensitivity in different life stages and in species. Available fish toxicity tests include test guidelines (TG) 229, 230, 234, 240 and guidance document (GD) 148. The number of fish used in each test fish, the covered life stages, the investigated EDs-related endpoints, their robustness (and to which extent these have been validated) and the species sensitivity in response to chemicals with EAS modes of action will be compared. To this aim, publically available data on different fish species tested according to TGs or TG-like protocols will be collected and analyzed. Analysing these fish toxicity data will help identifying which fish test, which species, which life stage of test are needed for the identification and/or risk assessment of EDs. Based on the overall data analysis, we will propose an environmental testing strategy, which is important for minimizing vertebrate testing and costs.

TH049 Towards developing a list of reference chemicals for endocrine assay validation
C. Prosseg, ExxonMobil Biomedical Sciences, Inc.; M.R. Emby, 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 interlaboratory variability for the same endocrine mode of action (e.g., estrogenic/androgenic effects). When evaluating the current, validated, assays in OECD Guidance Document 150, there is a great disparity in the reference chemicals selected, and no discussion as to why various chemical were chosen for the validation procedure. Additionally, reference chemical selection is often not considered substantially. Thus ring trialing this means challenges to regulators and researchers in selecting assays with needed sensitivity and/or appropriateness of use. Here, we attempt to identify the parameters that should be evaluated when selecting validation chemicals. These range from simple physical/chemical properties, to more complex information related to a known mode of action. Additionally, reference chemicals used during assay validation should span a range of potencies incorporating both positive and negative controls. Some well accepted and commonly used chemicals are provided as a realistic starting point to compile a set list of reference chemicals for the validation of endocrine assays.

TH050
Assessment of endocrine disrupting properties of pesticides and biocides: data processing to support data analysis

In 2016 the Commission completed an impact assessment to estimate possible health, environmental and socio-economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the identified endocrine endpoints, gets a tool to make the local 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 to strategy to fill data-gaps.

TH051
Assessment of endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs

Before pesticides and biocides are allowed to enter the European market, a minimum set of toxicological data is required to be submitted in order to evaluate their (unintentional) toxicity and approve their use. In case of concern(s), specific conditions may apply to limit their use or approval might not be granted at all. The data that is required to be submitted is (mostly) coming from standardized test guidelines (TGs). While these TGs focus on a diverse range of toxic effects, none of the TG studies currently in the data requirements are specifically developed for the assessment of endocrine disruption (ED). However, ED specific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available sources to assess and categorise all pesticides and biocides currently registered in the EU. This assessment was driven by 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 dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH052
Plausible or Causal: Bioactivity and mechanistic potency as a critical piece in hazard characterization of endocrine active chemicals
E. Mihaich, ER2, Dow Chemical Company / Toxicology; E. Grignard, European Commission / F3 Chemical Safety and Reference Materials; E. Joosens, European Commission / DG Joint Research Centre

While methods have been and are being developed and validated, and regulatory programs around the world are moving forward with evaluating chemicals for their potential interaction with the endocrine system of humans and wildlife, the challenge still remains in distinguishing between effects that are specifically estrogenic or androgenic effects originating from the interaction of a chemical with an endocrine receptor and those that are not based on the interaction with an endocrine receptor. Without establishing a set of criteria it may prove problematic to assess if a substance is estrogenic or androgenic effects. When evaluating the estrogenic/androgenic effects ob has been considerable effort to establish criteria and driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH053
Addressing endocrine concerns for the environment in dossier evaluations with an FSST - possibility to avoid further vertebrate tests
F. Hornung, German Environment Agency / UBA; T. Arnin, German Environment Agency UBA / IV 2.3 Chemicals; J. Arnin, German Environment Agency UBA; E. Hassold, German Environment Agency UBA / IV 2.3 Chemicals; S. Germer, German Environment Agency UBA

In the context of the REACH regulation, long-term toxicity testing on fish is a standard information requirement for substances manufactured or imported in quantities of 100 or more tonnes per year. Additionally, some substance properties, for example a low water solubility, lead to the necessity to conduct a long-term toxicity test on fish. If a data gap in a registration for long-term toxicity to fish is identified in the process of a dossier evaluation (Dev), the preferred option is to request a Fish early life-stage Test (FELS - OECD 210). However for a substance with hints for endocrine disrupting properties, further tests would be needed to clarify the concern in a substance evaluation. In our opinion it is possible to avoid the economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the identified endocrine endpoints, gets a tool to make the local 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 to strategy to fill data-gaps.
TH054 Structural Alerts for Potential 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. Segelcke, UFZ Department of Ecological Chemistry

Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disruptors 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 second 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 thyroid hormones, systematics have 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 hormones 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/coecohem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 37146 412 0.

TH055 Mixtures of endocrine disrupting chemicals disturb behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae
L. Bjergrønn, J. Sturve, University of Gothenburg / Department of Biological and Environmental Chemistry

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, growth, development and brain function. Previous studies have mainly focused on single compound exposures or simple mixtures and further evaluation of complex mixtures at low concentrations is needed. Within the framework of the European Horizon2020 project EDC-MixRisk, EDCs linked to adverse effects on neurodevelopment and growth in a pregnancy cohort study have been identified. Mixtures of these chemicals (phthalate metabolites, phenols and PFASs) were synthesized to be tested in a range of in vitro and in vivo systems. The thyroid hormones (THs) are one of the targets of interest as they are essential for brain development and disruption of this axis may lead to alteration of neurodevelopment. The current study aimed to determine the effects of the EDC-mixtures on larval behaviour and to identify disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix N and Mix G (mixtures correlated with adverse effects on neurodevelopment or growth in the epidemiological study) for 48h in concentrations equivalent to 0.01x – 100x human levels. Alterations of larval behaviour caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be examined in an in vivo/sub-lethal-toxicity of endocrine disruptors. Larval locomotion was tracked using the ViewPoint ZebraBox and a protocol of alternating dark/light cycles. Quantitative PCR was used to determine the effects of the EDC mixture on the expression of thyroid related genes. Our results show that acute exposure to the mixtures significantly alter larval locomotion and expression of genes involved in TH signaling, including thyroid hormone receptors thra and thrb as well as the deiodinases dio1 and dio2 at concentrations corresponding to those found in pregnant mothers. These results will be combined with results from other model systems in the EDC-MixRisk project to improve risk assessment of EDC-mixtures.

TH056 Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures in multigenerational exposure studies
N. Cipoletti, St. Cloud State University / Aquatic 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 endocrine characteristics (VTG, glucose). Both urban and agricultural exposures resulted in growth alterations between treatments most likely due to density-dependent growth. Urban exposure indicated higher fecundity (both first and second generation) at low and environmentally relevant concentrations as compared to control and high treatments, potentially as a therapeutic hazard associated with the estrogenic nature of the mixture. Agricultural exposure indicated no differences in reproductive criteria, but endocrine studies were not anticipated in laboratory settings designed to test acute effects of single chemicals. 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 second 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 thyroid hormones, systematics have 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 hormones 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/coecohem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 37146 412 0.

TH057 Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity differences and environmental mixtures
S. Kohno, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; U. Hashby, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concerns (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, estrogen and nonylphenol 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 mimic endpoints lead to reductions in fecundity, and elevate 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.

TH058

433 SETAC Europe 28th Annual Meeting Abstract Book
Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures
U. Hasbay, 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 endpoints and have evaluated performance 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-butoxyethyl)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 indicated occurrence 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. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmonst, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/de-chlorination). The receiving aquatic ecosystem adjacent to these two wastewater treatment plants has been the focus of intense biological and chemical study for the past seven years and provides a unique opportunity to assess two divergent treatment technologies of wastewater and also indicated occurrence 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. Reisgräf, German Federal Institute of Hydrology; L. Moscovici, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Environmental Science; G. Reifferscheid, German Federal Institute of Hydrometry and Meteorology

Effects from simple exposures to complex mixtures (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-butoxyethyl)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 indicated occurrence 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.

TH060 Contaminants of emerging concern in the North American Great Lakes: Validation of effects through field-based exposures
V. Korn, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, Validation of effects through field-based androgen based androgen screen (YAS). The results from the presented study indicate 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.

TH062 Endocrine disruptors used in polymers in the offshore oil and gas industry
C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suehring, University of Toronto; A. Smith, Cefas / Ecotoxicology and Molecular Ecology

Contaminants 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. The selected endocrine disruptors were also exposed to different environmental conditions. To determine the potential of these polymers to release endocrine disruptors, four substances with known endocrine disrupting monomer groups were extracted using high pressure and temperature as well as acidification and/ or biodegradation and were tested using a Yeast-based estrogen screen (YES) and yeast-based androgen screen (YAS). The results from the presented study showed 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.

H.P. Ernsting, University of St. Thomas / Biology; P. Edmonst, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

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Thyroid hormone receptors alfa and beta for assessing endocrine disruption in environmental samples
V. García Herranz, INIA National Institute for Agricultural and Food Research and Technology; E. Sánchez Martínez, Instituto de Acuacultura 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 Acuacultura 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 aquatic exposure or injection. The pattern of brain aromatase mRNA expression at different levels of biological organization were assessed. Morphological (i.e., heart rate and swimming activity) and physiological (e.g., heart rate and swimming activity) changes were observed. The endocrine disrupting (ED) compounds, and estrogen receptor agonists, which cause premature launching of the molting process and subsequent death. Crustaceans, as a subphylum closely related to insects phylogenetically, also adopt this edocrine signalling system, as they share the hormone, hormone synthetises enzymes and the receptors. Thus, these endocrine disrupting insecticides, together with other untested potential endocrine disruptors, may post a thread on the crustaceans. Here we report the development of an in vitro reporter assay for the screening of edocrine receptor agonist in chery shrimp. The assay is done by transiently transfecing mammalian cells with plasmid vectors expressing chery shrimp EcR and RxR, together with a vector carrying a luciferase reporter gene fused to a minimal promoter linked to five copies of EcRE. The results show that the system responds well to the native edocrine hormones in a dosage-dependent manner. The adaptation of mammalian cells in in vitro assay for heteroegonous receptor is satisfactory. Three DAH/BAAH insecitcides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecitcides aimed for insect pest control can be potential hazards to crustaceans. More studies on different mammalian cells and comparison study with mixtures of chemicals are being carried out to validate this reporter gene system.

Mid-stage as an alternative for aquatic exposure? A case study in zebrafish embryos with 17α-ethinylestradiol.
E. Marchioli, University / Toxicological Centre Dep of Pharmaceutical Sciences; E. Lai, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; L. Vergauwen, University of Antwerp / Zebraslab/Zebraslab Dep of Pharmaceutical Sciences SPHERE; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; A.L. van Nuijs, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; J.S. van Cruchten, University of Antwerp / Applied Veterinary Morphology, Vet Dep Veterinary Sciences; D. Knaup, University Antwerp / Zebraslab Dep of Veterinary Sciences
Pharmaceutical companies have to perform an environmental risk assessment for every drug that is launched to the market. The mandatory tests for potential endocrine disrupting (ED) compounds are mainly aquatic activity tests. However, it is often difficult to expose fish to poorly water soluble EDs via water. Micro-injection in the yolk is therefore proposed as an alternative and ecologically relevant exposure route because the yolk of zebrafish embryos contains many lipids, and this route mimics maternal transfer. To be used as an exposure method, micro-injection needs to be characterized and compared to the standard aqueous exposure route. As a first step 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 after 5 days. 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. 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 disruptor for many years. Although several studies have investigated the effects of atrazine exposure on reproductive function, its safety remains controversial and the mechanisms of its toxicity remain unclear. In this study, we tested the hypothesis that atrazine can affect reproduction in crayfish through dysregulation of vitellogenin expression and estrogen 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. In addition, in the hepatopancreas of crayfish, 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 Procambarus clarkii and consequences of endocrine disruptor exposures

E. Gismondi, University of Liege

Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent the last plank of the so-called endocrine organs, such species 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 address 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-PCR on gammarids.

TH070

Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius

S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; V. Eiser, RWTH Aachen University / Physical Geography and Geocology; A. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliaevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; H. Hollett, RWTH Aachen University / Institute for Environmental Research.

Exposure to each ECD highlighted EDCs affecting vertebrates could also impact invertebrates specifically. In this study, we tested the hypothesis that atrazine can affect reproduction in crayfish through dysregulation of vitellogenin expression and estrogen 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.

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**TH071**

Assessing acute toxicity of Bisphenol A on Daphnia magna by passive dosing approach

H. Kwon, Y. Jeong, H. Jeon, S. Kim, KIST Europe / Environmental Safety Group

Bisphenol A (BPA) is a raw material for widely used polycarbonate plastics, but it is known to have negative effects on human health and the environment. It was classified as an endocrine disrupting chemical (EDC), which requires an accurate and reliable toxicity data for robust risk assessment. However, currently available toxicity data (48h-EC50) on Daphnia magna showed a significant discrepancy of 3.9-16.0 mg/L. Therefore, our aim is to determine the reliable toxicity of daphnia to BPA. Passive dosing as well as the existing toxicity testing protocol (i.e., spiking with co-solvent) were used to administer BPA to daphnia. Conventional spiking method often fails to control the exposure concentration of (semi-)hydrophobic organic compounds due to the loss of target compounds from sorption to the test vessel and volatilization. Here, passive dosing technique compensates for the concentration loss by using a biocompatible polymer as a reservoir. Moreover, the adverse effect of the only target compound can be considered in this format as passive dosing does not require a co-solvent to dissolve and deliver the target compound.

**TH072**

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Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi) N. 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. However, the increasing quantities of insecticides leached into water bodies severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disruptors known to interfere with the natural hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JHA insecticides would cause adverse effects on the development and reproduction in crustaceans as in insects. The aim of our study is to examine the toxic effects of JHA insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully 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 mg/L (4.64, 3.20 mmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 mmol/L) respectively. This shows that these two chemicals have adverse effects on the development of juvenile N. davidi. After six weeks chronic exposure to 100 μg/L (0.33 mmol/L) fenoxycarb and 200 μg/L (0.64 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 related genes were investigated in this study. The genes h3 (hormone receptor 3) and c75 in N. davidi were up-regulated, while Chdh6 (calponinlike protein), CHH (crustacean hyperglycemic hormone), c74, 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.

TH073 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asan Lake Watershed, Korea M. Choi, J. Kim, Greenecos Inc.; Y. Kim, Greenecos 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 considering environmental 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. Finally, a multimedia fate model for Asan Lake Watershed (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.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural atmospheric organic PM extracts in zebrafish embryos (brine shrimp, Artemia salina L.) M. B.L. van Drooge, IDAECS-CSIC / Department of Environmental Chemistry; A. Marqueno Bassols, Institute of Environmental Assessment and Water Research IDAECS-CSIC; B. Pina, C. Porte, IDAECS-CSIC / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAECS-CSIC / Department of Environmental Chemistry. Outdoor ambient air particulate matter and urban pollution are related to adverse effects on human health. The present study assesses the cytotoxicity and ability to disrupt aromatase activity of organic PM extracts from rural and urban areas at equivalent air volumes from 2 to 30 m³, in human placental JEG-3 cells. Samples were chemically analysed for particle bounded organic compounds with endocrine disrupting potential, i.e. PAH, O-PAH, phthalate esters, but also for organic molecular tracer compounds for the emission source identification. Rural samples collected in winter were cytotoxic at the highest concentration tested and strongly inhibited aromatase activity in JEG-3 cells. No cytotoxicity was detected in summer samples from the rural site and the urban samples, while aromatase activity was moderately inhibited in these samples. In the urban area, the street site samples, collected close to intensive traffic, showed stronger inhibition of aromatase activity than the samples simultaneously collected at a roof site, 50 m above ground level. The cytotoxicity and endocrine disruption potential of the samples were linked to combustion products, i.e. PAH and O-PAH, especially from biomass burning in the rural site in winter. Exposure of zebrafish embryos to the same organic PM extracts resulted in a significant test for JH in protozoa and to rats and mice, and in growth retardation of mice in other tests. However, the samples collected in summer, when traffic was low, showed a significant inhibitory effect on aromatase activity in JEG-3 cells, which suggests that these samples contained phthalate esters as well as organic tracers and could potentiate the effects observed in winter. In conclusion, the present study showed that the samples collected in the Asan Lake Watershed, Korea, contained potentially endocrine disrupting compounds that could cause adverse effects on reproduction in aquatic organisms.

TH075 Dietary and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study. M. Mar, INDEMIBIOFEM, I. Rovira, Universitat Rovira i Virgili; R.P. Sharma, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IISPV; V. Kumar, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química

Endocrine disruptors (EDs) are chemicals compounds that send confusing messages to the body causing various dysfunctions by mimicking or altering the effect of hormones in the human body. Several EDs such as Bisphenol A (BPA) and di(2-ethylhexyl) phthalate (DEHP), are involved in obesity and diabetes diseases in children. Recent studies have shown evidences that these chemicals can cross the placental barrier making fetal exposure closer related to maternal exposure. The aim of this research is to establish fetus exposure to EDs (BPA and DEHP). To address this issue, recently, pregnant women recruitment has begun. In present work, dietary and non-dietary (dermal, non-dietary ingestion and inhalation) exposure of these women was considered in order to predict the dose of EDs at which the child has been exposed in the early stage of the development. The data obtained from this cohort (such as, physiological data, dietary habits and lifestyle, among others) was implemented into a physiological based pharmacokinetic (PBPK) model, which assesses the absorption, distribution, metabolism and excretion of a chemical compound into human body, as well as the internal exposure to target organs. To estimate the early exposure of the child, the model was implemented with fetus compartment for these chemicals. Results indicates that for both, BPA and DEHP, diet is the main contributor to the total exposure. However, both, the environmental and dermal exposure also contribute significantly to the total DEHP exposure. Levels of both EDs were modelled in maternal blood and in fetus blood as well as in other body compartment. These results will be validated with the results of biological monitoring in the current cohort (n=72). The integration of the data obtained from current on-going human biomonitoring campaign and the physiological based pharmacokinetic model, here implemented, predict the early exposure of the child/fetus to EDs. This work is included in the frame of HEALS project (FP7-603946).

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. Diarre, Envigo / 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 immunoassay format. A method with a lower limit of quantification (LLOQ) of 5 pg/mL for T3 (final range 5 to 1500 pg/mL), and a final range of 70 to 700,000 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 the results were significantly prevalent in fetuses 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 ≤20% (25% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling. TH077 Steroid estrogens and estrogenic activity in wastewater in dairy farm and urban wastewater treatment plants L. A. Tremblay, Catchword Institute; J. B. Gadd, NWI / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited Steroid estrogens contamination has been linked to adverse effects on exposed 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 wastewater with differing DSE management practices: either catchment-based or farm-based. The toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy wastewater. Estrogen was the predominant steroid measured in wastewater because of its presence in dairy cow wastes and as a degradation of the main dairy cow estrogen, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalent concentrations [EEQ]) was sampled at low levels in 85% of the wastewater samples ranging from 1.44 ng L⁻¹ EEQ and up to 210.5 ng L⁻¹ EEQ. While estrogenic activity was generally low in all 10 (10) stream with measurable estrone, 17α- and 17β-estriadiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid estrogen 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. TH078 Toxic receipt: Why You Should Avoid it J. Mila, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šojić, ALHem - Safer Chemicals Alternative Bisphenol A (BPA) is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine system, it can cause allergic reactions on skin and respiratory irritation, and it can lead to serious eye damage. In December 2016, the European Commission made a decision to ban, i.e. restrict use of bisphenol A in thermal paper, if concentration of the chemical equals or exceeds 0.02 mass %. This decision shall be applied as of 2 January 2020. During 2017, ALHem carried out the campaign “Toxic receipts” in order to check the presence of BPA in thermal paper from public and private sectors in Serbia, as well as on paper and plastic packaging for food, comprising 33 samples, out of which 20 thermal papers (mostly cash receipts), 6 plastic boxes and 7 paper packets for food. The results indicated that all samples of imported thermal paper (rolls) tested in laboratories were positive on the content of BPA. In addition, 87.5% of thermal paper from private sector and 88.9% from public sector contains this chemical. BPA was present in samples in the range of 0.63 and 0.91% (w/w). In this campaign, food packaging was also tested, primarily the one used for packing of fatty food. BAP is soluble in fats so it easily migrates from the packaging into food, which is corroborated by the data that greatest intake of this toxic chemical by humans is by peroral route, i.e. by food. The obtained results indicated that tested plastic boxes for food from supermarkets did not contain BPA. When it comes to paper packaging, French fries bags did not contain BPA, while tested cardboard boxes contained BPA in traces. These cardboard packages are made of recycled paper, so it can be assumed that thermal paper enters the recycling together with other paper waste, thus contaminating final products made of such recycled paper. Taking into account that on European market there are providers of thermal paper free of this hazardous substance, ALHem hereby calls upon institutions from state and public sectors, as well as upon companies from private sector, especially upon trade chains, to replace this product with safer alternative free of bisphenol A, so as to contribute to health protection of their workers, especially cashiers, but also of all citizens. 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. Eliza, VITO / ABB, A. De 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) requires evaluation of the potential effects on the one hand (concentration effect relations for the target organisms) and evaluates the potential exposure of target organisms on the other hand (i.e. to define the environmental compartments and organisms of concern). Risk management either reduces the potential effects (i.e. redesigning the product) or prevents the predicted exposure (i.e. redesign the production process) to minimize the potential risk. Case study: ERA Ag-NP metal based ink. Potential effects and concern R. 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. Aries, ARCHE; J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF 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 nanoforms. 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. A toxic 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. 221): nanosilver 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 suspension 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 methods used in the ecotoxicity tests. The nanosilver dissolution behaviour qualitatively explained the observed toxicity. Since the ecotoxicity testing demonstrated that nanosilver was equally or less toxic than ionic silver, further fate testing in soil was not required. The data collection on the uses of the silver nanofoms 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. Skjolding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Bang, Technical University of Denmark / DTU Environment; J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF The European Chemical Agency (ECHA) is in the process of revising its guidance documents on how to address the challenges of ecotoxicological testing of nanomaterials. In these revisions, outset is taken in the hypothesis that ecotoxicological test methods, developed for soluble chemicals, can be made applicable to nanomaterials. European Research Council project EnvNano - Environmental Effects and Risk Evaluation of Engineered, which ran from 2011-2016, took another outset by assuming that: “The behaviour of nanoparticles
Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental potential. The results are based on the behaviour of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (factors 3 to 3 for high) for a so called “fate bond” which will be included in a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in the considered compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not needed to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate information of the ENM is needed since this will determine whether the ENM is persistent or not. This results in a 5 x 5 risk matrix with 25 possible combinations of exposure and ecotoxicological hazard properties (ecotox bond; present at an additional postor) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: transformation, transport, fate grouping Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03XP0002
In environmental risk assessment the risk quotient $R$ of the total ENM mass released to the environment, thereby calling for a special treatment of nano materials as well as ecotox models 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 (ecotocx flow-chart) is characterized by maximum 24 questions. For the parameter 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 (ecotocx-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 ecotocx-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 discharges and more important the risks that have been subject to environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

**TH087**

Forms of released engineered nanomaterials: A systematic assessment in material flow analysis

V. Adam, EMPA Technology & Society Lab / Technology and Society Lab; A. Caballero-Guzman, EMPA / Technology and Society Lab; B. Nowack, Empa Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab

The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO$_2$ flowing in dissolved, transformed (particles that have been subjected to chemical transformations), matrix-embedded (ENM released while embedded in a solid matrix), nanoparticulate (non-transformed, not embedded ENM including free, aggregated and agglomerated ENMs) and product-embedded (ENM contained within a whole product, going to solid waste treatment) forms to the environment. Transformations of ENMs in the environment are excluded from the scope of this work. The methodology includes 10 technical and 3 environmental compartments. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of the distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO$_2$ presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%; 94% and 99%, respectively). The only transformation identified is the incineration of transformation 1 (from nano to Ag). Transformations of ENMs in the environment affect both 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.

**TH088**

Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials

J.T. Quik, RIVM / DMG; J.A. Meester, E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Lofts, NERC Centre for Ecology & Hydrology / Shore Section; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox$^4$ modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox$^4$ model was recently extended for use with nanomaterials (SimpleBox$^4$-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this work we study the sensitivity of SimpleBox$^4$-nano to the newly added process parameters. This shows that in addition to the dissolution rate of a material, the efficiency of, among the concentration of natural particles and their size play a role. In order to use SimpleBox$^4$-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 SimpleBox$^4$-nano for estimating the risk quotient. 1. www.rivm.nl/simplebox4; 2. Meesters, J.A.J. et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4: 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) that are used in consumer products that are designed to be in contact with the skin or mucous membranes. Nanoengineered nanomaterials (NMs) are of special concern, especially in light of recent findings that their ecotoxicity and adverse effects to human health differ from those of their bulk chemical counterparts. Only a few methods have been developed to estimate the behavior of NMs in the environment and their potential toxicity to the surrounding matrix. To complement the available experimental data, in silico methods, such as Quantitative Structure Property Relationships (QSPRs), are useful tools to estimate the properties of NMs. In this study, we show the sensitivity of four in silico methods to the estimation of the hazard of NMs and NM related parameters in exposure modelling. Since they are more economical and have low restrictions, in silico methods are well suited to fill this gap in predictive risk assessment, under the condition that enough data of reliable quality becomes available.

**TH090**

NanoScreen - Minimizing the risk associated with nanomaterials used in sunscreen at all lifecycle stages

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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-TiO$_2$-UV-blockers typically used in sunscreen usually consist of rutile nanoparticles coated with a first mineral layer of silica or alumina aimed at blocking the photocatalytic character, and thus passivating the nanomaterial. In addition, the grafting of a second layer of organic coating is aimed at favoring the nanomaterial dispersion in the cream formulation. Once drained from the skin either through bathing activity or everyday usage and cleaning, the nanomaterials contained in the sunscreen can be released to the sea shore. Their behavior in this system is largely determined by this industrial coating and by their initial dispersion in the formulation. This project aims to develop the Eco-design of sunscreens through the combination of in silico methods of screening and in vitro and in vivo testing modules. The work is designed to answer the following questions: 1) Intrinsic characteristics specific to the NM, matrix or environmental conditions. This analysis is combined with the current state of Quantitative Structure Property Relationships (QSPRs) development, as a specific set of in silico methods, 2) Recommend further development of in silico methods that are suitable for predicting the environmental risk assessment of NMs. In particular, the use of descriptors related to the interaction between a NM and its surroundings, e.g. the attachment efficiency, is proposed. QSPRs as well as other in silico methods are well suited to fill this gap in predictive risk assessment, under the condition that enough data of reliable quality becomes available.

**TH091**

Using the SimpleBox$^4$ nano tool for predicting the environmental concentration of nanomaterials

J.T. Quik, RIVM / DMG; J.A. Meester, E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Lofts, NERC Centre for Ecology & Hydrology / Shore Section; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox$^4$ modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox$^4$ model was recently extended for use with nanomaterials (SimpleBox$^4$-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this work we study the sensitivity of SimpleBox$^4$-nano to the newly added process parameters. This shows that in addition to the dissolution rate of a material, the efficiency of, among the concentration of natural particles and their size play a role. In order to use SimpleBox$^4$-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 SimpleBox$^4$-nano for estimating the risk quotient. 1. www.rivm.nl/simplebox4; 2. Meesters, J.A.J. et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4: Model Definition and Evaluation. Environmental Science & Technology, 2014. 48(10): p. 5726-5736.
A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel Corbicula fluminea

S. Kühl, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism; B. Knopf, Fraunhofer Institute for Molecular Biology and Applied Ecology IME / Environmental Specimen Bank and Elemental Analysis; B. Volker, German Environment Agency

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 in benthos through conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMS (NM300K) and silver nitrate we were able to compare the accumulation and elimination of ionic and nanoparticulate silver. Mussels were exposed for a period of 4 - 6 days. In both cases steady state concentrations of total silver in the mussel tissue were reached within 24 hours. The quantification of the total silver content in mussel was carried out by ICP-MS or ICP-OES. The temporal course 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. marchio, ENEA / SSPT-PROTER-BES; S. sciavio, ENEA CR; M. Olioviero, Università Parthenope; F. Pacchierotti, ENEA; c. arcangeli, ENEA CR; E. Cordelli, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; g. leter, ENEA 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 and aquatic ecosystems. First studies were carried out using the freshwater mussel Corbicula fluminea. In the case of 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 the co-exposure to multiple toxicants which could lead to a change in the biological complexity and the toxic responses due to the diverse trophic levels. In the case of human health risk assessment, multiple potential target organs are considered, also as a function of exposure routes. DNA damage and consequent gene alterations are an essential component of toxicity assessment and often showed a very sensitive response to ENM exposure. Moreover, genetic alterations are transmissible to the next generation and can have an impact at the population level. Due to ENM reactive nature and therefore to their peculiar behaviour in the experimental media it is more and more evident the need to investigate the early molecular initiating events triggered by ENM that lead to subsequent DNA damage responses, e.g. oxidative stress and in common events across organisms and cell types. Therefore, an environmental risk assessment requires the development of new and alternative methods and tools applied to the evaluation of ZnO nanoparticles, which are present in the vast majority of commercial test systems at environmental hazard identification. We also compare dose-effect relationships and adverse outcome pathways for possibly drawing a unifying model and for establishing common safe limits.

From detection to action: advancements in assessing and managing highly fluorinated compounds (P)

# TH095 Assessment of persulfate oxidation liquid chromatography tandem mass spectrometry for the analysis of perfluoroalkyl and polyfluoroalkyl substances in water

G. Munoz, Universite de Montreal / Chemistry; S. Mejia, McGill University / Civil Engineering Assessment of Nanomaterials

OECD Test Guidelines and Guidance Documents for Environmental Safety Assessment of Nanomaterials

J. Ahtianen, Drumso Ecotox Consultancy; F. von der Kammer, University of Vienna / Department of Environmental Geosciences; M. Gonzalez, Organization for Economic Cooperation and Development; K. Schirm, German Federal Environment Agency UBA; D. Volker, German Environment Agency. The OECD test guidelines (TGs) for testing chemicals have been widely used for regulatory purposes all over the world since the establishment of the Mutual Acceptance of Data (MAD) principle in 1984. This MAD principle ensures that, if a chemical is tested under the Good Laboratory Practice (GLP) conditions accordingly to an OECD TG, the data should be accepted in all OECD countries. The TGs have been developed, harmonized, internationally validated (round-robin-tests) and adopted by OECD countries to be used for the phys-chem characterisation, fate estimation, and hazard identification for risk assessment of various chemicals. In addition to the TGs, OECD Guidance Documents (GDs) usually guide how to use TGs and how to interpret the results. These GDs do not have to be fully experimentally validated, and hence they are not under MAD, but they are based on the latest published scientific research. But are the existing TGs and the related TDGs applicable and adequate for the study of physicochemical properties of MNMs? In general, it is accepted that most of the “endpoints” or more precisely measurement variables are applicable also for nanomaterials. However, for some endpoints new TGs are needed. In addition, GDs are needed to give more precise advice on the test performance, e.g. including sample preparation and dosage of the test material, the characterization of the exposure and understanding the results in order to gain insight in the data obtained. The poster will present the status quo on recent TGs and GDs development for nanomaterials at OECD level with relevance for an adequate environmental safety assessment of nanomaterials. Selected activities on TG/GD development will be presented in detail regarding their objectives, challenges and status. Emphasis will be given to the OECD TGs on the stability in simulated environmental media, which was published in 2017 by the OECD, October 2017 and the draft GD on dispersion stability and dissolution rate of nanomaterials, which will support interpretation and utilization of data coming from this TG and a draft TG on dissolution rate which is in preparation. In order to illustrate the effort of TG/GD development the way the 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; L. Rincón, INIA - National Institute for Agricultural and Food Research and Technology / Department of Environment; F. Torrent, Universidad Politecnica de Madrid / Escuela Superior de Ingenieros de Montes; A. Valdehita, 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 OECD test guidelines (TGs) for testing chemicals have been widely used for regulatory purposes all over the world since the establishment of the Mutual Acceptance of Data (MAD) principle in 1984. This MAD principle ensures that, if a chemical is tested under the Good Laboratory Practice (GLP) conditions accordingly to an OECD TG, the data should be accepted in all OECD countries. The TGs have been developed, harmonized, internationally validated (round-robin-tests) and adopted by OECD countries to be used for the phys-chem characterisation, fate estimation, and hazard identification for risk assessment of various chemicals. In addition to the TGs, OECD Guidance Documents (GDs) usually guide how to use TGs and how to interpret the results. These GDs do not have to be fully experimentally validated, and hence they are not under MAD, but they are based on the latest published scientific research. But are the existing TGs and the related TDGs applicable and adequate for the study of physicochemical properties of MNMs? In general, it is accepted that most of the “endpoints” or more precisely measurement variables are applicable also for nanomaterials. However, for some endpoints new TGs are needed. In addition, GDs are needed to give more precise advice on the test performance, e.g. including sample preparation and dosage of the test material, the characterization of the exposure and understanding the results in order to gain insight in the data obtained. The poster will present the status quo on recent TGs and GDs development for nanomaterials at OECD level with relevance for an adequate environmental safety assessment of nanomaterials. Selected activities on TG/GD development will be presented in detail regarding their objectives, challenges and status. Emphasis will be given to the OECD TGs on the stability in simulated environmental media, which was published in 2017 by the OECD, October 2017 and the draft GD on dispersion stability and dissolution rate of nanomaterials, which will support interpretation and utilization of data coming from this TG and a draft TG on dissolution rate which is in preparation. In order to illustrate the effort of TG/GD development the way the idea for a new TG and new GD to an accepted OECD TG/GD guideline will be presented.

TH093
The global distribution of certain perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible adverse health effects. The sorption of PFASs to a variety of PFAS adsorbing solid materials, such as activated carbon, for this environmental application. In this work, sorption of PFASs to a variety of solid materials is studied, including biochars, and is assessed for both organic and inorganic contaminants removal from soil. Biochar (BC) is a high adsorption potential for organic and inorganic contaminants and can be used at a low cost. Biochar is thus a promising and economic alternative to other carbonaceous materials, such as activated carbon, for this environmental application. In this study, three BCs were used as sorbents: a wood BC (wBC) made from wood chip waste (used for all the treated soils), an iron enriched BC (Fe-BC) (used for the metal contaminated soils) and an activated biochar (aBC) (used for the PFAS contaminated soils). Isotherm batch tests have been carried out using a water and soil mixture (L/S=10) to which BC was added at increasing doses (from 0 to 20%). The aim of this work is to investigate i) whether biochar can be used as a sorbent material for the treatment of industrial contaminated soil, ii) whether BC can 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.

TH097  Sorption of 14 PFASs to organic soil constituents - the effect of H+, Na+, Ca2+ and Al3+ ions
H.F. de Campos Pereira, Swedish University of Agricultural Science / Department of Soil and Environment; M. Ulberg, Swedish University of Agricultural Sciences / Department of Soil and Environment; D. Berggren Kleja, Swedish University of Agricultural Science; J. Gustafsson, Swedish University of Agricultural Sciences / Department of Soil and Environment; L. Ahrens, Swedish University of Agricultural Sciences SLU / Dept. of Aquatic Sciences and Assessment Environmental risk assessment of perfluoroalkyl substances (PFASs) requires accurate prediction of their sorption in soils. The aim of this study was to investigate sorption of 14 PFASs, including perfluorocarboxylates (PFCas), perfluorosulfonates (PFSA)s and perfluorooctanesulfonamide (FOSA), to an organic soil horizon and the effect of solution pH and simulated soil organic matter (SOM) net charge as a function of pH and added concentrations of Al3+ and Na+. Generally, the organic C-normalized partitioning coefficients (Koc) were negatively correlated (r=−0.32 ± 0.11 log unit pH). Further, the SOM bulk net negative charge (−1.41 ± 0.40 log units per log unit pH). The sorption increased with increasing perfluorocarbon chain length (hydrophobicity) for both PFCCs and PFSA:s with 0.60 and 0.83 log units per pH unit, respectively. The sorption was found to be affected by pH and cation type. The relationship between sorption and pH was more strongly related to the pH value. This suggests that the most long-chained PFASs have a binding preference towards the highly condensed parts of the humin fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

TH098 Environmental degradation rates for new PFAS via decarboxylation potential in water, in a MS-collision cell and in a collision cell with an AFFF
V. Nilsson, NILU - Nordic Institute for Air Research
Straight-chain perfluorolipatic acidic carboxylic acids, like PFPOA, are extremely stable chemical compounds. In contrast, several other perfluorinated carboxylic acids are less stable and undergo decarboxylation - spontaneous degradation with loss of carbon dioxide. For instance, perfluorobenzoic acid decomposes slowly in aqueous solution, while perfluoropropionic acid lost CO2 so fast at room temperature that its spontaneous decomposition is a synthetic method for nonfluorooisobutane. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PFCCs is based on the same decarboxylation process: SRM transition from [M−1] to [M−45]. A collision energy, required for such transition is a measure of intrinsic stability of a compound. Relatively high transition energy for this transformation can be satisfactorily predicted by DFT calculations at standard B3LYP/6-31+(G,d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carboxylic acids also correlate well with MS and DFT-derived energies. Thus mass-spectral information and results of simple quantum-chemical modeling can be used as a measure of abiotic degradation potential for per- and polyfluorinated acids in aquatic environment.

TH099 Perfluoroalkylated acids (PFAs) in soil and invertebrates (Isopoda) near a fluorochrome plant in Flanders, Belgium.
T. Greffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; M. Ens, University of Antwerp / Department of Biology; L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Perfluoroalkylated acids (PFAAs) have been produced for over five decades. Due to their hydrophobic and lipophobic character they are suitable for a wide range of applications. However, PFAAs may enter the environment, accumulate in wildlife and may cause detrimental effects. The widespread use of PFAAs has resulted in a global presence. Therefore the major global manufacturer, 3M, phased out the use of PFAAs has resulted in a global presence. Therefore the major global manufacturer, 3M, phased out the production of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in 2002. Nevertheless, these compounds are still detected in high concentrations in the environment and biota. Especially the fluorochrome plant has been characterized as a PFAS hotspot for environmental contamination. In the present study we measured the concentration of 12 PFAAs (8 perfluoroalkyl carboxylic acid (PFCAs) and 4 perfluoralkyl sulfonylic acids (PFSA:s) in soil and isopods collected at a fluorochrome plant in Antwerp, Belgium. In addition, samples from four other areas were collected, representing a gradient in distance from the pollution source. We tested for both correlations between soil properties (e.g. total organic carbon (TOC) and PFAAs concentrations in soil, as well as correlations between PFAAs concentrations in soil and invertebrates. In the soil, PFBA, PFOS and PFOA were the only compounds that were detected at all sites. Soil concentrations of all other compounds, with exception of PFOA and PFBS, were ≤ LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOS and 8 ng/g ww for PFOA were detected in soil at the plant site, which are high compared to what has been reported in previous studies conducted in the area. Furthermore, these concentrations decreased significantly with distance from the plant. However, concentrations did not differ between the three locations that were situated farthest away from the plant. No significant differences in TOC were
THI100
Occurrence and distribution of legacy per- and polyfluoroalkyl substances (PFASs) and fluorinated alternatives in coastal waters of the German North and Baltic Seas

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Long-chain per- and polyfluoroalkyl substances (PFASs) are recognized as global contaminants of high concern as they have been shown to be persistent, bioaccumulative, and toxic, and ubiquitously present in the environment. This has led to a number of actions by industry and regulatory authorities aiming at restricting the production, use, and release of long-chain PFASs. Consequently, an industrial shift has been taking place, moving away from long-chain PFASs toward alternative substances, such as per- and polyfluoroether carboxylic and sulfonic acids (PFECAs and PFESAs). Due to structural similarities, the question arises whether the alternatives represent a substantial improvement on their predecessors. Public data on their properties and environmental exposure is still limited. This study aims at investigating occurrence and distribution of legacy PFASs and fluorinated alternatives in surface water samples from coastal areas of the German North and Baltic Seas. In summer 2017, two sampling campaigns were realized using the research vessel Ludwig Prandtl, during which 96 water samples were taken along the German coasts. The analytical method included 26 legacy PFASs and 5 fluorinated alternatives, among them the PFECAs GenX and ADONA. Filtered 1 L water samples were spiked with mass-labelled internal standards (50 μL, 60 pg/μL) and loaded onto preconditioned solid phase extraction cartridges (Waters Oasis HLB). Based on these and further results, it will be considered if regulations on long-chain PFASs and the subsequent ongoing shift to fluorinated alternatives lead to changes in the coastal environment.

THI101
Suspect screening for short chain PFAS in environmental water samples, waste water treatment plants, and building materials

I. Matzenbach, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology; D. Zahn, Hochschule Fresenius / Chemistry and Biology; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology; T. Frömelt, Hochschule Fresenius, University of Applied Sciences Polyfluoroalkyl and polyfluoroalkyl substances (PFASs) are very persistent, lipophilic, hydrophilic group balanced sorbents) were deployed across nine sites in the German North and Baltic Seas. In summer 2017, two sampling campaigns were realized using the research vessel Ludwig Prandtl, during which 96 water samples were taken along the German coasts. The analytical method included 26 legacy PFASs and 5 fluorinated alternatives, among them the PFECAs GenX and ADONA. Filtered 1 L water samples were spiked with mass-labelled internal standards (50 μL, 60 pg/μL) and loaded onto preconditioned solid phase extraction cartridges (Waters Oasis HLB). Based on these and further results, it will be considered if regulations on long-chain PFASs and the subsequent ongoing shift to fluorinated alternatives lead to changes in the coastal environment.

THI102
Utilization of passive samplers to detect poly- and perfluorooalkyl substances (PFASs) in wastewater and estuarine environments

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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 utilize 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 offshore and fire training bases, and more pristine areas. 25 PFASs (including fluorionic acids, 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 wastewater 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.

THI103
Distribution of per and polyfluoroalkyl substances in sediments of the Spanish coast

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Per- and polyfluoroalkyl substances (PFASs) configuration, consisting in an alkylated hydrophobic chain fully or partially fluorinated, hydrophilic group terminated, provides to PFASs simultaneous hydrophobicity and lipophilicity. Their persistence, bioaccumulation and toxicity make them a source of increasing environmental and public health concern. Presence of PFASs in the marine 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 semiconfined 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). PFOS, PFOA, PFOSA, n-MeFOSA, and n-EtFOSA were extracted from sediments by sonication, cleaned up by dispersive solid phase extraction and the analyzed by LC-ITQ-Orbitrap-HRMS in full mode (Concha-Graña E. et al. 2017). This is the first time that these compounds were measured in these areas. N-MeFOSA and N-EtFOSA were not detected in any sample, whereas PFOSA was only detected in two samples, but below the quantitation limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ría de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 ng/g in Mar Menor and below 0.1 ng/g in Ría de Vigo, being the total concentration of PFOS similar than the detected in similar areas. Some characteristics of the sediments were taking 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 (MINECO, project reference: CTM2013-48194-C3-1-R/2-R, and ARPA-ACUA, project reference: CTM2016-77945-C3-3-R). References: Concha-Graña E. et al. 2017. Reunión de la Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas, Furanos y Compuestos Orgánicos Persistentes Relacionados (2017)

THI104
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 Chemistry
Oceanography
Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial telomerization processes. They can degrade into various perfluorinated carboxylic acids (PFCAs) including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which are persistent organic contaminants of concern. This study assessed the use of polyethylene passive samplers as a sampling tool for volatile PFAS precursors coupled to their analysis via gas chromatography-mass spectrometry (GC/MS). Parallel active and passive sampling was performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 pg/m^3), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PWA}, were determined at a Waste Water Treatment Plant (WWTP) for the first time in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{Pw}, during the 3-week uptake experiments. Derived log K_{Pwa} values for 6, 8, 9 and 10 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSE and EFFOE, derived log K_{Pwa} 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, MeFOSE and EFFOE.

TH105 Occurrence and Removal of perfluoroalkyl and polyfluoroalkyl substances (PFASs) in full-scale water and wastewater treatment plants H. Blanckaert, P. Beelen, J. Ghekiere, W. De Clercq, K. Vleugels, J. De Smedt, J. Van Damme, 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, bioaccumulability and adverse 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 PFPA precursors. The treatment processes include conventional activated sludge system (CSA) and membrane bioreactor (MBR) system in plant 1, sand filtration (SF) and microfiltration (MF) in plant 2, and microfiltration, reverse osmosis (RO), ultraviolet disinfection (UV) in plant 3. Short-chain PFASs (e.g. PFOA, PFPeA and PFNA) are present at relatively high concentrations (several hundred ng/L) in the influent. Total PFASs concentrations (≥PFASs) were highest in Plant 1 (227 – 1,279 ng/L), followed by Plant 3 (174 – 215 ng/L) and Plant 2 (61 – 109 ng/L). Total PFASs concentrations in the treated water were 119 – 483 ng/L, 50 – 127 ng/L and 0.8 – 3.1 ng/L in Plant 1, 2 and 3, respectively. Results showed that RO is the only efficient process for removal of PFASs (>98%) for both short-chain and long-chain PFAS precursors. In SF and MBR systems, several PFAS precursors have limited removal efficiency (< 50%) for PFAs. In some cases, the efficient concentrations of PFASs were even higher than the influent, suggesting potential degradation of PFAS precursors. The biodegradation of PFAS precursors also leads to the higher removal of some PFAS precursors. Considering the low removal of PFASs in most of the treatment processes, further research is needed to improve the efficacy and efficiency of their removal.

TH106 Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers V. Kodes, D. Leonovoycova, Czech Hydrometeorological Institute / Section of water quality, R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses Objective of the Study The study compares PFOS and PFOA concentrations detected in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected compounds in biota was performed in aquatic environments, including wildlife and humans. Perfluorooctyl acids bind to proteins and the binding in bioaccumulation behaviour different from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biopsy cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFOA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these compounds. Several fish species from four Czech rivers in the Bohemian-Moravian uplands were seasonally collected for the analysis of 10 perfluorocarboxylates, 7 perfluorosulfonates and 5 perfluorosulphonamides. Individual fish were measured, weighed and dissected in three fractions: whole viscera, the muscle and the rest of the carcass (head, fishbone, skin and fins). The fractions of six fish were analysed separately or pooled in one or two samples for the subsequent analysis. The dry weight, the lipid and the protein content were measured in each fish fraction (muscle, viscera and the rest of carcass). PFAS analysis were carried out with fresh samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2-5 g) was performed by sonication with ACN/H2O mixture enhanced by salting out and acidification; extracts were purified on HybridSPE and cooled to room temperature. The gas chromatography/MS was performed as such to assess the bioaccumulation and biomagnification of perfluorooctyl acids (PFAAs) in the food web of an urban river. Conclusions In general the highest PFOS concentrations were found in fish, except fish muscle, as a level of 0.01 μg.g⁻¹ was detected. PFOA concentrations in fish and blood were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQS for PFOA (9.1 μg.g⁻¹).
precursors to the apparent biomagnification of PFCAs, via their biotransformation. In addition, the Total Oxidisable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFASs in sediments/biofilm/leaf litter samples (64-80 % of total PFAS molar concentration); this proportion was lower in invertebrates (28-54 %) and in fish (15-25 %). These results suggest either the biotransformation of precursors in benthic invertebrates and fish or the limited bioaccessibility of unidentified sediments-bound pre-PFASs.

TH109 PFAS and their precursors in the Environment. First indications from a large scale environmental monitoring study

Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the 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 aquaculture. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFAS), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFPA), and also precursors (e.g. PAPs, dPAFs, TFS, NAONDA) 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 gill eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH110 A physiologically based toxicokinetic (PBTK) model describing the bioaccumulation of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss)
A. Vidal, Istrea Lyon; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicology METO; E. Vulliet, CNRS / TRACES Team; E. Rochard, Istrea Bordeaux / UR EABX; J. Garric, Istrea Lyon / UR RIVERLY Laboratory Ecotoxicology; J. Liebert-Metzger, Fraunhofer IME / UR RIVERLY Water Quality; V. Hage

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 to predict the uptake, distribution, elimination and excretion of two selected perfluorinated substances (PFAS) in trout. The selected compounds are perfluorooctanesulfonic acid – PFOS - and perfluorooctane sulfonic acid – PFHxS. Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2010. The present study describes the absorption, distribution, biotransformation, elimination rate constants and environmental fate of these two compounds in rainbow trout (Oncorhynchus mykiss) by applying a PBTK model. This model is validated by comparing model predictions with experimental data from two dietary experiments. The first experiment involved the intake of PFOS and PFHxS by the rainbow trout after oral administration, and the second experiment involved the intake of PFOS and PFHxS by the rainbow trout after intravenous administration. The PBTK model was able to predict the absorption, distribution, biotransformation, elimination and excretion of PFOS and PFHxS in rainbow trout with high accuracy. The model also allowed for the prediction of the environmental fate of these compounds, which is essential for the management of PFAS pollution in aquatic systems. The present study provides a valuable tool for the assessment of the risk associated with PFAS exposure in aquatic ecosystems and for the development of effective management strategies to mitigate PFAS pollution.
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 Monomeric Fluorinated Substances of High Health and Environmental Hazard
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Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other nonomeronic and polymeric per- or polyfluoroalkyl substance (PFAS) classes, such as perfluoroalkylic acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of PBT (Persistent/Bioaccumulative/Toxic) or vPvB (very Persistent/very Bioaccumulative) chemical substances, nor do they meet the Persistent, Mobile and Toxic (PM or PMT) substances criteria proposed by the German Environmental Agency, Umwelt Bundesamt (UBA, 2017). As high molecular weight fluoropolymers (e.g., PTFE) are benignly persistent (i.e., not mobile, bioaccumulative or toxic), all “highly fluorinated” substances do not pose equivalent health or environmental hazards and thus should not be regulated as a single class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous nonomeronic per- and poly-fluoroalkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.

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

TH117 Challenges and Open Questions in Earthworm field testing
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In the risk assessment of plant protection products for in-soil organisms, the earthworm field test following ISO 11268-3 (ISO 2014) is used as the highest tier option. The test protocol is currently under revision and transition to an OECD document under the auspices of UBA (Germany), mainly focusing on improving/teststatistical aspects 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 Carbendazim? Examples and suggestions are 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
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Fluoropolymers, such as polytetrafluoroethylene (PTFE), constitute a distinct class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous nonomeronic per- and poly-fluoroalkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.
In the European Union (EU) the environmental risk of chemicals is regulated in various ways. Probably the most complex approach in place is the one for pesticides, mainly because these chemicals differ from other chemical groups by three reasons: (1) They are intended to harm organisms, i.e. those which are impacting agriculture. However, many of the pest species affected by pesticides belong to the same taxonomic groups being responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spraying, but also by 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 precaution 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 as for van Genuchten will be performed and the last sampling will be conducted in April 2018. First results of this project focused on the litterbag test assessment and earthworm field assessment. We have used this tiered risk assessment approach to assess the risk of more than 40 common used pesticides in China. The aim of the risk assessment for soil organisms is to prevent negative acute or long-term effects on soil functions and functionally most important species. The risk assessment approach established in China considers ecologically relevant groups of soil organisms, earthworm and soil microorganisms, which are involved in a range of soil functions providing essential ecosystem services, e.g. organic matter breakdown and mineralization, water regulation in soil. The tiered approach is a valuable tool to quickly identify those pesticides which do not pose acute or chronic risk (in a certain area of ecotoxicology) on soil organisms – even under worst case assumptions, and to identify those that need more attention and further evaluations. All risk assessments presented are based on Risk Quotients (RQ), calculated by dividing the Predicted Environmental Concentration (PEC) by the Predicted No Effect Concentration (PNEC). This calculation takes into account, that beside the toxicity of a pesticide, the amount of this pesticide in the environment plays a major role when assessing a risk. If $RQ > 1$, the risk is unacceptable and high tier risk assessment is conducted. By these we can predict exposure to soil organisms. A higher tier exposure analysis can be applied by refining environmental exposure parameters or using semi-field trial test. Currently, the models PRAESS and China-PEARL, which developed by NIES and ICAMA in China, are applicable to predict the exposure concentration at specific depth of soil layer and at specific scenarios in China. Proposed test systems for effect assessment include acute toxicity test or reproduction of earthworm, reproduction test, nitrogen transformation test, litterbag test and earthworm field test. The PNEC can be calculated using the endpoint obtained from ecotoxicological studies and corresponding uncertainty factors (UF). Tier 1 risk assessment mainly focuses on the acute risk assessment of pesticides which are involved in tiered assessment and N - transformation assessment. High tier risk assessment mainly focusses on the litterbag test assessment and earthworm field assessment. We have used this tiered risk assessment approach to assess the risk of more than 40 common used pesticides in China. Keywords: tiered, risk assessment, pesticide, soil organism.

TH122

Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks


Terrestrial non-target arthropods exhibit a vast array of life history strategies and migration tactics. However, their home range is rather small and, thus, they are a good model group to investigate the factors which influence ecological recovery in risk assessments. Arthropod communities are not stable, but the numbers of species and individuals per species fluctuate over time and space. Part of the variability may be due to the initial disturbance of the application rates of the pesticides, which are 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 yet considered.
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. Hagerbäumer, R. Raschke, Bielefeld University / Animal Ecology; S. Höss, Ecosa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology

Lower tier toxicity 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 important components of the soil food web. 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 microarthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products

Microarthropods are important components of the soil food web and are suitable for risk assessments of plant protection products (PPPs). However, the role of soil microarthropods in the degradation of organic matter (OM) is currently not well known and their functional role in OM degradation is dominated by soil microorganisms. The results indicate that the process of OM degradation is dominated by soil microorganisms. The mesofauna contributed only a minor amount to OM degradation. The microminchan test did not show a clear effect of invertebrates on the mesofauna driven organic matter degradation, although total abundances of Collembola and Acari were heavily reduced by the insecticide applications. In the recently published Soil Scientific Opinion (2017), EFSA proposed Specific Protection Goals for soil micro-arthropods in 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 minicon tin test on an arable field. Thus, the relevance of the structural endpoints on soil micro-arthropods (i.e. single species protection) within an in-field soil risk assessment for PPP, which focus on maintenance of soil fertility (protection of soil functions), is questionable.

TH125 The role of source sink dynamics in the assessment of risk to non-target arthropods from the use of plant protection products
G. Lewis, JSC International Ltd; S. Braaker, BASF France S.A.S.; C. Mayer, BASF SE / Ecotoxicology

The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980's culminating in the paper by Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issue does raise important questions particularly when looking at single soil functional endpoints, e.g. 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 groups of representative surrogate species and generating the necessary information for them and at the landscape level to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the concept of source-sink dynamics in field risk management decisions. Practically, this could mean that 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
A. Hunka, Halmstad University / School of Business, Engineering and Science; M. Møl, ADAMA Agricultural Solutions; S. Pashami, S. Waara, Halmstad University

Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and experimental results often result in a better perception of uncertainty. However, this is not always the case, 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 derive a model of some of the most widespread sources of uncertainty, classify different uncertainties and link them to recognition of 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
address and manage uncertainties.


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 (1996) are based on total concentrations ("aquarigen"). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc.) and various metal extractions (1M NH4NO3, 0.1M CaCl2, Ca(NO3)2 with ionic strength corresponding to soil solution, DTPA-CaCl2, 0.43M HNO3, plus aqua regia). Arsenic was chosen due to its high relevance as a soil contaminant, its low data availability compared to other metals and is an element of concern included in many soil regulations. Six soils covering a wide range of Central European soil properties were chosen and spiked with sodium arsenate dibasic heptahydrate (Na2HAsO4•7H2O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC10 and, respectively, EC50 values), based on the six extraction methods, have been determined. The variation in EC10 values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH4NO3 < CaCl2 < Ca(NO3)2 < DTPA < HNO3 among almost all 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.

TH128 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 usually involves the collection of soil cores followed by heat extraction such as Berlese-Tullgren or McFadyen 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, higher sensitivities are reached by activity-based sampling. Soil core sampling is an established and recommended method known to extract springtails, mites and some other small arthropods. Hypogean trapping is a relatively novel approach (cf Dehelean et al. SETAC 2016, Sims et al. 2016, Bakker et al. 2017) and seems to have a certain degree of selectivity. For purposes of method development and evaluation we have performed a comparative study in which soil core sampling and hypogean trapping (mine traps) were performed in the same fields. The study comprised both a hay meadow and an arable field. Soil cores were taken from the top 10 cm of soil, mine traps collected from various depths. With this contribution we will highlight the differences in species spectrum, numbers collected and variability observed with the different methods and discuss the implications for data analysis and interpretation.

TH129 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. Jansen, ECT Oekotoxikologie GmbH; P. Massey, Smithers Viscent; C. Müller, RWTH Aachen University / Institute for Environmental Research / 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 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 in the first part of the performance of CPCAT is assessed with 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 sound response of the outcome of field studies because data distribution and variance are adequately considered and smaller differences between control and treatments can be detected.

TH130 Relationship between soil microbial biomass methods used in environmental fate laboratory studies P. Massey, Smithers Viscent; P. Pearson-Davies, B. Earnshaw, Smithers Viscent ES; 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 extraction, 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 biomass size. This method determines the biomass size can then be determined by relating respiration and fumigation extraction data. In spite there being multiple recognised ways of determining soil microbial biomass, it is important to recognise that they reflect different aspects of the soil microbial community. One fundamental difference between these methods is that they can potentially distinguish between active and non-active components of the biomass. As noted in OECD 2097, substrate induced respiration cannot be used to estimate the active aerobic biomass, whereas in OECD 1420-2:1997, fumigation can extract carbon from both active and non-active biomass components. With such differences between methods, it is important to consider which method is more appropriate for determining soil suitability for environmental fate laboratory studies. In Work is currently being undertaken by Smithers Viscent to investigate the relationship between the soil microbial methodologies commonly used for laboratory soil studies. The aim of this work is to better understand how the choice of soil biological methods relates to soil suitability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies.

TH131 Where are the Springtails? New data on the vertical distribution of Folsomia candida (Colembola) and its population dynamic in artificial soil L.S. Tszchoppe, RWTH Aachen University / Institute for Environmental Research BioV; V. Roeben, RWTH Aachen University, Institute for Environmental Research / BioV for Environmental Research BioV; M. Roll-Nickoll, RWTH Aachen University / Institute for Environmental Research BioV

Folsomia candida is a non-target arthropod species which is often referred as the „Standard Soil Arthropod“ (Fountain and Hopkin, 2005). It is part of the regulatory framework of pesticide risk assessment and in the last years an increasingly important model organism in ecological and effect modelling. However, the knowledge on the population dynamics on a long-term scale and the vertical dispersal within the soil column is still scarce. We will present the results of two experimental studies exploring those unknown topics – one on the population dynamics over time and one on the vertical dispersal in relation to food location.
The population dynamics experiment is a one-year study assessing the dynamics of *Folsomia candida* in artificial OECD soil at constant 20°C. The study started with 25 individuals of different age classes in 100 g OECD soil. Since then the population increase was measured on at least a monthly basis with five replicates per testing day. The food regime is adapted to the increasing population density to make sure that the maximum population level is achieved during the study. We will show a fast growth at the beginning of the experiment and expect each an oscillating state with its maximum at the end of the study. In a second experiment the vertical dispersal of *F. candida* in relation to food location is investigated. Transparent PVC columns were filled with an 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, biofilm in the middle, in the ground or at all three compartments. Our hypothesis is that food is a main trigger for the vertical distribution of *F. candida* in soil. Two of three large examination dates have been processed so far. The data confirms our hypothesis and the results of the study will present new data for the otherwise well investigated Collembola species *F. candida*.

**TH132**
Why zinc doesn't matter: habitat quality drives invertebrate response to zinc, not concentration
S. Siciliano, University of Saskatchewan / Department of Soil Science; K. Jegede, H. Fujana, University of Saskatchewan Toxicology Centre
The responses of organisms in soil ecotoxicity tests are often determined by the bioavailable concentrations of contaminants they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, *Oppia nitens* exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of 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.

**TH133**
Effects of atmospheric hydrogen chloride and ammonia on Paronychiurus crypticus (Annelida) and enchytraeids of the species *Chlamydosomamas reinhardti* and *Chlorococcum infusionum*
S. Siciliano, University of Saskatchewan / Department of Soil Science; C. S. Fontanetti, Sao Paulo State University
In this context, the development of ecotoxicological tests presents itself as a tool of assessing the extent to which habitat promotes indiv

**TH134**
Effects of atmospheric hydrogen chloride and ammonia on *Paronychiurus kimi* (Collembola : Oxyuriidae)
J. Yeo, 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 contaminants they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, *Oppia nitens* exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of 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.

**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 *Chlamydosomamas reinhardti* and *Chlorococcum infusionum*. *Eisenia andrei* were exposed with 1 LE of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including clipping, fragments, swelling, bleeding, and mucous secretion were measured. For soil algae, *Chlamydosomamas reinhardti* 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, 7d-LOEC and 7d-EC50 of MEK to *Eisenia andrei* were calculated as 1136 mg MEK/kg dry soil and 1910 (1643.00-2221.58) mg MEK/kg dry soil, respectively. For soil algae, *C. infusionum* was more sensitive than *C. reinhardti* for MEK, 6d-EC50 to *C. reinhardti* 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(KETI) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment (MOE) (No. 2016001970001).<key_word>methyl ethyl ketone, earthworm, soil algae</key_word>

**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 using *Chlamydomonas reinhardti*. Soil algae treated with BPA, DEHP, or nonylphenol were exposed 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 reinhardti* 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</key_word>

**TH137**
Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in natura 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 residence 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 biondicato evalol for 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 study, we used different soils that were exposed to vinasse natura 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 bioassays vinasse compared to exposed to vinasse in natura. The results allow to infer that the pH adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction in both species used, since the environment favored the reproduction of the animals tested.

**TH138**
Ecotoxicological Characterization of Nitrogen-Based Energy Soil Contaminants
R.G. Kuperman, Edgewood Chemical Biological Center / Molecular Toxicology Branch, R. Checkai, U.S. Army Edgewood Chemical Biological Ctr / Molecular Toxicology / Environmental; M. Simini, U.S. Army Edgewood CB Center /...
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-hexaazaisowurtzitane (CL-20), 2,4-dinitrotoluene (DNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrophenol (2,4-DNP), 2,4-dinitroaniline (2,4-DN)，tand 4-amino-2,6-dinitrotoluene (2-ADT), and nitroglycerin (NG). Ecotoxicological effects of these EMs were determined in definitive studies with Sassafras sandy loam (SSL) soil using soil invertebrate, terrestrial plant, and biological activity endpoints. SSL soil was selected because it has physicochemical characteristics (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. Toxicoecological 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 Contaminant Sensitivity Values (SCSVs). Both SCSV and Eco-SSL values developed in these studies will be submitted to the USEPA Eco-SSL Work Group for use in establishing soil invertebrate- or plant-based Eco-SSLs for the individual EMs, and will be made available for use in Ecological Risk Assessment of terrestrial habitats at U.S. Army testing and training sites and other military locations. The SCVs can provide site managers and regulators with a risk assessment tool which allows them to develop specific soil contaminant thresholds (e.g., HCs or HCS protection level) that they wish to use to derive a site-specific SCSV protective of plants, soil invertebrates, and critical soil processes.

TH139
Occurrence 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 copper agricultural metal-based fungicide applied to fungicidal for fungal control, contains 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna. Metal-tolerant bacteria such as Bacillus cereus strain have been identified for their bioremediative traits in metal polluted soils. We examined the effect of Achromobacter sp. - Bacillus cereus consortium on the ecotoxicity of copper oxychloride. LD50 and EC50 values developed in this study, the bacterial strains used (Achromobacter sp. and Bacillus cereus) were previously isolated from gold and gemstone mining sites and confirmed to tolerate to 200 mg kg⁻¹ Cu. Twenty-four hours pure broth cultures of the two bacterial strains were inoculated into fungicide spiked soils. Utilizing standard ISO and OECD protocols, 10 mature Eisenia andrei and Enchytraeus albidus albidus were exposed separately into both unamended un-inoculated copper oxychloride amended soils. Survival, growth, and biomass were measured at seven days in soil samples collected at the beginning of the exposure and at the end of the exposure time. The results showed that the bacterial consortium comprised of Achromobacter sp. and Bacillus cereus can be used as bioremediative agents against copper oxychloride in contaminated soils. Their ability to tolerate high copper concentrations is likely due to the presence of metallothionein and metal-binding proteins in the bacterial cell wall, which can bind copper and reduce its bioavailability. Further research is needed to investigate the potential of these bacteria for the bioremediation of copper oxychloride-spiked soils.

TH140
Development of a terrestrial biotic ligand model (TBLM) for predicting acute toxicity of cadmium and zinc to soil collembolan Paronychopus kimi
J. Son, K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

Cadmium and zinc are toxic metals that can accumulate in plants and soils, and their bioavailability is affected by various factors such as pH, soil type, and organic matter content. The development of a biotic ligand model (TBLM) is essential for predicting the acute toxic effects of cadmium and zinc on soil collembolan Paronychopus kimi in a simplified soil solution system under the assumption that soil pore water is the main route of exposure to metals. After 7 days of exposure, survival and internal metal concentrations in P. kimi were determined. The free metal ion activity for each metal was calculated by the Visual MINTEQ using inputs of soil metal concentrations, cation and anion components of the soil solution, and pH of the soil solution. The toxicity of cadmium and zinc was linked to the fraction of biotic ligand binding of free metals (i.e., Cd²⁺ and Zn²⁺). The results showed that the fraction of the biotic ligand and the metal by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors affecting bioaccumulation and toxicity of metals.

TH141
Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam
T. Mahalati, C. Beuzienhoudt, M. Maboeta, North-West University / Unit for Environmental Sciences and Management

The presence of mine tailings is problematic in terms of the development of both heavy metal and metalloproteins resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phenotypes such as heavy metals and antibiotics resistance due to gene transfer. This study describes the characteristics of plasmids isolated from various bacteria that displayed an inability to withstand high metal concentrations. Isolated plasmids were individually transformed into Escherichia coli JM109. The plasmids were found to have a DNA molecular weight of 0.2-10 pg and a resistance potential for metal tolerances using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/μl after transformation. 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 found using the agar dilution method. These results indicated that transformed E. coli JM109 developed ability to grow in the presence of several heavy metals. Some strains were resistant to high concentrations (+10 mM) of Ni(II)/Pb²⁺, Pb²⁺ and Ba²⁺ with metal resistance of Ni(II)/Pb²⁺Ba²⁺Mn³⁺Cr³⁺Cu²⁺/Co²⁺/Hg. Moreover, protein profiling was used to determine the impact of plasmids on E. coli JM109. Proteins were extracted from both transformed and un-transformed E. coli JM109 and subjected to one-dimensional (1D) and two-dimensional (2D) SDS-PAGE. One dimension SDS-PAGE illustrated general similarity of the profiles except for two banding positions in the 30 to 35 kDa region where bands were present in the transformants that were grown in the Al/Ni alloy containing media. Two-dimensional elecrophoresis in PAGE and 2D SDS-PAGE showed that some of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15 – 75 kDa. Since 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 the latter metal-tolerant. The results of this research clearly characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

TH142
Sensitivity of the waterside species, Yuukanura szegytoki (Collembola: Neanuridae), to cadmium and copper
Y. Leg, 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

Collembola is the most abundant organism in the soil ecosystem and some species are used as ecotoxicological evaluation species for toxic substances in soil. However, Neanuridae species, which is one of the family of Collembola, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of cadmium and copper of Yuukanura szegytoki, known as the species in which they live water side, and their bioaccumulation amount were examined based on the ISO guideline 11267. After 28 days of exposure to tested metals, LC50 for adult survival and EC50 for reproduction were estimated. These toxicity values of Y. szegytoki were also compared to those of other collembolan species (F. candida and Paronychopus kimi). The results showed that the response of Y. szegytoki to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szegytoki to cadmium is considered to be very important. Because their special habitat can provide an understanding of ecotoxicity against certain environmental conditions.

TH143
Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments

SETAC Europe 28th Annual Meeting Abstract Book
451
explained by their overwintering or ageing. In contrast to insecticides, tebuconazole in terms of their active ingredients (g a.i. ha$^{-1}$) and RFD respectively. However, the toxicity of both insecticides was almost identical for individual individuals and exposed individually to a single pesticide spray applied with the spring (after overwintering) or autumn (population dominated by newly emerged Bembidion lampros organophosphate insecticides).

TH145 Toxic Effects of Cadmium on Chinese Cabbage, Foliosoma Candida (collombella) 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, Chinese cabbage, foliosoma candida (collombella) were used as the research object. The germination and root elongation of cabbage under different concentration of cadmium in soil were measured. The endpoint of the F. candida was reproduction. The results show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxicity threshold and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.

TH147 A Field Trial to Determine Effects of Thiamethoxam-treated Sugar Beet Seed on the Non-Target Arthropod Fauna of Arable Land in The Netherlands

C. Elston, Syngenta Ltd / Product Safety; M. Coulson, Exponent International; M. Finnegan, Syngenta / Environmental Safety; P. Thorbek, University of Rostock

The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluviosols - effects of soil and pesticide attributes.

M. Sudoma, N. Neuworthová, Masaryk University; M. Svobodová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Hvezdová, Z. Šimek, L. Skučová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

The class of conazole fungicides (CFs), among them epoxiconazole, tebuconazole, fluoxastrobin and prochloraz are currently used pesticides and members of the triazole group, used as broad-spectrum fungicides that inhibit ergosterol biosynthesis and are typically applied as foliar sprays for cereals, sugar beet or oilseed rape. Conazole fungicides are widely used in EU countries and their residues are frequently found in European arable soils which corresponds to their environmental properties. CFs are strongly sorbed to soil (log KOC of 3–4) and have low to moderate water solubility (50 µg/L to 750 µg/L). They are very persistent in soils and tend to form long-term residue. However, the typical DT50 values range from 120 days to 1 year. These attributes predetermines them to be highly bioaccumulative and hazardous. However, in real ecosystems, complex interactions occur (between pesticides, soil, microbes, earthworms, plants... and these are poorly understood. Hence, in this contribution (poster), we would like to present the novel microcosm experiment, where the combined effects of soil properties, microorganisms, plants and earthworms on CF multimedia fate and bioavailability were evaluated. In particular, the CF fate (by means of total, desorbable and freely dissolved concentrations) and bioavailability (by means of uptake to model fauna, flora and passive samplers) is studied in complex microcosm systems consisting of agriculturally used fluviosols under the addition of selected model compounds (RECETOX; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX)

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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

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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 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 4.55–9.3 for chlorpyrifos and 2.2–13.1 for tebuconazole. Bioaccumulation factors were also calculated as the ratio of uptake and elimination rates 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 Keq 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

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To assess the effects of the herbicide diuron and the insecticide 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 30 years for diuron, constants with results consistent with steady-state bioavailability. For the representative for the response of nematode species to toxic stress, showed no significant response to imidacloprid at high concentrations up to 119 mg L–1 regarding growth or reproduction. Diuron inhibited 82% of reproduction success of Caenorhabditis elegans, but showed no significant effect on growth at high concentration (33 mg L–1). Then, we compared the lethal effects of diuron and imidacloprid on eight species of free-living nematodes: Apherelochoides sp, Caenorhabditis elegans, Pristionchus pacificus, Diploscapter coronatus, Rhubidotes sp, Plectus velox, Plectus opisthocirculus, Plectus acuminatus. Nematodes were exposed in water for 48h to two concentrations (35 and 350 mg L–1 for imidacloprid and 10 and 100 mg L–1 for diuron). Results indicated a low risk of these pesticides to nematodes, as the chemicals did not affect significantly the survivability at their solubility limit in water for every tested species.

TH150 Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida

M. Qian, O. Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China

The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (DEBT) on the springtail Folsomia candida were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or BDE47 for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method, which shows that BDE47 affects egg hatch rate and the reproductive capacity of adults in the affected endpoints of springtails can be inferred by the two methods. TCP and BDE47 do not influence completely the same endpoints.

TH151 Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioaccumulation factor (BSAF) for risk assessment

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Secondary poisoning to mammals and birds is a critical pathway for risk assessment of Pb in soil. This risk is generally assessed for the food-chain soil => earthworms => earthworm eating predators. Therefore, a correct evaluation of bioaccumulation of Pb in earthworms is essential for risk assessment of Pb in soils under the REACH Regulation and a literature review of biota-to-soil accumulation factors (BSAF) for Pb in earthworm species was made. To ensure that biota Pb burdens are in equilibrium with soil Pb concentrations, only data from field studies or laboratory studies using soil and biota collected at the same field site were considered. Data from laboratory studies where Pb was added to the soil as a Pb salt were only used as supporting evidence. In total, 248 BSAF values for earthworms were identified that meet the reliability criteria, ranging from 0.01 to 22.05 (dry weight basis, median 0.23). Results are available for several earthworm species, belonging to different ecological groups of earthworms: anecic, endogeic and epigeic earthworms. No distinct differences in BSAF values across these groups could be identified. BSAF values are derived in a wide range of soils and the data available can be considered as representative for earthworm species 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 eCEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.028 for soils with high and low eCEC values in Europe, respectively, corresponding to the 10th and 90th percentile of eCEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

TH152 Hazard assessment of liquid organic hydrogen carriers in terrestrial environment

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A proactive environmental hazard assessment of liquid organic hydrogen carriers (LOHCs) – a novel energy system which can efficiently and relatively safely store and transport hydrogen – was conducted by characterisation of potential behaviours and ecotoxicities of these chemicals in soil environment. Adsorption properties of promising LOHC candidates including indoles, quinaldines, carbazole derivatives, benzyltoluenes and dibenzyltoluene in terms of carbon-water partition coefficients (Koc) were investigated via HPLC screening. Further characterisation was performed via adsorption isotherm modeling and soil column leaching with the examination of soil-water and earthworm (Eisenia fetida) bioaccumulation (Quin-2Me) as examples. Soil ecotoxicity was estimated for the quinaldines in the soil bacteria Arthrobacter globiformis and Collembola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles < quinaldines < carbazole derivatives < benzyltoluenes < dibenzyltoluene. The mobility of LOHCs was thus classified as highly mobile, moderately mobile or immobile. Adsorption isotherm and column leaching showed the strongest adsorption and retention of the partially hydrogenated form (Quin-2Me-H10) in soils. The H2-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-lean form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH; while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinaldines in the Arthrobacter at the highest test concentrations (500 mg L–1 and 750 mg kg–1 dry weight (dw) soil). Higher toxicity was found in the Collembola and malfonations
of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10^{-1} LC_{50} ≥ 100 mg L^{-1} (liquid-only exposure) and 100 < EC_{50} ≤ 1000 mg kg^{-1} dw soil (calculated soil pore-water based) of the 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 un-contaminated 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 un-contaminated soil samples (hereafter referred to as soil) were collected in representative sites expected to be irrigated with treated wastewater. The phytoavailability of Pb and Zn was estimated on each soil by measuring Pb and Zn concentration in the aerial parts of field-collected plants and by deploying the RHIZoTest and measuring the uptake flux of Pb and Zn in the whole plants exposed to soil in an ex situ approach. The field and the ex situ approach exhibited a large range of Pb and Zn concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZoTest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

TH154

Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation?


According to the current 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 needs of the environment into consideration (e.g. 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, cellulose) 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.

Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update

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The protection in tier 1 risk assessment of plant protection products (PPP) is expected to increase due to revision of the PEC_{calc} modeling guidance. The new EFSAs guidance foresees to use worst case PEC_{calc} values for each European regulatory zone considering a lower soil bulk density, a lower organic carbon content, and a reduced crop interception rate due to consideration of worst case wash-off assumptions. Furthermore, several different soil layers for which PEC_{calc} values could be calculated are under discussion, i.e. 0-1 cm, 0-2.5 cm, 0.5- cm, and 0-20 cm soil depth. Calculated PEC_{calc} 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 pesticides 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). PEC_{calc} values, however, can vary from the different assessment factors depending on the regarding correction of laboratory endpoints for lipophilic compounds (logP ≥ 2). A correction of endpoints by a factor of 2 is proposed by EFSAs (2015, EFSA Supporting publication 2015:EN-924) for studies containing artificial soil with 5% peat (formerly only endpoints from studies with 10% peat were corrected for high logP). Furthermore, in its Scientific Opinion, EFSAs (2017) proposed Specific Protection goals for earthworms which include a maximum acceptable recovery time of 6 months for initial effects in field studies. This deviates from the current procedure of an acceptable recovery time of one year for earthworm populations. The dataset of 54 case studies was re-evaluated considering the new EFSA proposals and the new results will be presented.

TH156

Digging into the soil risk assessment of pesticides: current approach and its uncertainty

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According to the Uniform Principles (Reg No 546/2011) in the context of Regulation (EC) No 1107/2009, all possible sources of uncertainties should be considered when performing a regulatory assessment in the context of pesticides authorization. The current risk assessment for soil organisms, conducted according to SANCO/10329/2002, foreseees, at Tier 1, the application of a trigger value of 5. The current uncertainty limit is equal to 2 orders of magnitude variability in the extrapolation of toxicity endpoints from lab- to field. However, the current approach presents additional uncertainties. Test methodology for soil organisms only requires dosing verification after the application of the pesticide to the soil. The determination of the tested concentration at regular intervals is currently not required although it may be very relevant for a proper hazard characterization (e.g. bioavailability), since, for example, during laboratory bioassay procedures of spiked soils, possible losses of the pesticide may occur. In case further refinements of the risk are triggered, higher tier tests (semi-field or field studies) under more realistic conditions may be one option. Standardised field protocols are mainly available for earthworms. The available standardised field methods evaluate the effects on abundance and biodiversity of earthworms, taking into consideration the likely level of effects, the species/groups affected, population recovery (within 1 year) as well as information on the application and fate of the pesticide. The magnitude of effects is directly assessed in terms of risk without the application of any assessment factor. However, field studies only give a picture of a particular situation as effect manifestation and recovery are dynamic processes which depend on the local environmental conditions and the species community level which takes into account interspecies interactions and indirect effects is currently not implemented as well as the statistical power of test is not properly evaluated. An approach aimed at defining a Regulatory Acceptable Concentration (RAC) could be useful to address those uncertainties and would allow the harmonisation of the risk assessment of the different taxonomic groups.

TH157

SETAC Soils Interest Group

M.H. Wagelmans, Bioclear earth

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

Newly issued Kentucky 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 drinking water (pH set). A project on a per-cents of (daily, seasonally) basis at the monitoring stations. Further, the APP is being extended to classify harmful alga microscopically at the genus level using a convolutional neural network approach.

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. Due to the damaging the liver 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 toxins in two tap-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 (residential). A preliminary result revealed that MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.

Smelly HABs: response-surface optimized HS-SPME/SCS method for simultaneous multi-class HAB odor compounds in water C. Ayavigan, M. Pisania, T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL AT.C. are known to produce a wide range of malodorous compounds belonging to various chemical classes such as terpenes, ionones, amines, aldehydes, ketones and sulfurous compounds. Such compounds have detrimental effects to the aesthetic quality of water, making drinking water unacceptable by consumers and damaging recreational and tourism enterprises in lakes. Although HAB odorous compounds are generally non-toxic to humans at environmentally relevant concentrations and they do not inevitably indicate the co-occurrence of cyanotoxins, there is a need for water utilities and water authorities to apply techniques for the screening of these odorous compounds. The objective of this study was to develop and optimize an efficient method for monitoring of multi-class HAB odors in freshwaters using automated HS-SPME/GC–MS. The study focused on optimization of the SPME factors, including salting-out effect, pre-incubation and extraction times, extraction temperature and stirring rate. 20 model compounds of various chemical classes were optimized as indicative of the wide range of odorous compounds, ranging from volatile, early-eluting (e.g. alkyl sulfides) to late-eluting compounds (e.g. ionones). Factor effects on the responses (extracted ion peak areas) were assessed. Design of experiments (DoE) techniques included preliminary Plackett-Burman factorial designs for screening of significant factors, followed by a 4-factor Box-Behnken design to assess linear and quadratic main effects and factor interactions and to optimize responses. Optimization based on a broad range of factors to optimise the objectives for maximum sensitivity screening of the whole range or of certain classes/groups of compounds. Optimization experiments resulted in full-quadratic response models for individual compounds, while desirability functions can be
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-GC/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. Acknowledgments The authors thank CYANOCAST – COST Action ES 1105 www.cyanocost.net

TH163
Suspended 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 microeukaryotic ecession in perilimnetic form. 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 structural and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water supply and recreational water use. The most widespread cyanotoxins are microcystins (MCs) variants MC-LR, RR, YR, with MC-LR being the most toxic one. For this 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 and identification on high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample pre-treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5μm) using methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanotoxins 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.

A. Martínez has received a PhD scholarship from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 772493.

TH164
Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters
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Harmonious cyanobacterial blooms have been increasing in freshwater ecosystems in recent decades, mainly because of eutrophication and climate change. In some cases, cyanobacterial species can produce toxins and this phenomenon can have a negative impact and pose a risk for ecosystem and human health. Of the 15 known cyanobacteria genera, more than 40 species produce toxins, which are natural compounds showing different chemical and toxicological characteristics. Cyanobacterial toxins are responsible for both acute and chronic poisoning in both animal and human health (Lucernert and Ottaviani, 2011). Fast and sensitive methods to identify unequivocally Microcystis aeruginosa and Planktothrix agardhii are very useful to discriminate these species with respect to the non-toxic cyanobacteria. For this purpose, we designed, developed and validated some oligonucleotide probes (GNPlankS02, PLAgD03, MicAerD03) for FISH (Fluorescence In-Situ Hybridization) analysis to detect these species in freshwater samples. The FISH probes were designed using the ARB software with the Silva database in the framework of the MicrCoKit project. We tested different fixative methods to minimise the natural autofluorescence from chlorophyll-a (Groben and Medlin, 2005) to visualize Microcystis aeruginosa and Planktothrix agardhii under a laser confocal microscope. Firstly, the FISH probes designed have been tested on pure cultures of M. aeruginosa and P. agardhii species, then the probes were successfully applied to natural samples collected from surface waters. Keywords: Microcystis aeruginosa; Planktothrix agardhii; FISH probes; algal bloom

References

TH165
Adequacy of EPA 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 methods need to be developed. This work presents the development of a sensitive, fast, and robust method of analysis and identification on high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample pre-treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5μm) using methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanotoxins 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.

A. Martínez has received a PhD scholarship from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 772493.

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 risk assessment and management plans. Natural toxins from various kingdoms, those produced by aquatic 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 classified in subclass structural class characterized by indicative monomeric building blocks. Microcystins are by far the most intensively studied class of cyanopeptides. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides beyond microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides under different culturing condition of common cyanobacterial strains. Our targeted LC-HRMS analysis of biomass samples of single strain cultures show that besides microcystins, cyclamides and various cyanopeptolins are co-produced. Our data shows the evolution of the
peptide abundance throughout the growth phase of single strains (e.g., Microcystis aeruginosa and Anabaena flos-aquae) and under different culturing conditions (e.g., N:P ratios and light intensities) by 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 ptaquiloside under alkaline conditions

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The carcinogenic ptaquiloside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus *Pteridium* (Bracken fern), which is the most prevalent species. PTA is a potent plant secondary metabolite (alkaloid) and carcinogenic, serving as an approximation of exposure. To identify the phytotoxins relevant for the aquatic environment we used a procedure, which systematically ranks substances suspected of causing human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosin B is formed from caudatoside and ptesculoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions, pH 7–7.7; 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 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 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 aquifers. PTA (4,700 ppb) was deglycosidated using 0.10M HCl/NaOH and 3 different 0.025M buffer systems (approx. pH 7–12; NaHPO4/NaH2PO4; pH regulated with 0.1M NaOH). Deglycosiation 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 further 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. In 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 product was identified as the bracken dienone (BDE), a ultimate carcinogenic. BDE is formed immediately while the unknown is formed from BDE reaching stoichiometric balance within the timeframe of the experiments. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

**TH168**

Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins

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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 be transported to aquatic receptor systems. 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 toxins 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 log Kow from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoflavonoids as reference compounds in addition to representative metabolites of the soil and plant classes. In regards to predicted toxicity, persistence and mobility as well as plant occurrence, specific alkaloid 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 activities, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NaToXaq. [1] ECTOC; Technical Report No. 123, 2013 [2] Schenzel, et al.; *Environ Sci Technol* 2012, 46 (11), 6118-26. ln

**TH169**

Phytoxins as aquatic micropollutants: a procedure for prioritization

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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 phytoxins were characterized as toxic, frequently produced, mobile and persistent and we propose to consider them in further monitoring programs and risk assessments.

**TH170**

Sorption of pterosin B to soil materials

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Bracken ferns (*Pteridium aquilinum*) are considered environmentally problematic due to their content of the carcinogens ptaquiloside, caudatoside and ptesculoside (‘the ptaquiloside group’). Brackens are classified by WHO/IAJC 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 pterosin B is formed from caudatoside and ptesculoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions, pH 7–7; 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 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%: 0.1-7.4, pH 3.3-7.7). 0.25g of dry soil were equilibrated with 9ml 0.01M CaCl2 over-night. 1mL of pterosin B solution in 0.01M CaCl2 was added resulting in a CINIT of 0-10 mg L-1 (n=20). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI (SIM; 100µL injections; range 0-100 µg L-1; r2 > 0.999). CSORB = CINIT x Cd/v, where v is the volume of soil material dispersed in 100µL. The study shows that pterosin B sorbs strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g-1 for the soils tested corresponding to a Koc values of 300-2,500 mL m-2. The study demonstrates that pterosin B sorbs strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties such as the soil pH and mineralogical composition, variation was 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 study of ptaquiloside

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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 these fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work a model code DAISY, a soil-water-plant 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 climate events - as 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. 

Aflatoxins (AFs) are the most toxic group of mycotoxins and secondary metabolites of various species of Aspergillus that can occur in all agricultural commodities under inappropriate field or storage conditions. These molecules can cause important health problems and have high potential toxic effects. A validated Enzyme Linked Immuno Assay (ELISA) to monitoring the presence of aflatoxin...
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 that pistachios from Turkey and almonds from Brazil and Peru were contaminated, while pistachios from Turkey were contaminated and the 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 shell fish is probably due mostly to an easier aflatoxin contamination following the fact that pistachios and almonds are more resistant to the A. flavus colonization. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in 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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**TH177**

**Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems**

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-RR, -YR, -I-, -LW, -LA, -LY, -WR; nodularin; cylindropermopsin and anatoxin-a) as well as other bioactive metabolites of cyanobacteria (isomers of lipopeptide puwainaphycin F). The quality of the anatoxin-a analysis was assured by the use of D5-phenylalanine internal standard. Cylindropermopsin (CYN) has been confirmed (4.25 microgram/g d.w.) in a single bloom from the pond Pisekensy (South Moravian region close to Slovakian and Austrian boundaries) dominated by invasive species Cylindropermopsis raciborskii. The other species found in CYN-positive blooms were CylindrospermumPlaylist, Sphaerothespinopsin aphanizemoides (formerly known as Anabaena aphanizemoides). Pseudonanaea limnetica and Planktonholyga limnetica. For the first time we have identified anatoxin-a in total 3 samples from the Czech Republic (concentration ranging 0.34 - 2.82 microgram/g d.w.), all originated from South Bohemian region around the city of Pisek (during years 2012-2015). The species of Dolichosphormmm sp. were found in all three anatoxin-a positive samples (different species in different samples - D. planctonica, D. smithii and D. flos-aquae). The phytoplanktonic communities of the anatoxin-a positive blooms were fairly rich in composition containing also Aphanocapsa sp., Aphanizemonen sp., Microcystis sp., Woronuchin sp., Sphaerothespinopsin sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

TIH10
Toxic cyanobacteria succession during a drier season 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 fourties-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 D.L. 15/2006, conducted to 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 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-Sep the composition of the cyanobacterial community changed dramatically. In July the bloom was dominated by Microcystis sp. and Cylindropermopsin raciborskii (in the order of 10⁷ and 10⁵ 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-Sep were still growing (10⁶ and 10⁵ cell/L, respectively). Disueri Lake is among the largest lakes, with a surface of 1.85 km² and a maximum depth of 31 and 15.2 m. However, due to landfill interferences 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 have been detected). Cyanobacteria blooms are a threat to the organisms present in just a few hours, leading to a reduction of biodiversity of the water catchment. Results on chemical (nutrients and cyanotoxins) and bioactive metabolites with several of them being odorous, causing taste and odor (T&O) must be considered. Cyanobacteria as well as eukariotic algae produce a wide range of volatile bioactive metabolites with several of them being odorous, causing taste and odor (T&O) compounds in natural freshwaters of Greece as well as in cyanobacterial strain cultures isolated from Greek lakes. To do this, analytical workflows combining targeted and non-targeted analysis based on automated HS-SPME- GC/MS for fast and sensitive detection of a wide range of T&O compounds were developed. Samples of water and lakes reservoirs of Greece were collected for T&O analysis according to specified procedures. Samples of cyanobacteria cultures (50 strains) isolated from 15 Greek freshwater bodies were also taken for T&O analysis. Results showed that a wide range of T&O compounds were present in natural water samples and cyanobacterium strains. Examples of bioactive metabolites include trimethylamine (fishy), dimethlyl and dimethyl-sulfide (septic), methanol (septic), β-cyclocitral (tobacco), a-β and b-ionones (floral). Interestingly, results showed that in surface water bodies of Greece geosmin and MIB have a minor role, while other T&O compounds having characteristic odor (e.g. fishy, swampy) may be more important. Based on our findings, T&O profiles of cyanobacteria cultures were developed. It is concluded that non-targeted HS-SPME-GC/MS analysis is an effective and efficient technique for wide-range screening of cyanobacteria T&O compounds in water. Volatile and odoriferous bioactive metabolites of cyanobacteria strains can be useful in interpreting T&O incidents in natural surface waters and water reservoirs. To better understand and anticipate T&O incidents, monitoring should be established on reservoirs, beyond geosmin and MIB. Acknowledgement - The authors thank CYANOCOST COST Action ES 1105 www.cyanocost.net. C. Christophoridis acknowledges the program of Industrial Scholarships of Stavros Niarchos Foundation

TH112
Determination of multi-class cyanotoxins in fish tissues
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The analysis of cyanotoxins in aquatic organisms, particularly in fish, has lately received increasing interest, due to environmental concerns and public health issues. This study presents the development and optimization of novel, sensitive and accurate analytical methods for the simultaneous determination of multi-class cyanotoxins i.e Cylindropermopsis (CYN), Anatoxin-a (ANA-a) and Microcystin (MC-LR) in freshwater fish tissues. For the efficient extraction of selected cyanotoxins from fish tissue (muscle and liver), prior to LC-MS/MS 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, enhancing the maximum extraction of the target compounds. The LC-MS/MS method consists of using a LC-QQQ instrument, where a MS-SIM setup was used for targeted analysis based on automated HS- SPE extraction. Patrohomorphs were also used for 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-MS/MS 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 matrix effect was minimal. CYN and ANA-a co-eluted with several matrix components, which induced matrix suppression and affected method trueness. The use of the optimized methods, including several clean-up steps, significantly improved the recoveries, reaching 85% for ANA-a. Nevertheless, the use of isotopically-labeled surrogate standards, especially for CYN, would significantly improve the efficiency of the method. The diversity and accumulation of toxins in fish collected by Greek lakes, is presented in relation to the risks associated to human consumption. Acknowledgments: The authors would like to sincerely acknowledge COST Action ES 1105 “CYANOCOST” and the program of Industrial Scholarships of Stavros Niarchos Foundation

TH113
Effects of Asparagopsis armata exudate on the fatty acid profile of two marine invertebrates
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Invasive alien species represent a worldwide threat to the integrity of native communities, which includes the loss of habitat and global changes in species composition and ecosystem services, creating new and complex interactions. Invasive species, such as Asparagopsis armata, are responsible to harmful algal blooms (HABs), which is a problem worldwide. Indeed, due to the growth and release of toxic metabolites, the invasive species have the potential to become important in navigation on coastal areas, thus posing a threat to human health. The aim of this study was to investigate the effects of Asparagopsis armata on the fatty acid profile of two marine invertebrates (Haliotis tuberculata and Aplysia californica). The main fatty acids found in the tissues of both species were oleic acid (C18:1n9), palmitic acid (C16:0), linoleic acid (C18:2n6), and arachidonic acid (C20:4n6). The Asparagopsis armata exudate significantly altered the fatty acid profile of both species, with an increase in the palmitic acid content and a decrease in the linoleic acid content. These changes may have implications for the nutritional value of these species, as linoleic acid is an essential fatty acid for humans. The results of this study suggest that the Asparagopsis armata exudate has the potential to alter the fatty acid profile of marine invertebrates, which may have implications for marine ecosystems and human health. Acknowledgments: This work was supported by the Portuguese National Funds through the FCT—Fundação para a Ciência e Tecnologia, under the project Pest-OE/AGR/UI0327/2014.
especially FAs have great structural diversity and high biological specificity, essential for every living cell, as sources of energy, as membrane constituents, or as metabolic and signaling mediators. FAs have long been used as food-web tracers, and, more recently, changes in FA profile have also been exploited to better understand how contaminants affect organisms in aquatic food-web (Silva et al. 2017). In this study, the potential impact of A. armata exudates in the FA profile of two marine invertebrates was assessed. For this, after calculating the lethal concentrations of the alga exudate, *Gibbula umbilicalis* and *Palaemon 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 marine macroalgae exudates 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**

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The introduction of non-native seaweeds outside their native distributional range, through human activities, has been causing documented negative effect on native species. The red alga *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 organisms such as other seaweed, vertebrates, and invertebrates leading to severe consequences for coastal ecosystems. The main objective of this study was to evaluate the potential impact of *A. armata* on marine invertebrates by exposing the common prawn *Palaemon 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. Experiments of macroalga exudate toxicity in cohabiting invertebrates, after assessing the lethal concentrations of the algae exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed by biochemical biomarkers responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for *G. umbilicalis* and the avoidance behavior for *P. serratus*. The biomarker responses analyzed 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* exudate exposure. These results represent an important step in the research of biochemical responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for *G. umbilicalis* and the avoidance behavior for *P. serratus*. The biomarker responses analyzed 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* 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**

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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 and projected climate 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?**

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Microcystin LR (MCLR) is probably the most frequent and abundant cyanobacterial LPS in human airway in vitro model. After assessing the intensity of toxic cyanobacterial exudates toxicity in cohabiting invertebrates, thus representing an impact on these organisms' cell function since some of these FA can represent an impact on these organisms' cell function since some of these FA are the major regulators of MAPKs ERK and p38. Although protein adducts with the molecular weight corresponding to MCLR-protein adducts were detected, MCLR did not alter phosphorylation of MAPKs ERK and p38. Furthermore, ERK and p38 are critical regulators of MAPKs ERK and p38. However, extrahepatic manifestations of CYN toxicity have also been reported and adverse respiratory conditions have been frequently linked to cyanobacterial blooms. Detection of cyanobacterial toxins in aerosols and dust particles raises the question of potential associated hazard of human exposure via inhalation. The susceptibility and vulnerability of human bronchial epithelial to CYN were investigated in vitro. To assess inhalation toxicity on airway epithelia, monolayers of immortalized human bronchial epithelial cells (HBE1 and 16HBE14o) were exposed to a concentration range of 0.1-5 μM CYN. Toxic endpoints were assessed as morphologic alterations, resazurin reduction capacity, esterase activity, membrane integrity and by real-time cell analysis. Both cell lines were sensitive to CYN. Depending on the endpoint assessed, EC50 values ranged between 0.8-2.1 μM (HBE1) and 1.6-4.8 μM (16HBE14o). To evaluate alterations of other cellular events by sub-cytotoxic concentrations of CYN, phosphorylation of regulatory switches, mitogen-activated protein kinases (MAPKs) ERK and p38, was evaluated. After prolonged exposure (8-48 h), stress-activated MAPK p38 was hyperphosphorylated in both cell lines, while elevated phosphorylation levels of ERK following CYN treatment were detected only in 16HBE14o - cells. This study suggests possible hazards of cyanotoxin inhalation, which might have a severe impact on the integrity of airway epithelia and epithelial cell signalling, including chronic inflammation due to extended p38 hyperphosphorylation. Further research of CYN-induced toxicity and underlying mechanisms is needed, as well as more data on environmental concentrations of cyanotoxins in aerosols and exposure assessment. The research was supported by the Czech Science Foundation Grant No. GJ17-2537Y9 and from H2020-MSCA-ITN-2016 Project No.722493 NaToxAu.

**TH187**

**Effects of microcystin-LR and cyanobacterial LPS in human airway in vitro models**

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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. Here, we investigated effects of MCLR in human bronchial epithelial cell lines (HBE1, 16HBE14o, BEAS-2B). Cyanobacterial lipopolysaccharides (LPS) represent another bioactive component of cyanobacterial biomass, which is likely to expose human beings simultaneously with MCLR, thus we studied also effects of LPS isolated from a culture of cyanobacterium *Microcystis aeruginosa* PCC7086. Dose- and time-dependent formation of MCLR-protein adducts was observed in the exposed human bronchial cells. Several genes from OATP family previously implicated in the cell uptake of MCLR were found to be expressed in HBE1 and/or 16HBE14o - cells. Nevertheless, MCLR (up to 20 μM and 48 h) did not induce significant cytotoxic effects. MCLR targets protein phosphatases (PP1/PP2A), which are the major regulators of MAPKs ERK and p38. Although protein adducts with the molecular weight corresponding to MCLR-PP2A complex were detected, MCLR did not alter phosphorylation of MAPKs ERK1/2 and p38 in bronchial cell lines. Short
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercellular communication in bronchial cell lines. Regardless of 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 hazard-causing cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-23279Y and H2020-MSCA-ITN-2016 Project No.722493 NaToxQa.

**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 cyanotoxins and metabolites could include compounds with estrogenic 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 hormonoids, alklyphenols or phytoestrogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ngEQ/L. We analysed the presence of nine retinoid 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 relative potency of individual analysed 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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2,4-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 like activity was almost fully explained based on concentration and relative potency of individual analysed 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.

**Keywords:** 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

**TH190**

Generating ecotoxicity information on microcystins and prymnesins: A different approach


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The literature indicates that LC50 for cyanobacterial blooms is 21-22 mg/L. There is even less ecotoxicity information available for prynemins which is produced from the estuarine algae Prymnesium parvum. This flagellated alga has invaded freshwater systems in the U.S. and has caused numerous fish kills recorded in inland Texas lakes and blooms in 10 other states. Given the uncertainty with the purity of existing toxin standards and the cost of using them to conduct toxicity studies, a new approach is proposed using pure cultures and ambient bloom samples. Herrera, Echeverri and Ferra-Filho (2015) conducted toxicity tests on several different cladoceran species using lyophilized phytoplankton 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 cladocerans had different sensitivities to microcystin. In this study we have taken a similar approach but have used laboratory cultures of a toxin-producing strain of unicellular Microcystis aeruginosa, non-toxic producing filamentous strain of Anabaena 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 80–85°C. The f-alo aqueae cells were lyophilised. Forty-eight-hour acute tests were conducted with Ceriodaphnia dubia, Hyalella azteca larval Pimephales promelas and Neolecoem triungulifer 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-aqueae caused significant mortality to N. triungulifer 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 microcystis chronic results will also be presented.

**TH191**

Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure

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Irrigation with cyanobacterial-blooming water containing microcystins (MCs) poses potential threat to the growth of agricultural plants. Rice (Oryza sativa L.) is an important grain crop and is widely grown for domestic consumption in China. However, large amounts of rice field in the middle part of China has been irrigating with cyanobacterial-blooming water. So far, the molecular mechanism of MCs induced inhibition of cell growth and apoptosis has not been clearly uncovered. In the present study, rice plants were exposed to 1.0 μg/L and 50 μg/L of microcystin-LR (MC-LR) in the hydroponic nutrient solution for 34 days. The proteomic profiles of rice leaves after exposure were analysed using tandem-mass-tag labelling and LC-MS/MS analysis. The results showed that a total of 298 differentially expressed proteins were found, 89 differentially expressed proteins of them in 1.0 μg/L and 50 μg/L of MC-LR treatment group, and 289 differentially expressed proteins in 50.0 μg/L MC-LR treatment group. Different response characteristics of protein expression were found in rice leaves exposed to low-concentration (1.0 μg/L) and high concentration (50.0 μg/L) of MC-LR, respectively.
respective, and the different biological pathways involved in the mechanism of MC-LR induced toxicity to rice were revealed using GO Term and KEGG analysis. Exposure to 1.0 μg/L and 50 μg/L of MC-LR could disturb the photosynthetic and ribosome pathways in rice leaves, causing the adverse effects on the normal growth and photosynthesis of rice. The significant alterations of the biological processes induced by the exposure to 50 μg/L of MC-LR were the inhibition of ribosome, phloem, and chloroplasts; photosynthesis and transcriptional backbone biosynthesis-related pathways, and the induction of thioredoxin, insoluble phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provided evidence of the molecular mechanisms underlying adverse effects in terrestrial plants exposed to water containing microcystins (MCs). Keywords: rice, microcystin-LR, photosynthesis, proteomics

Acknowledgments This research was financially supported by the National Natural Science Foundation of China (Grant number 21407056).

Development of the use of bioassays for chemical and environmental risk assessment (P)

TH194 Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida)
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Th194 of this work was that the application of the invertebrate Dendrobaena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (metabolism and lysosomal membrane stability), and at tissue level (GPX and MTs), following the exposure to two perfluorinated alkyl acids (PFOA and PFBS) for short (72 h) and longer (14 and 28 days) times. The exposures were carried out in soil microcosms prepared with glass containers filled with 300 ml of soil humidified at 30% with PFOA or PFBS spiked water. As for the 72 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% of 1x or 10x MAC-EQS μg 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 μg values. Different accumulation patterns were observed for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significantly higher coelomocyte mortalities than in the controls, with both compounds, were detected after the 14 and 28 days exposures. As for the lysosomal membrane stability significant decreases were detected both after the short and the long-time exposures. In the soft tissues primary data don’t show significant differences between control and treated organisms regarding the GPX activity. A significant MT total decrease was detected after PFOA exposure, both at 14 and 28 days while after PFBS exposure only at 14 days. As for MT, because it has been reported that 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. 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.

RESPONSES TO PFOA AND PFBS EXPOSURE IN THE SEDIMENT DWELLING INVERTEBRATE DENDROBAENA VENETA (ANNELIDA), BIOACCUMULATION PATTERNS AND CELLULAR AND BIOCHEMICAL RESPONSES IN COELOMOCYTES (METABOLISM AND LYSOSONAL 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.
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 contaminated with more than 100 yotoids had been “closed” (EC directive 2016-2017). Among the conclusions, it was noticed that the selection of the control soil may have a significant influence on the expression of the results and therefore on the risk assessment. This impact is particularly obvious for the assessment of a heterogeneous site and for the first TIER (screening level) of the TRIAD method. This statement is illustrated by observing the consequences on the assessment conclusion when the results of bioassays are expressed according different control/reference soils.

TH197 Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with predicted no effect approach

J. Kaak, 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, chlorophyceae, secernentea, clitellata and collemboza) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collemboza) were investigated. Finally, acute and chronic hazardous concentrations for HCH, HCB, HB, HCB 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 (1485014458).

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro

K.L. Hill, Intrinsik / Department of Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; T. Hamers, VU University Amsterdam, Institute for Environmental Studies (IVM) / Department of Environment and Health; J. Kamstra, NMBU / BaSam; W. Willmore, Carleton University / Department of Biology

The toxicological properties of organophosphate (OP) triesters that are used as surfactant cleaners and packaging. However, few researches on soil ecotoxicity of nonylphenol were reported. In the present study, we conducted a battery of bioassay, generated soil ecotoxicity data and then estimated soil hazardous concentration for nonylphenol for soil ecosystem protection based on species sensitivity distribution (SSD). For the acute assay, eight soil species from six different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae, secernentea, clitellata and collemboza) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collemboza) were investigated. Finally, acute and chronic hazardous concentrations for HCH, HCB, HB, HCB 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 (1485014458).

TH199 In Vitro and In Silico Competitive Binding of Brominated Polyphenyl Ether Contaminants With Human and Gulf Thyrhoan Hormone Transport Proteins

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Tetrabromobenzene-1,4-diphenylethenylene (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Brominated photodegradates of TeDB-DiPhOBz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4'-OH-2,2',4'-tetrabromo-DiPhOBz. Chemically related methoxylated tetrabromotrhexa- to-hexabromoDPhOBs are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBz-based compounds. The present study investigated the potential thyroid hormonemia of 2,2',2'-tetrabromophenyl phosphine (TBP) and its methoxylated analogues, using an in vitro competitive protein binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). Para-OH-tetrabromo-DiPhOBz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive with T4 in the TTR and ALB,, and the competitive degree for T4 was not so big different. These strong results and these findings suggest there is potential for these xenogenous 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 the stored product insect pests has been reported over the world. In South Korea, Sitophilus oryzae has been developed phosphine resistance after the severe use of phosphine. In this study, how S. oryzae survived under the recommended dose of phosphine and we assessed the biochemical and molecular mechanisms for referring phosphine resistance. Three strains of S. oryzae were isolated from different silos, and suggest there is potential for these xenogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

TH201 Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS

S. Bask, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kark, KIST Europe / Environmental Safety Group

Glutathione is an important non-protein compound and existed in both internal and external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) is one of important external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) is one of important ecological effects induced by oxidative stress. GSH and GSSG are usually analyzed in positive ion and negative ion electrospray modes. Among all available assays to detect and quantify GSH and GSSG, the intermediate of this study, and suggest there is potential for these xenogenous 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 enhancement of sensitivity was due to a less than 0.5% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZPL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZPL exposed to different concentrations of a target chemical as well as 6 μg/L of H2O2, a negative control. The lowest concentration of GSSG in this work was 5.0 ng/mL, higher than its detection limit, 2.0 ng/mL. This is meaningful because it could not be achieved by other conventional methods and assays with higher detection limit than its original concentration. Therefore, we can conclude that our method could avoid underestimation to quantify biomarkers such as GSH and GSSG.

TH202

Rapid analysis of bivalves' xenometabolome using High Resolution Mass Spectrometry

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A wide variety of contaminants are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly 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 metabolites that organisms accumulate in highly consumed organisms like bivalves, seems to be the way forward. In the present work, for the profiling of the xenometabolome, a fast analytical method has been developed for the extraction and identification of priority contaminants in bivalves from Ebro Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebro Delta and possible sources of contamination. Taking into account the information that 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 bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the target compounds. The purifying extracts were injected in Orbitrap-XP-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 year an ecosystem approach mainly based on multilevel biomonitoring methods has been developed 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 μAPPAVE 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 upjiand virological analysis of total Hepatitis A, B, C, HAV and HEV, Norovirus NoGI and NoGII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41. The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The ecological approach (apical) aspect in the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and 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.

TH204

INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT

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A wide variety of contaminants are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly 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 information that 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 bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the target compounds. The purifying extracts were injected in Orbitrap-QP-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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TH205

Assessing exposure risk for marine bivalve Mytilus posidonia microplastic polystyrene particles

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BACKGROUND: Microplastics (MPs) are one of the most widespread emerging pollutants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs to marine organisms. ORIGIN: In this study, microplastic bivalve Mytilus posidonia microplastic polystyrene (PS-MPs) and MPs based on bioassays results from related published literature. METHODS: We used Hill-based dose-response model to simulate the effects of PS-MPs on the lysosomal destabilization and phagocytosis in bivalves. The predicted no-effect concentrations (PNECs) causing 1% inhibition of immune function were also estimated. A review of risk-based probabilistic model was used to characterize the potential hazards of marine bivalves in response to predicted environmental concentrations (PECs) of PS-MPs or MPs by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyes.
RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytic cells were 0.04 and 0.07 μg mL⁻¹, respectively, implying 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

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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 POCIS passive sampler extracts from 7 of these locations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality. Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is thus concluded that using 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

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The European Union Water Framework Directive requires member states to assess chemical water quality of surface waters by monitoring the presence of 45 priority substances. However, these substances are often banned and their concentration in surface waters is strongly decreased, frequently to levels below the limits of detection. Simultaneously, industries have switched to a myriad of alternative compounds that have serious impacts on water quality, most of which are not listed as priority substances. Consequently, a large portion of the observed toxic effects of surface waters cannot be attributed to compounds measured by the water authorities. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy, applied in a nationwide water quality assessment campaign in The Netherlands. The innovative monitoring strategy combines passive sampling (PS) with a battery of bioassays to investigate ecotoxicological risk to aquatic biota. At 47 locations siliconic rubbers and Polar Organic Chemical Integrative Samplers (POCIS) were exposed to surface water for 6 weeks. Alongside the PS a 7-day in-situ daphnid test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in-situ daphnids (attributed to Ucciarelli gene expression (CALUX) bioassays was exposed to the re-dissolved extracts. The bioassay battery was selected such that it can identify the risk posed by a wide range of chemical pollutants and their transformation products, while simultaneously allowing for more targeted identification of groups of compounds that cause specific effects. Bioassay responses were compared to effect-based trigger values to identify potential ecotoxicological risks at the investigated locations. Subsequently, the SIMONI model was applied to rank sites based on ecotoxicological risk, rather than on the presence of priority compounds. It is concluded that the Smart Monitoring strategy allowed prioritization of sites based on ecotoxicological risks, identified the presence of hazardous compounds, regardless of being listed as priority compounds, but meanwhile could prevent costly chemical analysis at sites with low ecotoxicological risks.

TH209 Passive sampling in effect-based monitoring of two European rivers - ex-dividual toxic effects of in vitro detected chemicals

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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 sampler device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance reference compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from the weight of the SR discs. The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQs) of respective model compounds in water. The BEQs levels were significantly lower 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 (BEQs). The combination of bioanalytical and toxicological equivalents showed that the detected chemicals explained mostly a low fraction of the BEQs. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQs were comparable with the BEQs 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

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The use of passive sampling as a tool in environmental monitoring has gained wide acceptance within the past decades. More recently the possibilities of combining passive sampling and biotesting gained higher attention and researchers focus on reconstituting environmentally realistic contaminant mixtures in aquatic biotest systems. Equilibrium based samplers (e.g. silicone rubber sheets) can mostly be used as passive dosing devices in biotest systems without prior treatment but have the disadvantage that only one single concentration level can be tested. For innovative samplers (e.g. Speedisks™) an extraction is needed before sphere of biotest medium and the downside of this approach is that an extraction always changes the natural mixture composition due to compound specific partition coefficients. The advantage on the other hand is that the extraction of the samplers is well established, efficient and easy to combine with chemical analysis. Thus, even though this approach does not reconstitute the natural concentration profile quantitatively it allows for testing of environmentally realistic contaminant mixtures in biomimetic systems. Equilibrium based samplers, the sampling rates were either calculated from literature (POCIS) or calculated from the weight of the SR discs. The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQs) of respective model compounds in water. The BEQs levels were significantly lower 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 (BEQs). The combination of bioanalytical and toxicological equivalents showed that the detected chemicals explained mostly a low fraction of the BEQs. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQs were comparable with the BEQs 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.
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. spinipes.

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 substances. Dosing phases such as Oasis HLB 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 approach of Oasis HLB as a passive dosing was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broad mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

TH212
Passive dosing strategy for in vitro test systems: static concentration generator and continuous release
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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 in tests systems, and becomes highly challenging when dealing with hydrophobic (logK<0.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their dissolution of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading concentrations of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous enrichment. Specific handling tools and concentrating models were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

TH213
Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach
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Research GmbH - UFZ / Cell Toxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Biologically active substances (generally termed as endocrine disrupting chemicals (EDCs)) are present in untreated municipal wastewater, which may cause deterioration of freshwater ecosystem due to their potential to disrupt the endocrine system of aquatic organisms. Untreated municipal wastewater is directly discharged into Danube River, Novi Sad, Serbia and the objective of this study is to identify compounds responsible for alteration of endocrine 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 hormonal activity for progesterone and glucocorticoid receptors (PR and GR). The extracted sample was subjected to cytoxicity. On the other hand, the main goal of this study was to investigate the cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C-18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioassays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using anionoeropoly 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 human 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 models. Especially, 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 PFAS 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 PFAS; 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 effect specific effects in vitro test systems. The effects of mixture samples will be assessed by using a combination of biotests. The results will be used to perform comprehensive risk assessment of contaminated sites and will be communicated with industry partners and stakeholders.

TH215
Analyzing chemical pollutants in water samples from an urban river and wastewater effluent in Hyderabad (India) and their ecotoxicological effects using effect-directed analysis (EDA)
J. Daniel, RWTH Aachen University; P. Böhm, RWTH Aachen University / Department of Ecosystem Analysis; J. Allhaim, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; A. Dayakar, Gamana Vittal, Shubha, Sadashiv, Narra, Prathap, National Institute of Technology Madras / Department of Civil Engineering; V. Schiller, RWTH Aachen University / Department of Ecosystem Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of
multi-resistant bacteria in the Musi River, which might be due to large pharmaceutical production located in Hyderabad. A cooperation between the Department of Ecosystem Analysis RWTH Aachen (ESA), the Helmholtz Centre for Environmental Research Leipzig (UFZ) and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India). The study aimed to assist 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 lyticase yeast estrogen screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and 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
P. Bhowmik, J. Daniel, RWTH Aachen University / Department of Ecosystem Analysis; J. Ahlhelm, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; A. Dayakar, Gamna NGO Hyderabad; A. Sathish Lekha, J. Vijayan, I.M. Nambi, Indian Institute of Technology Madras / Department of Civil Engineering; V. Schiller, RWTH Aachen University / Department of Environmental Research, UFZ; M. Junghans, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; S. Schiwi, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Hollett, RWTH Aachen University / Department of Environmental Engineering. Contamination of surface water is a common issue in urban areas of India. Large proportions of urban river water may consist of untreated wastewater, both domestic and industrial. The city of Hyderabad (Telangana state, India) has large industrial clusters including pharmaceutical, dye and battery factories that have the potential to affect surrounding waterbodies. Recent studies on antibiotic resistances proposed pharmaceutical industries as a potential cause for antibiotic resistances in bacteria in surface waters of Hyderabad. Daily contact of cattle and cattle herding shepherds as well as monsoon flood events are only two examples in which the river pollution is not only an environmental risk but also a human health issue. To work towards a more sustainable water management in urban areas of India, a cooperation between environmental engineers from the Indian Institute of Technology Madras and scientists from the Department of Ecosystem Analysis (ESA), RWTH Aachen University and environmental chemists from the Helmholtz Centre for Environmental Research Leipzig (UFZ) has been formed. For a complementary assessment to previous studies, water samples were extracted from an urban river (Musi river), its tributary, the effluent of a wastewater treatment plant and industrial wastewater, in Hyderabad in June 2017. The samples were taken using a novel device for onsite large-volume solid phase extraction (DOE 10.1016/j.scitotenv.2016.12.140) with a defined extracted water volume between 40 and 100 L per sample over 4 to 8 hours. The resulting water extracts will be investigated through non-targeted and target chemical analysis as well as effect-directed analysis (EDA). A bioassay battery to investigate the toxicological effects of the samples included algae (Pseudokirchneriella subcapitata) growth inhibition, daphnia (Daphnia magna) immobilization, fish embryo toxicity (Danio rerio), endocrine disruption (lyticase Yeast Estrogen Screen; ER-CALUX), genotoxicity (Ames fluctuation; micro nucleus test), neurotoxicity (D. rerio) and dioxin-like activity (micro EROD), these tests are currently ongoing. Preliminary results indicate adverse effects on P. subcapitata, D. magna, as well as endocrine disruption in the lyticase Yeast Estrogen Screen in four out of five samples. The combined results of this work will provide a comprehensive ecotoxicological characterization of an urban Indian river and potentially raise awareness of possibly related risks.

TH217 NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments
M. Langer, Centre Ectoco EAWAG-EPFL / Aquatic Ecotoxicology; M. Jungkans, Centre Ectoco EAWAG-EPFL; S. Spycher, Eawag Swiss federal Institute of Aquatic Science and Technology; M. Koster, Amt für Umwelt, Thurgau / Gewasserschutzqualität; C. Baumgartner, AquaPlus; E. Vermeiren, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluated pesticides in streams in connection with 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, it 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 risk (49%) while chronic fish toxicity at one site also contributed to the mixture risk (11%). Fish toxicity was not involved in the mixture risk for the other streams. The SPEArpesticide index also indicated a poor condition for invertebrates in the Eschelisbach. In this study, the biological investigations proved to be a valuable link between the chemical compound risk assessment and stream biology.

TH218 An ecotoxicological assessment of Lake Mondsee, Austria: a two year survey S. Goncalves, 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. Wanzenbök, University of Innsbruck / Institute for Environmental Engineering, Austria; I. Lopes, University of Aveiro / Department of Biology & CESAM; I. Eschelisbach. In this study, the biological investigations proved to be a valuable link between the chemical compound risk assessment and stream biology.

TH219 Availability of estrogenic compounds in evaluation of W and S samples' toxicity, 2) spring 2016 (possible best-case scenario, since lake was frozen for the winter) and 3) summer 2016 (worst-case scenario, tourist activities peak). The WWTP inflow and outflow, plus pre-treatment, were evaluated for ecotoxicity. The WWTP inflow and outflow, plus pre-treatment, were evaluated for ecotoxicity. In addition, it 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 risk (49%) while chronic fish toxicity at one site also contributed to the mixture risk (11%). Fish toxicity was not involved in the mixture risk for the other streams. The SPEArpesticide index also indicated a poor condition for invertebrates in the Eschelisbach. In this study, the biological investigations proved to be a valuable link between the chemical compound risk assessment and stream biology.

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Izmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were affected very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and dredging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980s, when all the city smelf very badly. Micronuclei (MN) tests are a method of microscopical testing used to determine the potential of the pollutants to induce DNA changes in DNA fragments such as micronuclei in the cytoplasm of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (Mytilus galloprovincialis). According to our results MN frequency of 10 station varied between %39.33 - %5.6, and Binculeated cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. **Key Words:** Izmir Bay, Pollution, micronucleus, Mytilus galloprovincialis

**TH222** Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment

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Commercial objects made of plastics are composed of two or more different components with dissimilar ecotoxicological properties, namely the polymer matrix and the chemical additives used to provide the final physical and chemical properties demanded by the consumers. Most conventional polymers are made of innocuous monomers (olefins, terpethalates), they are inert under environmental conditions and, according to standard ecotoxicological bioassays using early life stages (ELS), do not pose any ecotoxicological risk to marine organisms, with the possible exception of mechanical damage. In contrast, many common plasticizers (e.g. orthopthalates), 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 not cause 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 kinetcs of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some commonly 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.

**TH223** ECOLOGICAL EFFECTS OF POTASSIUM BROMATE ON THE EMBRYOLOGICAL DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758)

A. Arslan, University Ege / Hydrobiology; D.Z. Ayvaz, Les Établissements Scolaires Tévéfik Fikret; G. Kenanoğlu, Turkish Education Foundation İnanç Türkeş

Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than air. Potassium bromate leaches out from plastic bags and the 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 kinetcs of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some commonly 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.

**TH224** DETERMINATION OF IZMIR BAY POLLUTION BY USING GENETIC BIOMARKERS IN THE MUSSEL (MYTILUS GALLOPROVINCIALIS) TAKEN FROM THE NATURAL ENVIRONMENT

A. Arslan, University Ege / Hydrobiology; H. Parlak, Ege University; M. Boyacıoğlu, Ege University; M.A. Karaaslan, University of Ege; G. Gölsiev, Ege University

Izmir Bay, which is surrounded by many agricultural and industrialized cities like
Effect of thermal stress on endocrine disruption in Daphnia magna

J. Na, Korea University; H. IM, J. Jung, Korea University / Environmental Science and Ecological Engineering

Endocrine disrupting chemicals (EDCs) include various types of natural (17β-estradiol, estrone) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in animals and humans. Recently, several studies reported that daphnia species, which reproduce by parthenogenesis, may generate 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 used for comparing the endocrine disruption effects using adult (10-17 days old) daphnids. Animals were exposed to two temperatures of 20 °C and 25 °C, and reproduction, growth, male production and survival rates were evaluated. This study can give an insight into the endocrine disrupting effects of EDCs on aquatic organisms under influence of thermal effluents discharged into streams and rivers.

TH225

Microplate Alga Growth-Inhibition Bioassay

I. Iturria, O. Jaka, C. Marti, A. Alzuale, 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 faster 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 SEE BALANCE®

P. Salinger, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenenwald, P. Koehl, BASF SE / CDS/S

Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed during the development phase. Give so, there is a need for new fast and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 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.

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 gum production, (2) Environment: groundwater-neutral approaches and best practices in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (S-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

P. Falcone, E. Imbert, A. Tani, V. Tartiu, P. Morone, Uniteima Sapienza University of Rome

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 depends on: stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of what is to be measured is the critical point in S-LCA, and, by employing recognised participative techniques, the stakeholders’ involvement can be used to shape the final sustainability criteria and regulatory recommendations. Against this background, our study aims at investigating to the social dimension, which incorporates different social and business aspects, in a sustainable bioeconomy context. Our study focuses on: (1) the development of sustainable bio-based products; (2) the introduction of innovative and efficient participative techniques for the social dimension of the transition towards bio-based products; (3) the development of an integrated methodology 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 as other limits related to these new developments.
Concerning the oil extraction activities into the sea and gas offshore platform activities, the Italian Ministry of the Environment, Land and Sea has adopted a new approach to decide for the release/renewal of the authorisation to discharge the Produced Formation Water (PFW.a) by-product of both oil and gas extraction, into the sea. This approach aims at assessing more deeply the possible environmental impact of the additives used in hydrocarbon extraction activities. In this context, we present the application of the environmental risk assessment methodology, set out by REACH Regulation on chemicals, for some additives (e.g. Dietylene glycol) used in oil and gas platform activities. This approach allows to define specific concentration limits eligible for seawater discharge of these additives. By applying this methodology we compared the Predicted No-Effect Concentration (PNEC) with the predicted environmental concentration (PEC) related to the release of the substance in the seawater. The work already concluded on Dietylene glycol showed that the concentration considered as a bound was 730 mg/l for constant/frequent release and 5900 mg/l for intermittent release. These limits have been included by the Ministry of Environment as a binding condition for granting the authorisation of discharge to the platform manager.

Session: 3.12
Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries. Authors: S. Santoro - National Research Council (CNR) - Institute of Atmospheric Pollution Research and SETAC Europe 28th Annual Meeting Abstract Book; A. Carone, Dow AgroSciences Italia srl; A. Whyte, Dow AgroSciences Ltd; A. Aix, Dow AgroSciences / Risk Management; G. Aimonti, ICPS International Centre for Pesticides and Health Risk Prevention; R. Cabella, INAIL - Dipartimento di Medicina, Epidemiologia, Igiene del Lavoro e Ambientale; G. Canha, Lusosem S.A.; C. Civitella, T. Corinti, ICPS International Centre for Pesticides and Health Risk Prevention; M. Corvaro, Dow AgroSciences Ltd; N. Dalla Valle, Dow AgroSciences Italia srl; F. Dias, Cooperativa Agricola Montemor; E. Garcia, I. Gonzalez, Dow AgroSciences Ibérica, S.A.; M. Guirase, Dow AgroSciences srl; P. Hanns, Dow AgroSciences LLC; M. Luini, F. Marchetto, ICPS International Centre for Pesticides and Health Risk Prevention; G. Mereggalli, Dow AgroSciences Italia srl / Ecotoxicology; M. Osuna Ruiz, CYCITEX; A. Ritter, Waterborne Environmental, Inc.; M. Rubbiani, ISS Istituto Superiore di Sanità; C. Thomas, Centre Français du Riz; I.S. Travlos, Agricultural University of Athens; S. Ullucci, ICPS; W. Williams, Waterborne Environmental, Inc.; V. Zaffagnini, C. Vaj, Dow AgroSciences Italia srl./

In Europe and in the context of Regulation (EC) 1107/2009 for placing into the market of plant protection products rice as a crop is an anomaly and has created several difficulties in its evaluation. For regulators, there is a need for comprehension of the unique agronomic practices, application techniques, management and environmental concerns, both from an ecotoxicology and environmental fate perspective considering the majority of rice cultivated within the Europe is grown in paddy fields. This gap in knowledge caused issues in the evaluation of rice as a representative use in the process of European authorization of active substances for plant protection products and raised questions over the suitability of environmental indicator species and risk assessments within the context necessary. Rice is a major crop in many Southern Zone Countries and the difficulties gaining an understanding of rice practices, compounded by uncertainty with changing regulatory requirements and a lack of transparency in evaluation procedures has hampered the process of active substances approval. Such a complex framework could dissuade active substance renewal by agrochemical manufactures or indeed inhibit innovation. In conjunction, an increase in weed resistance to plant protection products currently available has forced Member States to continually rely on Emergency Uses Permit year on year to support the rice growing community. Weed and pest tolerance to agrochemicals is increasing across Europe. A, in conjunction with the lack of technical tools available for weed and pest control. Rice farmers recognise the urgent need for active substances to be placed on the market with different modes of action to combat resistance and safeguard the production. The above mentioned topics have been deeply discussed among experts of different disciplines from the rice producing European Countries in an ad hoc workshop facilitated by Dow AgroSciences in July 2017. The outcome of the discussion highlighted the potential of using a multidisciplinary approach, with farmers, local networks, users and research institutes facilitating an environment to coordinate a strategy for implementation, with a Member State authority championing this venture through zonal steering groups. The main conclusions of the workshop will be presented and discussed in the poster.

TH234
The Water Column Monitoring Program in Norway: when regulation and science meet
D. Pampanin, International Research Institute of Stavanger; J.S. Brooks, NIVA
The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity.

TH237
Canada’s Approach to Determining Causes of Impairment at Federal Contaminated Sites
M.H. Henning, D. Pelletier, Ramboll EH; M.T. Sorensen, Ramboll / Senior Science Advisor
Canada’s Federal Contaminated Sites Action Plan (FCSAP) was developed to reduce risks to human health and the environment from—and to reduce the financial liabilities associated with contaminants discharged from federal programs. A key component of Canada’s assessment framework is the use 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 CADDIS guidance, though it is simplified in an effort to facilitate its use at FCSAP sites and to reduce the financial and litigation risks associated with determining causality for contamination resulting from exposure via the environment. As a result of comprehensive biological monitoring campaigns undertaken by European Member States in the past and supplemented modelling data, a large body of data is available on lead body burdens in the European population (children and adults). However, little information is reported for blood lead in populations surrounding lead manufacturing facilities and in adults. Data on the primary expected source of exposure (with soil and dust also contributing to children’s exposure due to play habits), it is difficult to apportion the source of this exposure to specific uses. Under REACH authorization processes (as part of a socio-economic analysis), it becomes more important to estimate the contribution of a specific use and specific exposure pathways. Consequently, there is a need to develop the 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 Monte Carlo analyses for risk assessment. As a first step, local site-specific and regional environmental exposure scenarios and assessments are updated. Next, lead specific empirical bioaccumulation and transfer factors are derived based on a comprehensive literature survey. These parameters are used to describe additional pathways missing in EUSES, such as deposition on crops and soil/dust ingestion. Such pathways have been demonstrated to be dominant sources of lead exposure in humans, and thus included in a so-called EUSES MVE. Based upon the results of this EUSES-like screening exercise, higher tiers 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
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 genetic, worst-case exposure assessment. The guiding principle behind this approach is that for any selected exposure pathway, the highest lifetime exposure is considered. However, integrated assessment of human exposure pathways is needed for harmonizing the application date selection to parametrize the application scheme among the selected crops. These interpolation curves are meant to be used to reduce 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.

TH235
DAPHINE: a supporting tool for pesticides risk assessors and stakeholders
A. Linguadoca, F. Galimberti, S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; S. Menabaldi, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health
DAPHINE (DAtes and PHenological Estimation) is a tool created to contribute supporting the Environmental Risk Assessment (ERA) of pesticides. The rationale behind its development is based on correlating crop phenological stages (BBCH) to specific dates for representative geographic areas is often a crucial step both for the exposure and higher tier effects assessment. However, currently there is no source of information clearly addressing this issue at the national, Zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These interpolation curves are meant to be used to reduce 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.

TH236
The applicability of the assessment entity concept in the REACH registration of complex mixtures. A case study for fragrance substances
K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Kreutzer, Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA
The assessment entity (AE) concept was developed by ECHA together with Givaudan Suisse SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA; M. Torres Sanchez, Givaudan Suisse SA; K. Jenner, Givaudan Suisse SA; S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health. The tool was introduced in IUCLID 6 and aims to assist users in documenting complex assessment cases in a transparent and systematic way. The assessment entities (AEs) may be imported in Chesar 3 for the purpose of exposure assessment. The relevance and applicability of the AE concept to multi-constituent substances is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer exposure assessment, a worst-case exposure assessment was used. However, to assess environmental exposure and risk, a constituent block approach was used because the substance consists of components with different environmental fate properties (e.g. water solubility, log Kow, adsorption coefficient) and ecotoxicity profiles (e.g. acute EC50/LC50 values). The use of whole substance testing versus constituent data is explored. The adaptation of standard tests, such as the ecotoxicity tests, to the traditional whole substance paradigm is explored. The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity.
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. The model is supported by data from monitored chemical fate in industrial STPs (iTreat, Strujs et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the waste water stream of this specific STP were gathered and compared to the calculated elimination. The biodegradation rate constant of the substances was estimated using the chemical fate in industrial STPs data and the time series of measured elimination. The data were also compared to the non-parametrized model of iTreat and to the municipal models of Simple Treat 4.0 and Simple Treat 3.1. Overall, the iTreat model was successfully adapted to model chemical fate and behavior in an industrial, site specific STP. The elimination rate of the parametrized iTreat model was generally in better agreement to the measured elimination rates than for all other models investigated. The biodegradation rate constant of substances turned out to be a 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 an additional two-fold higher elimination rates which reflect the measured elimination. The application of site specific degradation rate constants (derived from biodegradation tests with adapted activated sludge of the respective site) for the site-specific model of iTreat will also be discussed in this poster contribution. Taken together, the validation exercise was successful and the parametrized iTreat model is applicable to other substances being produced at this site where measured data is not available.

TH241
A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.
A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Evolution and Ecology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC, Université Bordeaux / UMR 5805 EPOC; L. Perez, CNRS/UMR EPOC LPTC; N. Delorme, H. QUEUE, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Bubat, Irstea / Water

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. The model is supported by data from monitored chemical fate in industrial STPs (iTreat, Strujs et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the waste water stream of this specific STP were gathered and compared to the calculated elimination. The biodegradation rate constant of the substances was estimated using the chemical fate in industrial STPs data and the time series of measured elimination. The data were also compared to the non-parametrized model of iTreat and to the municipal models of Simple Treat 4.0 and Simple Treat 3.1. Overall, the iTreat model was successfully adapted to model chemical fate and behavior in an industrial, site specific STP. The elimination rate of the parametrized iTreat model was generally in better agreement to the measured elimination rates than for all other models investigated. The biodegradation rate constant of substances turned out to be a 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 an additional two-fold higher elimination rates which reflect the measured elimination. The application of site 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.

TH242
Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater crustacean Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.
A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Evolution and Ecology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC, Université Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Bubat, Irstea / Water

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TH243
Chemical Exposure Disparities by Demographic Traits in the US Population 1999-2014
M. Li, University of Michigan / Department of Computational Medicine and Bioinformatics; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; University of Michigan / Department of Veterans Affairs

Identifying individuals or populations at high risk for adverse health outcomes due to chemical exposure requires understanding how chemical exposure patterns vary by inherent traits. Currently, we lack of comprehensive screening to study the thousands of chemicals populations are exposed to on a daily basis. The purpose of this study is to develop a systematic approach that quantifies chemical exposure disparities for a broad set of chemicals by demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.
Our findings show that race/ethnicity, gender, and socioeconomic status can be statistically significant predictors of chemical exposure. More specifically, parabens, which are chemicals used in personal care products (PCPs), and 2,4- and 2,5-Dichlorophenol, which can be a products of photo-degradation of triclosan, a common antibacterial and antifungal agent, were observed to elevated in African Americans when compared to White Americans. In addition, higher levels of parabens were observed in women, while men had showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be from women using cosmetic PCPs more frequent and in larger amounts, and men using insect repellent slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and triclosan, which could possibly be explained by more accessibility to PCPs. In this study, we have identified inherent and demographic traits associated with elevated biomarker concentrations. We hypothesize that this is due to use patterns of consumer product, particularly PCPs. This could support research findings emphasizing the importance of near-field chemical exposures.

**TH244**

**Occupational exposure to flame retardants among Canadian e-waste dismantlers**

L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; V.H. Arrandale, Cancer Care Ontario; M.L. Diamond, University of Toronto / Department of Earth Sciences

The amount of e-waste produced globally is growing dramatically. National numbers suggest in PM 10, PM 2.5 and volatile organics in the air across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/y. One hazard associated with e-waste dismantling is flame retardants (FRs) which are added to electronic and electrical products to meet flammability standards. Little is known about exposure of workers to FRs in e-waste dismantling facilities in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations of selected FRs detected in air at a fixed FRs e-waste dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers at the facility to these FRs. Sampling was conducted daily over a total of five days in February 2017. Thirty-three dust samples were collected using vacuum cleaners and air samples were collected using polydimethylsiloxane (PDMS) passive air samplers (PDMS-PAs) co-deployed with active low-volume air samplers (LV- AAS). A Micro-Orifice Uniform Deposition impactor (MOUDI) was used to obtain particle size distribution of air samples. Post-deployment, samples were extracted and analysed for 12 target FRs, including novel brominated flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs) and organophosphate esters (OPEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samples were the novel brominated FRs ranging from 1930 ng/m³ to 2900 ng/m³. Preliminary estimates made using air concentrations measured here suggest that the total daily inhalation intake of all 12 FRs was ~17 μg/day FRs among e-waste dismantlers. Results for the MOUDI samples showed that triphenyl phosphate (TPhP) and other replacement FRs were more abundant than the brominated FRs. Levels of dust samples from this Canadian e-waste recycling facility suggest opportunities for inhalation exposure to flame retardants among e-waste dismantlers in Southern Ontario, Canada.

**TH245**

**Global approaches to environmental exposure - assessment of e-wastes**

D. Purchase, Middlesex University / Department of Natural Sciences, Faulty of Science and Technology; L. Bischoff, Ermansus 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 / Vernadski Institute; H. Garlich, Middlesex University; N. Kandile, Ain 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 Architectural Technology; 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, volatile organic solvents, 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 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” (#2014-031-3-400)], supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global expertise to explore different avenues to the above 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 the around the world to highlight the following: i) discrepancies in the provision 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 specification 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**


Natural background concentrations of cyanide can originate from the degradation of cyanogenic glycosides, cyanogenic enzymes, and cyanophytes. Cyanide can 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” (#2014-031-3-400)], supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global expertise to explore different avenues to the above 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 the around the world to highlight the following: i) discrepancies in the provision 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 specification analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.

**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 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 specification analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.
µg/L. Here an existing continuous flow analysis (CFA) method was selected using a system with a special cuvette installation allowing a higher sensitivity. The protocol was validated and accredited according to standard ISO/IEC 17025. With this system an LOQ of 0.15 µg/L can be reached under optimal conditions while an LOQ of about 0.3 µg/L is achieved during routine operation. Previous to field testing it was verified that samples can be stabilized for at least 24 h by adjusting the pH of oven-dried samples to 12 and storing them 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 WWTX Yvelines, H. K. with J. Schaeffer / R.W. Aachen University / Institute 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, i.e. EU Water Framework Directive, is to perform monitoring for priority substances, which is efficient approach in water management. However, the capturing variable contaminant level is also critical for eco-toxicological risk assessment. The present study reports on how to exploit equilibrium and kinetic passive sampler in parallel and evaluate dynamic chemical profile in order to satisfy the 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,wa}) over the full sampling period. PDMS sheets with two different thicknesses (76 and 203 µm), as an equilibrium passive sampler, were deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration (C_{true}) of a range of target compounds was determined. In parallel, two types of polar organic chemical integrative sampler (POCIS) were selected as kinetic passive sampler. The one is typical POCIS with Oasis HLB® sandwiched between polyethersulfone membranes and the other is modified POCIS with Oasis HLB® sandwiched between polyethersulfone membranes and the other is Oasis HLB® sandwiched between polyethersulfone membranes and the other is Oasis HLB® sandwiched between polyethersulfone membranes.

**TH250**

**Improvement of relationship between water pesticide contamination and land use**

J. Steiner / University of Limoges / Research Group on Water Soil and Environment GRESSE, S. Boutey, I. Bordeux / UR EABX; M. Saut, J. Rebillard, AEAG Toulouse; N. Mazzella, I. Bordeux / 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, Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels 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. 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 diffusion gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to evaluate 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. Reuter, I. Bordeux; C. Måge, A. Daval, M. Gregson, I. Bordeux Lyon; N. Mazzella, I. Bordeux / 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, Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels 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. 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 diffusion gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to evaluate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

**TH252**


S. Freedlander, Smithers Viscent, LLC / Environmental Fate and Metabolism; S. RAO, Gowun Company / Regulatory; K. Malekani, S. Kang, Smithers Viscent / Environmental Fate and Metabolism

Once applied to a plant, pesticide residues have the potential to move to other plant tissues (via a phloem or xylem) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels 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. 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 diffusion gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to evaluate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

**TH253**

**Improvement of relationship between water pesticide contamination and land use**

J. Steiner / University of Limoges / Research Group on Water Soil and Environment GRESSE, S. Boutey, I. Bordeux / UR EABX; M. Saut, J. Rebillard, AEAG Toulouse; N. Mazzella, I. Bordeux / 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, Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels 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. 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 diffusion gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to evaluate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.
Standards for High Resolution Mass Spectrometry Dioxin Analysis: Comparison of International Quality Assurance and Quality Control

from the studies indicate that SEM can be useful tool for evaluation of images were very valuable, allowing visual comparison of acini. Data obtained and increases of acini and their number per 1 mm². For example, in a study using paraformaldehyde in phosphate buffer, then postfixed in 1% OsO₄, the number of acini was quantified. The study was conducted on Honey bees (Apis mellifera) and a sandfly species (Phlebotomus luteolus), providing insights into the acinar structure.

The current presentation will focus on the initial microbial biomass as an indication of health and viability of sediments at the time of their collection. A collection of initial sediment microbial biomass values has been summarized and presented based on their time of collection during the year. An example of a study with four seasons, over a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Weweantic 2017 Taunton Weweantic Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Spring 0.76 0.82 Summer 0.63 0.28 Summer 0.51 0.41 Full 0.40 0.22 Fall 0.60 0.71 late summer. Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and % OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

Use of scanning electron microscopy (SEM) in evaluation of hypopharyngeal glands development in Honey bees (Apis mellifera L.)

A. Drzewiecka, M. Napora-Rutkowska, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; E. Kulec, Institute of Industrial Organic Chemistry, Branch Pszczyna / Department of Toxicological Studies

McLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, K. Malekani, 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 intercalate. In view of this, the development of a GC/OriOrbitrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high mass resolution spectrometry (GC-UCHRM). Here we report use of GC-UHMR 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 capabilities provided by image current detection and high mass resolution (>100,000 FWHM). Robustness of the PCDF/AF 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 identification of congeners and quantification and provide validation of the methods. 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.
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. Quek, R.W. Heth Aachen University / Department of Ecosystem Analysis; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; C. Gembl, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; G. Reiferscheid, German Federal Institute of Hydrology; H. Howe, University of Wales Trinity St. Davids / Institute for Environmental Research Sediments can act as a sink and source of pollution in aquatic environments, particularly with respect to persistent organic pollutants (POPs) which bind to sediments and then can be released into the aquatic environment if, and when, the sediments are disturbed (e.g., dredging, floods, storm events). Among POPs, dioxin-like compounds (DLCs), which consist of a variety of contaminants that share similar structures and can bind to the arylhydrocarbon receptor (AhR) in cells, are of particular concern. In addition to chemical analyses, which are often expensive and unnecessary if the contamination is low or below threshold concentrations, measurement of the induction of ethoxyresorufin-O-deethylase (EROD) activity using the rat hepatoma cell line (H4IIE) has been identified as a potential bioanalytically screening tool for the presence of DLCs in the environment. In a recent presented study, the biodistribution of compound involved the use of a 96-well plate-reader-based assay to measure EROD induction with the rat hepatoma cell line H4IIE. The micro-EROD assay can be used to determine the cytochrome p450 subfamily 1a (CYP1A)-inducing potential of a variety of substances, including extracts of sediment samples. For this project, micro-EROD assays and chemical analyses were performed on extracts of 22 sediment samples collected from wate...
produced from guideline values (Canadian soil quality guideline and EU REACH PNEC values) and a ratio based on the average concentrations in a contaminated site (Sudbury) for each metal. Each mixture was tested with 11 doses in toxic units estimated from Folosoma candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing mixture contamination. These community dose response curves allowed the estimation of microbenthic 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

Assessment of the toxic interaction of lanthanides on aquatic organisms

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, ccs, cat, gr, gpx) and thyroid-related genes (trt, trfi, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The expression of trt, trfi, dio1, dio2, nis, sult1-s1, sult1-s2, sult1-s3, ugt1ab, ugt2a1, 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. Transcript levels of gr and gpx were induced upon both individual exposures and co-exposure, suggesting that both lead and BDE-209 were capable of inducing oxidative stress balance. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH265

Assessment of the toxicity interaction of lanthanides on aquatic organisms

A. Romero, Univerisite de Lorraine / LIEEC, CNRS, UMR 7360, Univerisite de Lorraine, Campus Brdoux, Bâtiment IBISE, 8 rue du General Delestraeit, 57070, Metz, France; E. Joonas, M. Muna, National Institute of Chemical Physics and Biophysics, D. A. Vogni, CNRS / LIEEC UMR7360; L. Giamburini, Univerisite de Lorraine, CNRS UMR 7360 / LIEEC, CNRS

The relevance of lanthanides (LNs), in agricultural, industrial and, especially in high-tech applications has increased in the last decades. As consequence, more LNs are expected to enter into the environment and accumulate in the ecosystem. Although no great accumulations have so far been recorded, alterations in the LNs natural cycle have been detected, particularly in the accumulation of Ln toxicity focuses on the effect of single elements, however they are commonly found as a group in nature. LNs are expected to have cumulative toxic effects on organisms, owing to their similar chemical properties, but studies as mixtures, more representative of real scenarios, are required to support this hypothesis. In this research, we evaluated the toxic interactions of binary and tertiary mixtures of cerium (Ce), gadolinium (Gd) and samarium (Sm) at sub-lethal concentrations, on oxidative light and light LNs, respectively, on seven aquatic species belonging to different trophic levels. From the seven organism studied (A. fischeri, R. subcapitata, C. vulgaris, B. calyciflorus, H. incongruens, D. magna and D. rerio) potential toxic effects were observed only in five; and the inhibitory LN effects were consistently concentration-dependent only for A. fischeri, R. subcapitata and B. calyciflorus. Bioavailable LN concentrations significantly decreased during all tests and the major decline took place at the beginning of the tests, but the extent of the decrease varied across test media. Thermodynamic speciation calculation highlighted important differences: in distilled water and 1 % NaCl, LNs were predicted to occur mainly as free ions; in more complex media, LNs appeared as free forms and with important differences: in distilled water and 1% NaCl, LNs were predicted to occur less than additive toxicity was instead observed for the rotifer Pseudomonas aeruginosa. On the other hand, the presence of LNs did not affect the toxicity of Cu, Cd and Zn. The toxicity of the combination of these metals was estimated from guideline values produced from different locations at the Mambilla artisanal mining site, Nigeria. The Chinese University of Hong Kong / School of Life Sciences; C. Leung, The Chinese University of Hong Kong / Life Sciences; B. Slootmaekers, University of Antwerp / Department of Biology; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SHERE Research Group)

TH266

Detecting the chemical and biological effects of tertiary metal mixture (Ni, Cu, Cd) in aquatic plant, Lemma gibba under different dissolved organic carbon concentrations

S. Martinez, CONICET PRIET UNLU; Y. Gopalapillai, Environment and Climate Change Canada; M. Saen, PRIET CONICET, National University of Luján; B. Hale, School of Environmental Sciences, University of Guelph, W.D. Di Marzio, CONICET-PRIET / PRIET

Toxic effects of single metals on aquatic environments are well established. In nature, organisms are exposed to a mixture of them at different bioavailability conditions. However, this situation is not always well studied. Here Lemma gibba were exposed to Ni, Cd and Zn individually and as ternary mixtures. The influence of the uptake and toxicity of dissolved organic carbon (DOC) as an environmental light was studied. Two sets of tests were performed. 0.5 mg/L and 10 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 test cases. Frond number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [M dissociated] and external dose [M tot] were calculated for all chronic tests. Simple 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 %RGI, when concentration expressed as M dissociated (20.8 µg/L) being 6 times more toxic than Ni and 30 times than Zn. When concentration expressed as M tot/Cd was also the more toxic metal (IC52/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 tot, but Cd when expressed as M dissociated. At the end of assays, for both DOC concentrations, [Cd dissociated], [Ni dissociated] and [Zn dissociated] 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 (a) model for the mixtures’ toxicity, the combinations of concentrations were used to calculate the ‘sum of toxic units’ (STU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH267

ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA IN SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA

O. Otoju, federal University Wukari / Department of Biochemistry; T. Silas, federal University Wukari; A. Martins, S. Asemave, federal University Wukari / Biochemistry

Incidence of soil contamination by heavy metals is widely increasing with the spread of industries. Arthurian mining sites in Benue state is one of the most polluted sites in Mambilla plateau has 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 bacterial 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 bacterial strains: A. fischeri, R. subcapitata, B. calyciflorus, H. incongruens, D. magna and D. rerio potential toxic effects were observed only in five; and the inhibitory LN effects were consistently concentration-dependent only for A. fischeri, R. subcapitata and B. calyciflorus. Bioavailable LN concentrations significantly decreased during all tests and the major decline took place at the beginning of the tests, but the extent of the decrease varied across test media. Thermodynamic speciation calculation highlighted important differences: in distilled water and 1 % NaCl, LNs were predicted to occur mainly as free ions; in more complex media, LNs appeared as free forms and with important differences: in distilled water and 1% NaCl, LNs were predicted to occur less than additive toxicity was instead observed for the rotifer Pseudomonas aeruginosa. On the other hand, the presence of LNs did not affect the toxicity of Cu, Cd and Zn. The toxicity of the combination of these metals was estimated from guideline values produced from different locations at the Mambilla artisanal mining site, Nigeria. The Chinese University of Hong Kong / School of Life Sciences; C. Leung, The Chinese University of Hong Kong / Life Sciences; B. Slootmaekers, University of Antwerp / Department of Biology; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SHERE Research Group)

TH266

The exceptions to the rule: Metal bioaccumulation in macroinvertebrates from a contaminated polluted site

B. Slootmaekers, R.M. Town, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Department of Biology; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

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
guidelines for surface waters, in order to reach a good ecological water quality status for all water bodies. Nevertheless, many rivers and streams are still experiencing trace metal concentrations that exceed the current Environmental Quality Standards (EQSs). In combination with other stressors, this situation may lead to an unfavorable shift in the composition of the ecological community due to a variety of direct and indirect effects. The range of concomitant contributing pressures is in fact too broad to identify the way in which a specific aquatic environment and community will respond to the presence of a stressor(s). To gain insights into the contributing factors, we are investigating eleven sites for which apparently contradictory effects are observed. That is, based on monitoring data (www.vmm.be/geoview) gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQSs, yet a good ecological quality is observed as explained by the gastronomic and biodiversity level of the sites. We hypothesize that the macroinvertebrate communities at these locations have (i) adapted to high trace metal concentrations and/or (ii) experienced a lower metal bioavailability due to the water chemistry. To sort out the involved processes, we will systematically characterize the bioaccumulation and exposure patterns of trace metals in a suite of macroinvertebrate taxa collected at these sites and determine the trace metal concentrations in the different ecological compartments (water, sediment and biota). The results, together with general water quality parameters (pH, conductivity, temperature, DOC and macronutrients) will identify whether the ecological quality is primarily governed by chemical or biological factors, or a combination of the two. The outcomes of our research will provide mechanistic insights into the determinants of ecological quality and facilitate development of a more differentiated basis for the setting of EQSs.

**TH269 Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio**

G. Cassida, University of Antwerp / Biology; G. De Boeck, University of Antwerp / Biology SPHERE; G. De Boeck, University of Antwerp / Department of Biology (SPHERE Research Group)

The aquatic environment is continuously under threat because it is the final receptor and sink of waste streams. This environment receives a huge number of different compounds including heavy metals that can harm the health of aquatic organisms. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of defense mechanism and biomarker enzymes related to ionoregulation, oxidative stress and defense mechanisms. Preliminary results indicate that metal accumulation induced expression of metal binding and stress proteins, and metal specific compensatory effects were seen in genes related to ionoregulation and oxidative stress. Further analysis will determine whether antagonistic, additive or synergistic effects occurred.

**TH270 Silver nanoparticles exposure inhibits glycans synthesis and induces cytotoxicity in human cell line**

K. Shimizu, Toyo University; M. Horie, Advanced Industrial Science and Technology; S. Kashiwada, Toyo University / Graduate School of Life Sciences

Silver nanoparticles (SNPs) are used in industrial products worldwide. Hence, there are concerns about environmental pollution and its associated risk. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycans are one of the targets of silver nanocolloids (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycans function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. In this study, we employed four different SNPs including SNCs to compare their different toxicities using three human cell lines. Of SNPs in this study, one was coated with sulfur and diameter was 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, BAGAL2 and GNS) expressions. Tested gene expression levels were all suppressed by SNPs and SNCs exposures. Since this study demonstrated that SNPs inhibited glycan synthesis in medaka in vivo and human in vitro models, toxic effects of SNPs on glycans is probably universal among vertebrate organisms.

**TH271 Mixture toxicity of ZnO and silver nitrate to Daphnia magna**

M. Baek, KIST Europe; Y. Seol, University of Science and Technology; H. Kwon, Y. Kim, KIST Europe / Environmental Safety Group

Zinc oxide nanoparticles (ZnO NPs) and silver nanoparticles (AgNPs) as Engineered nanomaterials (ENMs) can be mainly found in numerous materials or consumer products. These applications of metal (oxide-) nanoparticles indicate that there is an exposure to nanomaterials in the aquatic environment. The aquatic environment may lead to mixture forms of by biological system. In this study, the acute toxicity tests using Daphnia magna were conducted for examining the single- and mixture toxicity. The methodological approaches for mixture toxicity (Mixture I – 5.5; Mixture II – 7.3 and Mixture III – 3.7) were conducted as three binary mixtures of AgNO3 and ZnO based on the estimated toxicity data (i.e., EC50 values) of single substance. To compare with control response and mixture results, the mode of action in mixtures, the effects of mixture were analyzed using the MIXTOX models. The EC50 values of AgNO3 and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-2.0667 mg/L), respectively. Among the 3 mixtures, mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of all mixture, the non-IA model was calculated as a mixture model indicated an increased toxicity when the mixture effect was caused mainly by ZnO, and the positive b Values of both model indicates a decreased toxicity (antagonism) when the mixture effect was due mostly to AgNO3. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO3, MIXTOX model, nanoparticle toxicity.

**TH272 How relevant is mixture toxicity of herbicides in surface water?**

R. Saur, Bayer AG / Crop Science Division / Environmental Safety; A. Weyers, Bayer AG / EnSa. Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology; T. Kiessling, Bayer AG Crop Science Division / Terrestrial Vertebrates Expert Team; D. Haets, Bayer AG Crop Science Division / Sustainable Operations

The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)idi sampling intervals. Mixture toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to pose a real concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution.

**TH273 Simplify: reasonable approaches to Mixtox assessment for plant protection products**

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Established regulatory implementation of risk assessment of mixtures has increased and several guidance documents describe the process. Our suggestions here deal with mixtures of PPP that require an environmental risk assessment (ERA) for cumulative exposure. Depending on the regulatory context, this may include PPP with multi active substances, relevant co-formulants, adjuvants, safeners or metabolites. While publications on mixture toxicity understandably tend to focus on more detailed evaluations. Therefore a guiding principle in the regulatory process is that in a first tier some over-conservative assumptions can be made; if they allow to correctly identify scenarios of low risk. If formulation studies are available, the measured toxicity of the mixture (and exposure to it) should be used in ERA. When
a calculation of cumulative risk is needed based on active substance endpoints, risk indicators that have already been calculated for single substance ERA such as toxicity exposure ratios or risk quotients should be used to describe the cumulative risk. In a first simple step different endpoints, species and PECs in time and space can be mixed, to show that a given scenario is of low concern. After that first step, a mixture toxicity assessment would describe the cumulative risk more precisely at a given time and place for a defined species and the same endpoint.

TH274 Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms

E. Rozmková, RECETOX, Faculty of Science, Masaryk University / Research center for toxic compounds in the environment RECETOX; B. Morin, J. Cachot, University of Bordeaux / EPOC; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; L. Blaha, Masaryk University, Faculty of Science / Research centre for toxic compounds in the environment RECETOX

Pesticides are widely used throughout the world in many agricultural and domestic activities. By their presence in the environment, they can have an impact on non-target organisms. Moreover, due to the persistence of some products and the formation of active metabolites, more or less complex mixtures of pesticides can be found in the environment. Thus, the aim of this study was to evaluate the effects of one herbicide (S-metolachlor and his two metabolites) and an insecticide (imidaclopride) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their groups in the Arcachon Bay in France. 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 prototypical (eco)toxicity model organism. Firstly, the embryos were exposed to the separate substances, then 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 metolachlor metabolites. 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, Board for the Authorization of Plant Protection Products and Biocides; E. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; W. Beltman, Alterra Wageningen UR; H. Holterman, Wageningen University & Research / Agrosystems Research; L. Wipfler, Alterra Wageningen UR / Environmental Risk Assessment Team; J. Van de Zande, Wageningen University and Research / Agrosystems Research

This study presents a number of stepping stones towards answering the question if the current product-by-product and active substance-by-active substance evaluation provides sufficient protection in the context of the authorisation of plant protection products (PPPs) in the Netherlands. This report is based on a literature review and an evaluation of tank mixture applications in a spraying schedule for strawberries. The topic of tank mixes has been identified by Cgb (the Board for the Authorisation of Plant Protection Products and Biocides in The Netherlands) as an important knowledge gap. We have quantified the environmental risk for an intensively cultivated crop with sequential applications of products and mixtures of products based on a realistic application schedule and spray drift on surface water in a ditch, the corresponding exposure profiles and the effects based on the Regulatory Acceptable Concentration (CAC) of the used active substances. This study shows that the actual strawberry crop scenario is not protective for invertebrates and fish in surface water. Therefore, for the risk assessment of PPPs it needs to be considered that PPPs are part of a crop protection programme and thus should be evaluated in this context. Keywords: multistress, pesticides, environmental risk, aquatic Poster presentation

TH276 MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES

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To destroy or prevent insects, rodents, and weeds that might harm agricultural crops, and to control and mitigate plant diseases, farmers started to use pesticides, which are highly toxic chemicals or mixtures. Due to their persistence in the environment and ability to bioaccumulate in living organisms, pesticides generate environmental and human health impacts and risks, which are in a complex relationship. The present study proposes a model, in order to assess the acute and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMo model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in a double factorial design, in order to evaluate if the plants subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, it appears that acute and chronic risks of pesticides residues in sour cherries are low. Sour cherries dietary intake of pesticides residues poses an acute risk for children lower than 64.6% and lower than 22.5% for adults. The highest chronic risk level reaches 2.4% for adults and 9.5% for children. Our study suggests that the risk assessment estimates are strongly influenced by age and dietary preferences.

TH277 Environmental and Human Cumulative Risk Assessment of Pesticides Using Local Monitoring Data: A Case Study from the Pucara River Basin, Bolivia

L. Herrero Noaegara, University of Copenhagen / Department of Plant and Environmental Sciences; M. Álvarez Caero, H. Antezana Fernández, Universidad Mayor de San Simon / Facultad de Ciencias y Tecnología; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

In Bolivia, pesticides are widely used to protect the environment and ability to bioaccumulate in living organisms. These pesticides are the most abundant representatives of their groups in this Bay due to oyster farms and the zebrafish (D. rerio), chosen as a prototypical (eco)toxicology model organism. Firstly, the embryos were exposed to the separate substances, then 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 metolachlor metabolites. 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.

TH278 Developing a strategy to improve the environmental risk assessment of complex mixtures: a new HESI Emerging Issues Committee

D.T. Salvito, Research Institute for Fragrance Materials, Inc. / Department of Environmental Science; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI)

An international workshop was held in 2016 to address challenges in assessing ecological risk of complex mixtures, whether resulting from manufacturing environments or plant-derived materials. Several industrial sectors (e.g., petrochemical, personal care) have developed frameworks and methodologies to characterize and analyze these complex substances, and best practices and key research needs were identified at the workshop to support...
environmental risk assessment. Bridging from the workshop discussions and conclusions, a new HESI Emerging Issues Committee was formed in late 2017, with the overall mission to develop a tiered approach to UVCB and MCS ecological risk assessment. Initial objectives of this committee are to identify and develop models and methods, develop best practices and guidance, and engage with multi-stakeholder collaborative research projects. This presentation will highlight the initial goals and strategy of this multi-stakeholder, collaborative group.

TH279 Environmental Risk Assessment of Technical Mixtures under REACH

E. Hassold, W. Galert, German Environment Agency - UBA / IV 2.3 Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals Assessment 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 down-stream users have to assess and guarantee the safe use of the registered substances, formulations and products. Recently, some attempts have been made by industry organizations with the concept of LCID/SUMI to improve the assessment and communication of safe use conditions for technical mixtures. However, essential improvements are needed. The development of sound prioritization criteria is essential for a mixture assessment. But a sole consideration of toxicological profiles may not be sufficient. Natural complex mixtures: Ecotoxic behaviour, what we know and what is natural complex mixtures: Ecotoxic behaviour, what we know and what is not directly applicable to mixtures. The first issue is related to the physical state leads to further difficulties for ecotoxicity testing: they were (mostly) complex as EO but their composition was mostly unknown and their fragrances.

TH280 Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?

R. Samsera, CEHTRA SAS; N. Delplét, Laboratoires des Pyrénées et des Landes; P. Bichere, KREATiS; J. Rivera, A. Barret, C. durou, CEHTRA SAS; P. C. Thoms, CEHTRA SAS / Ecotoxicology and Risk Assessment

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, the number of chemical classes presented for testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals fall under multiple categories: natural, synthetic, monoisocutent, multiconstituent or considered as UVCBS. One group of chemicals 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, resins 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) solid, 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, resins, concretes and everything in between) to optimize our testing strategies for such compounds. 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 PRAP S HE

When the properties of a mixture cannot be estimated from the related properties of its components then testing on the mixture is required under most chemical regulations. However, the available standard methodologies to assess the environmental fate and toxicity have been developed for single substances and are often not directly applicable to mixtures. The first issue is related to the identification of the relevant constituents to monitor during the tests (e.g. composition main constituents, bioavailable fraction...) which may differ according to the substance regulatory frame(s). Second, the development of a specific and quantitative analytical method for each relevant constituent could be technically challenging because (1) all analytical standard substances might not be available since some constituents of the mixture are produced by reaction and (2) the different chemical nature of the constituents may require different type of analytical techniques that might not be (all) available in the (same) GLP testing laboratories. Once the analytical data base has been set up, the exposure time. Indeed, if the constituents are found to be all stable, then the effect concentrations (e.g. ECx or NOECo) can be based on the nominal concentration of the mixture. But, in case the constituents have different degradation patterns during the test, then the recommendation for single substances to base 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. Bigonzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, M. Fuart-Gatków, M. Pavan, S- IN Soluzioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

Natural complex mixtures: Ecotoxic behaviour, what we know and what is not directly applicable to mixtures. The first issue is related to the physical state leads to further difficulties for ecotoxicity testing: they were (mostly) complex as EO but their composition was mostly unknown and their fragrances.

TH283 Deriving USEtox aquatic freshwater toxicity Effect factors from OpenFoodTox database (EFSAs) using R-Studio program

E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Bigonzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, S- IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs; J. Rivera, A. Barret, C. durou, CEHTRA SAS / Ecotoxicology and Risk Assessment

Natural complex mixtures: Ecotoxic behaviour, what we know and what is not directly applicable to mixtures. The first issue is related to the physical state leads to further difficulties for ecotoxicity testing: they were (mostly) complex as EO but their composition was mostly unknown and their fragrances.

TH284 Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?

R. Samsera, CEHTRA SAS; N. DELPLT, Laboratoires des Pyrénées et des Landes; P. Bicherel, KREATiS; J. Rivera, A. Barret, C. durou, CEHTRA SAS; P.C. THOMS, CEHTRA SAS / Ecotoxicology and Risk Assessment

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, the number of chemical classes presented for testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals fall under multiple categories: natural, synthetic, monoisocutent, multiconstituent or considered as UVCBS. One group of chemicals 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, resins 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) solid, 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, resins, concretes and everything in between) to optimize our testing strategies for such compounds. We will present our hypothesis and overall conclusions on the probable next steps for these complex substances.
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 mean with standard deviation and count of species as well as count of SSD group for each chemical. Acute 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 stress from food contact materials K. B. de Zwart, DdZ Ecotox / Centre for Sustainability, Environment and Health; J. van Gils, Pollution Control Agency / Environmental Outcomes; J. L. J. Weigelt, Southern California Coastal Water Research Project / Toxicology; N. Vinas, US Army Engineer Research and Development Center; A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; E.M. Curran, University of St. Thomas; C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; M.L. Ferrey, Minnesota Pollution Control Agency / Environmental Outcomes

TH285 A unique index to characterize the global noxiousness of stable and radioactive substances for both human health and ecosystems K. de Bie, EFCE Foundation; M. Baas, Delft University of Technology; J. van Gils, 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 Meent, Association of Retired Environmental Scientists ARES / Environmental Science; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health Status reports of the Water Framework Directive suggest many cases of non-compliance according to formal criteria for Good Ecological and Good Chemical Status as well as for River-Basin Specific Pollutants. This signals problems for both the assemblages of species and the functions we try to protect. Multiple stressors, including 100k chemicals and their mixtures, are the causal agents. In the FP7 project Solutions, a modelling train is developed with the purpose to support derivation of water quality management plans that provide best value for money regarding chemicals and their mixtures, i.e., help to identify the largest potential risk reduction per euro spent. Thereby, the challenge is to focus on those chemicals that matter most, which can result in prioritization to sites (where are largest impacts to be expected), to times (when are largest impacts to be expected, e.g., crop-growing season & pesticides), to affected species groups (which species (groups) are most sensitive to the present impact) and to 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 integrated modeling. In SOLUTIONS, the modeling train is used to result in complex chemical footprints (ChFs). 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 extends the potential transfer of risk from one catchment to another by including 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 is 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.
the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessments, and 2) where in situ chemical and bio-effects data are integrated directly (without the prior knowledge of toxicity of individual chemicals). Samples from 50 randomly selected locations in Minnesota were analyzed for 146 chemicals of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, N=70). Site 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 expression of pro-hypoxia receptors; their predicted chemical initiators were bisphenol A, caffeine, carbamazepine, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but iopamidol (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signaling. Collectively, and also toxicity is a gasoline component of unburned cars. These three health-guideline 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. Hadjamberdiev, Toxic Action Network Central Asia; Chief Scientific Officer; A. Rospokova, Asian Medical Institute named Tentishev; Y. Didenko, Asian Medical University named Tentishev; I. Kniazev, Asian Medical Institute named Tentishev; B. Hadjamberdiev, Toxic Action Network Central Asia.

We study the radioactive and toxic wastage health impact: in areas of tailings and mines, total radioactive waste from the mining and processing of the uranium, DDT and obsolete gasoline. The overall aim of the study is to identify the human health status of the people living near the tailings area of Uranium, DDT and obsolete gasoline. The study was conducted in 3 tailings (high concentration cost), in Uzbekistan 11 tailings and mines. Total radioactive wastage volumes 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, air pollution is a gasoline component of unburned cars. These three health-guideline 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.

**TH290**

**Evaluating HPC ingredients in WWTPs & surface water 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 IURC-PTS, in the Songhua catchment (China) undertaken from June-July 2017, sampling WWTPs and watersheds. The results were used to parameterize the hydrobasins and助攻 model overpredicting concentrations for most ingredients. Modelling 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:** Our combined modelling and monitoring approach is advantageous for assessing exposure, as monitoring data can be used to evaluate model predictions and refine parameterization 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. chemical, 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**

1. sabater, CSIC-IDAEA / Department of Environmental Chemistry; A. Ginebreda, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; O. Pereda, University of the Basque Country; F. Romero, ICRA Catalan Institute for Water Research; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry.

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, which depend on the nature and magnitude of the stressor. 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 54 days, followed for 22 days of recovery. 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 parameters (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 balance and the final return to equilibrium. **Acknowledgements** - The research leading to these results has received funding from the European Communities 7th Framework Program under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua.

**TH292**

**Risk assessment of chemical mixtures in the Erft river basin**

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The objective of this study was to identify the human health status of the people living near the tailings area of Uranium, DDT and obsolete gasoline. The study was conducted in 3 tailings (high concentration cost), in Uzbekistan 11 tailings and mines. Total radioactive wastage volumes 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, air pollution is a gasoline component of unburned cars. These three health-guideline 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.
explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, WWTPs increased mixture toxicity in the receiving surface waters. For most samples highest SUM TU could be calculated for macrophytes and algae. As a substance highly toxic for algae Triclosan generated high TU. It was detected in nearly all WWTP effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be a possible risk for the aquatic organisms. In waterbodies strongly influenced by WWTP discharges 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 (contribution 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
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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 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 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 chemical 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 210). To take in consideration the complexity of the mixture, binary mixtures was used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicated interaction between the contaminants in *D. magna* and *D. rerio*.

TH294 Mixtures effect of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
C. Jonander, University of Gothenburg; I. Dahlöf, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

In coastal and oceanic environments mixtures 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 (SDS) were among the highest risk substance (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 death/live 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 (SDS) and 0.32 µmol/L (DBP), respectively. The combination of structural end points as well as taxonomic experiments are currently (Nov. 2017) ongoing and will be presented on the poster.

TH295 Analysis of the mixture Toxicity Burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef
E. Spilsbury, University of Gothenburg / Dept of Biological and Environmental Sciences; M.S. Warne, Coventry University / Centre for Agroecology, Water and RESilience; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2300km along the coastline in north-eastern Australia. A total of thirty-five major river basins discharge to the GBR and many transport large loads of pesticides, suspended sediment, 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 the pesticides on the riverine environments and to the GBR we analysed the risk posed by the individual pesticides and their mixtures. Australia currently does not have water quality guidelines for 17 of the 38 pesticides detected. For those, we calculated ecotoxicity thresholds using a simplified version of the Australian methodology for determining water quality guideline values, based on species-sensitivity distributions. In all rivers, multiple pesticides were routinely recorded and concentrations were higher than their levels 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. 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.
Economies.

TH297 Effect of antibiotic mixtures on the growth of Anabaena flos-aquae
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Antibiotics can be released to the environment, following use in both human and veterinary medicine. As a wide range of antibiotics active ingredients are in use, the natural environment will be likely exposed to mixtures of these compounds. The environmental risks of these mixtures are however not well understood. In this study, the toxicity of single and mixture of six major human antibiotics from different classes; amoxicillin (AMO), oxytetracycline (OXY), clarithromycin (CLA), meropenem (MER), ciprofloxacin (CPO), cephalaxin (CEP) to the blue green algae, Anabaena flos-aquae was assessed. All antibiotics showed high toxicity to the cyanobacteria with EC50 concentration ranging from 0.001 to 0.08 mg/L (CLA, 0.001 mg/L; CEP, 0.003 mg/L; CPO, 0.008 mg/L; OXY, 0.008 mg/L; MER, 0.02 mg/L and AMO, 0.03 mg/L). Use of these toxicity data alongside predictions of surface water concentrations, using simple models, resulted in risk characterisation ratio values of 30.2, 2.5, 2.4, 1.9, 1.4 and 2 for AMO, OXY, CLA, MER, CIP and CEP respectively, suggesting that five of the six compounds may be adversely affecting the aquatic environment. The mixtures toxicity studies are ongoing but up to date data available; these will be used to evaluate the concentration addition (CA) and independent action (IA) for estimating the mixture toxicity. The best performing model will then be used alongside exposure modelling approaches to explore the risks of mixture for different scenarios.

TH298 Exposure to mixtures of Persistent Organic Pollutants (POPs) can inhibit the transactivation activities of Aryl hydrocarbon Receptor (AhR) in vitro
Q.T. Doan, Université de Liège (ULiege) / Département des Sciences des Denrées alimentaires; M. Muller, University of Liège / GIGA-R. Laboratory for Organogenesis and Regeneration; H. Berntsen, NMBU-School of Veterinary Science / Department of Production Animal Clinical Sciences; K.E. Zimmer, NMBU-School of Veterinary Science / Department of Basic Sciences and Aquatic Medicine; S. Verhaegen, E. Ropstad, NMBU-School of Veterinary Science / Department of Production Animal Clinical Sciences; L. Connolly, Queens University of Belfast / Institute for Global Food Security, School of Biological Sciences; M. Scippo, University of Liège / Department of Food Science, FARAH. AhR is a key receptor involved in an organism’s response to POPs as xenobiotics. In this study, three different luciferase reporter cell lines (rat hepatoma H4IIE, human mammary gland carcinoma T47-D and human hepatoma Hep G2) were used to screen AhR transactivation activities (i.e. agonistic and antagonistic) of 29 compounds listed as POPs under the 2001 Stockholm Convention. Their mixture, prepared according to the same proportional concentrations found in human blood, was also tested for the same activities. We show that these compounds have species- and tissue-specific effects and that the rat cells DR (Dioxin responsive)-H4IIE are more sensitive than the two human cell lines (DR-T4-D and DR-Hep G2). Only 6 out of them showed AhR agonistic activities. PBDE-153, PBDE-154, PCB-138, and PCB-118 were able to activate the AhR in H4IIE cells only, γ-ICH was active in DR-T4-D only, while PBDE-99 was found to be an AhR agonist in both cell lines. No agonistic effect was seen for DR-Hep G2. In contrast, 19 out of the 29 compounds showed AhR antagonistic activities in DR-H4IIE, while 10 and 6 compounds displayed AhR antagonistic activities in DR-T4-D and DR-Hep G2 cells, respectively. Not surprisingly, the mixture of the 29 compounds also showed an AhR antagonistic action in all cell lines. In H4IIE, AhR inhibition was observed with concentrations of the POP mixture corresponding to 75 times the blood level and above, which could be plausibly reached in humans after a food contamination incident. The IC50 for the POP mixture was 262.6 ± 104.6 times the background blood level, which corresponds to an interpolated antagonistic equivalent of 0.165 µM BDE-47, while only 0.0047 µM BDE-47 presents in the mixture at the IC50 level. In addition, the isobologram coefficient of the mixture is 0.3 ± 0.1 according to additive mixture effect model. This indicates that AhR antagonistic effects are significantly enhanced in real mixtures.

TH299 Ecotoxicity of biofuel-mixture DnBene and 1-Octanol on aquatic organisms
Daniao rerto and Daphnia magna
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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 DN-n-betyl ether (DnBE) (20%). These fuels are based on the raw material lignocellulose and are neutral-oxidative. However, their effect on single mixture induces no risk of thinning, especially for aquatic ecosystems. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction of the two substances. Acute embryotoxic and developmental effects were investigated in the fish embryo toxicity test (FET) with Daniao rerto (OECD 236). The acute immobilization assay (OECD 202) was performed to determine the LC50 of this mixture. To interpret the results for possible interactions between the two substances, the investigation of DnBE and 1-Octanol as single substances was necessary. In the acute immobilization test, the EC50 values were 14.7 mg/L for 1-Octanol and 17.3 mg/L for DnBE. Both biofuels led to teratogenic and lethal effects in the FET (LC50, DnBe: 24.7 mg/L; LC50, 1-Oct: 11.3 mg/L). Especially in the study of DnBE was a low hatching rate, while embryos were often observed at the pericardium of the developing 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-methylfurran, 2-methylylhydrofuran) showed a higher toxicity of the mixture. DnBe showed a higher toxicity on D. magna than the tested mixture. For the comprehensive ecotoxicological assessment of the mixture and the compounds as single substances further tests are required. Especially regarding to the possible impairment of the hatching of D. rerio. Preventing of slippage can cause the larvae to be no longer viable, resulting in a misinterpretation of the detected LC50. In future, further ecotoxicologically relevant endpoints should be investigated. This work was performed as part of the Research Cluster "Environmental Chemoecology" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TH300 Single and combined effects of propiconazole and ZnO (bulk and nano form) on various biomarkers and reproduction in Enchytraeus albidus
N. Ćurčić, . Lonńarḯ , University of Osijek / Department of Biology; D. Hackenberger, Department f Biology, University of Osijek / Department of Biology; L. ZeliDŽ, University of Osijek / Department of Biology; B. Hackenberger, Department f Biology, University of Osijek / Department of Biology
This study focuses on the ecotoxicological evaluation of this mixture and there compounds as single substances further tests are required. Especially regarding to the possible impairment of the hatching of D. rerio. Preventing of slippage can cause the larvae to be no longer viable, resulting in a misinterpretation of the detected LC50. In future, further ecotoxicologically relevant endpoints should be investigated. This work was performed as part of the Research Cluster "Environmental Chemoecology" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TH301 Mixture toxicity of abamectin and difenoconazole to zebrafish embryos (Danio rerio)
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There are many agrochemicals used in agriculture, among them the insecticide abamectin and the fungicide difenoconazole. They are widely used compounds in strawberry cultivation and the fungicide difenoconazole is often used as a combination with propiconazole as well as the effect on reproduction. This study presents an investigation of DnBE and 1-Octanol as single substances further tests are required. Especially regarding to the possible impairment of the hatching of D. rerio. Preventing of slippage can cause the larvae to be no longer viable, resulting in a misinterpretation of the detected LC50. In future, further ecotoxicologically relevant endpoints should be investigated. This work was performed as part of the Research Cluster "Environmental Chemoecology" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.
inherent to the use of the insecticide abamectin and the fungicide difenoconazole, the main objective of this research was to evaluate the effect generated in Danio rerio embryos exposed to pesticide mixtures and evaluate the effects produced by the interaction of these compounds. For this, Danio rerio embryos were exposed for 96h to the binary mixtures of abamectin and difenoconazole following the recommendations of OECD TG 236. The concentrations used were 0.5; 1.1; 2.4; 5.3 and 11.7 mg L⁻¹ of abamectin and 0.2; 0.5; 1.0; 2.3 and 5.0 mg L⁻¹ of difenoconazole. The factorial design was used to study 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 software. It was observed 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 mixtures. Similar results were obtained for mixtures with different proportions, especially exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

**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 was adopted, focusing 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 (CEENE) method. First results show that the unit operations with the highest impact are: i) The first chromatographic process for purification (Direct Product Capture), since it requires the highest quantity of buffers which are produced using chemicals as well as complex organic compounds such as amino acids. ii) Fermentation, as similar complex components are required for its medium, which are also produced through biotechnological processes. Furthermore, fermentation is the process that takes the longest (several days), leveraging the Heating Ventilation and Air Conditioning (HVAC) system to achieve the clean room conditions needed for the production of biologics. HVAC has shown to be the utility with the highest impact, consuming a significant percentage of the total electricity used in the plant. Performing an LCA on a biologic mainly using primary data has been proven to be a possible task. However, challenges such as the data unavailability of biotechnologies used to produce the nutrients needed throughout the process, as well as the further integration of these technologies into databases should be addressed.
Cavani, Toso Montanari Department of Industrial Chemistry, University of Bologna / Dept. of Industrial Chemistry; P. Mizsey, D. Fozer, Budapest University of Technology and Economics / Department of Chemical and Environmental Process Engineering

The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results accessed 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-octane and p-xylene; Friedel-Crafts 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 assessment of the scenarios, a simulation of the scenarios 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, residing in an application in each eco-scenario. LCA can evaluate the environmental weight associated with the entire life cycle of a product, in our case 1 ton of terephthalic acid. The model was developed using 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, resident of an applicative ins in each eco-scenario, LCA can real the evaluation with VFB systems. Especially the innovative concept of extruded graphite composite bipolar plates leading to large-area electrodes (about 2.7 m²) paves the way to megawatt applications. Thus, a sharp increase in research and development may be observed in the last decade with strong efforts towards cost-effective VFB systems [1]. In a holistic approach besides of technical optimization and economic feasibility, the environmental impact of the whole system is also considered. For this reason, the manufacturing process of sustainable VFB systems has to be assessed. A research gap on environmental assessment of VFB has been identified. The most cited LCA has been published in 1999 [2]. To date the VFB technology has been further developed and commercialized. Based on preceding detailed studies on the production of VFB components and systems an update of their environmental assessment with primary LCA data is developed [1]. A focus is set on the potential for recycling of battery components at their end of life. In a recent study it has been quantified for a small 5 kW-4 kWh-VFB-system with only 18wt.-% associated with a potential of 16% ecological impact reduction by recycling [3]. In the present study recycling paths for all VFB components are assessed in detail considering substantial differences in design of small systems for residential and large systems for industrial applications (megawatt-size). 1. Minke C, Kunz U, Turek T (2017) J Power Sources 361: 114–121. 2. Rydahl JF (1999) J Power Sources 80: 41. 3. Unterreiner L, Jülch V, Reith S (2016) Energy Procedia 99: 229–234.

**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/milli-flow 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/milli-flow (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 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, namely LFP (LiFePO₄), CuO and PbO₂. 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 potential impacts of Cu, LFP (LiFePO₄) and NMC (Ni-Mn-Co) nanoparticles on the environment as compared to their equivalent 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 up-scale to pilots at SMEs and industry facilities. This project is co-financed by European Union under The Framework Programme for Research and Innovation HORIZON 2020. The project is developed by 10 different partners, where LEITAT is in charge of the Life 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 characterized for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks comparative, and results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu inks. A Hotspot analysis represents the impact category due to LFP production. 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**

A. Claré, LEITAT Technological Center / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE / LEITAT TECHNOLOGICAL CENTER / Sustainability Division

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, namely LFP (LiFePO₄), CuO and PbO₂. 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.

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A. Claré, LEITAT Technological Center / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE / LEITAT TECHNOLOGICAL CENTER / Sustainability Division

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, namely LFP (LiFePO₄), CuO and PbO₂. 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 and a detailed process looking for high performance materials but environmentally friendly. Some improvements are being made such as: use of aluminium instead of silver in the mirror reflective coating, to meet the European requirements for use of non-critical materials; the reduction of materials weight; and the increase in materials robustness. The expected results are to: Obtain a complete environmental profile of IN-POWER CSP architecture. Calculate the environmental impacts associated to: new polymeric materials for mirrors; higher 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 Eisenzen, Austria. The case of RICAS2020 PROJECT.
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European society has a highly dependency on electric power. In 2009 European Union fixed that at least 20% of EU gross final energy consumption have to come from renewable energy sources until 2020. The increasing use of renewable energy sources to produce 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, by combining 3 excavations techniques 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
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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 using 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 that consists of a new wastewater treatment scheme, i.e., (i) a first stage of enhanced biological phosphorus removal with struvite recovery and (ii) a second stage of autotrophic biological nitrogen removal in two-steps. A life cycle assessment will determine the environmental impacts and benefits of this upgraded system with respect to the conventional setup. Policy tradeoffs will also be assessed. This wastewater treatment plant originally benefited from cogeneration, but eventually decided to use biogas flare systems due to the taxes on self-supply of electricity imposed by the Royal Decree 900/2015 approved by the Spanish Parliament. As a result, we need to determine if applying technologies that generate more biogas will result in larger impacts than the current scenario if the biogas cannot be used for cogeneration.

TH314

Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for greenhouse glass
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Technological innovation is crucial for 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 technological innovation using an explorative approach. Here, we show the application of Anticipatory LCA in the assessment of the anti-reflective greenhouse glass coatings. The light intensity is essential for the crop growth in the greenhouses. A portion of the light is lost when it reaches the greenhouse glass due to the glass reflection. The anti-reflective glass coatings can be applied on the surface of the greenhouse glass to allow more sunlight to enter the greenhouses. As a result, more yield of crop could be obtained under coated glass. The Netherlands Organization for Applied Scientific Research (TNO) is developing a novel anti-reflective coating for greenhouses which is expected to have higher light transmittance than the conventional coatings by 2.5%. In this study, three reference coatings in addition to the novel coating were assessed. The functional unit was the mass of tomatoes obtained under a certain area of the greenhouse with uncoated/coated glass during 30 years. The novel coating is being synthesized in the laboratory scale, and thus, in LCA, What-if scenarios were used to scale-up the coating system to pilot and industrial scales. The laboratory parameters, e.g. the amount of electricity used to produce the coating and the solution volumes, were optimized using literature and expert consultation. The comparative analysis comparing the conventional and the innovative coatings, and this could be due to the simplicity of the coating method applied by TNO. Also, it was revealed that the coatings do not bring significant environmental benefits rather they bring economic benefits in terms of increased yield of tomatoes. Finally, the sensitivity analysis showed that electricity used for the production of glass has higher impacts than transmitsance or degradation time of the coatings.

TH315

Combine process simulation analysis with Life Cycle Assessment method in polyurethane rigid foam production
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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 algorithms and mathematical models to predict the outcomes of the process, as well as in the process optimization stage, where the optimum value of the process variables is sought. The process of process simulation is an important tool for understanding the potential of a process and for designing new processes.

In this work, we present the process simulation of polyurethane rigid foam production from cradle to grave in tight connection with process simulation methods, thus understanding the characteristics of the process, 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
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As a way to address the climate-related CO2 emissions from fossil fuel power plants, photocatalytic methanol production using a novel form of CO2 conversion process has been investigated within the research project “Low Carbon Fuel”. The primary goal of this study is to evaluate the environmental performance of photocatalytic CO2 reduction in comparison to conventional fossil-based technologies for power generation and methanol production. Life cycle assessment (LCA) is used to determine and compare the environmental performance of the methanol production systems. In the LCA study, cradle to gate system boundaries are used because the downstream processes and properties of methanol are similar for CO2-based and fossil-based systems. Since the main environmental motivations for methanol utilisation are reducing CO2 emissions and establishing an alternative carbon source, this study compares the CO2-based and fossil-based methanol production systems with respect to global warming and fossil resource depletion. The CO2-based methanol production system consists of the following three stages: CO2 source including CO2 capture, electricity compensation, and CO2 utilisation for methanol production. The fossil-based methanol production system serves as benchmark and is divided into electricity generation and fossil-based methanol production. The main functions of the CO2-based and fossil-based systems and their environmental impact are quantified using the Ex-IO analysis method and compared, based on life cycle assessment. Our analysis reveals that CO2-based methanol production system using photocatalytic CO2 conversion is not always mandatory to achieve CO2-based system with lower environmental impacts than the fossil-based system. However, CO2-based methanol production has the potential to reduce impacts for global warming and fossil depletion if the energy intensities per unit of energy intermediates and steps are decreased, compared to the corresponding fossil-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

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, both alone and in combination, and their potential effects on larval development and survival. The results demonstrated that 3.5-DCP caused concentration-dependent effects in chloride and mitochandria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorphylls content, reproduction rate and final size were more sensitive to 3.5-DCP compared to other responses as well as reactive oxygen species (ROS) formation, lipid peroxidation (LPO) and impairment of photosynthesis efficiency. Principal component analysis (PCA) indicated that suppression of photosystem II (PS II) efficiency, electron transport rate (ETR), ROS production and LPO, pigments content and growth were strongly correlated while inhibition of oxidative phosphorylation (OXPHOS) which was more closely correlated with growth parameters. A set of conceptual Adverse Outcome Pathways (AOPs) were developed by using Bayesian network model to decipher the causal relationship between exposure and endpoints. This study may occur in L. minor to form a basis for future studies with similar compounds.

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TH319

Development of adverse outcome pathways for oxidative stressor-mediated reproductive effects in aquatic invertebrates

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Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous antioxidative defenses. Environmental stressors and pollutants that damage DNA, protein and lipids can be damaged by ROS through oxidation and peroxidation, thus leading to diverse types of adverse effects, such as growth arrest, developmental abnormalities, reproductive failure and lethality. A wide range of oxidative stressors such as ionizing radiation, ultraviolet (UV) radiation, metals and organics are known to induce oxidative stress. The consequences of oxidative stress have been well studied in vertebrates, especially mammalian species. However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs based on a combination of literature survey and in silico predictions; evaluate the key events in the AOPs and develop forecasting models for ROS; simulate AOPs using the forecast species Daphnia magna. An extensive literature survey to collect existing knowledge on ROS-mediated reproductive effects in aquatic invertebrates, and metals, ionizing and non-ionizing radiations as prototypical stressors. A network of conceptual AOP 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 excessive ROS production, lipid peroxidation, DNA damage, apoptosis, mitochondrial depolarisation, impairment of AOXI (oxidative stress resistance) and AOXII (oxidative stress tolerance). However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited.

TH320

Development of an Adverse Outcome Pathway for cardiotoxicity mediated by the blockade of L-type calcium channels

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A diverse set of chemical compounds, including some pharmaceuticals and...
insecticides, have the potential to perturbate the functionality of calcium channels. Among the different types of calcium channels, the L-type calcium channel (LTCC) is responsible for the excitation-contraction coupling of skeletal, smooth, and cardiac muscle. Chemicals that unintentionally block this channel in cardiac cells may impair heart function and health, leading to various cardiac pathologies and predisposing individuals to heart failure. Advancing our understanding of the mechanisms underlying these adverse effects is of paramount importance if we want to develop effective strategies able to accurately predict the cardiac risk posed by chronic exposure to those chemicals. In this presentation, we describe the development of an Adverse Outcome Pathway (AOP) that outlines the series of causally related key events triggered by the blockade of LTCC, and that can ultimately lead to cardiac adverse effects. We discuss the integration of *in silico*, *in vitro*, and *in vivo* evidence to support the AOP development, as well as the application of computational and network biology approaches that may accelerate the identification of relevant key events. Considering the multifaceted role of LTCC in different components of the cardiovascular system other than the heart, we also discuss the importance of applying AOP network considerations to guide a reliable and fit-for-purpose AOP development. This AOP will represent a valuable knowledge base able to guide the identification of key events that are highly predictive of *in vivo* toxicity, and that can be measured *in vitro* without relying on animal testing. The knowledge base will also be used as platform to drive future development projects aimed at incorporating additional layers of complexity in the model, and at driving the transition towards a fully quantitative AOP able to effectively support regulatory decision-making and risk assessment.

**TH321 Quantiﬁcation of AOP by Bayesian network modelling: linking 3,5-DCP exposure to adverse outcomes in Lemma minor**

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AOPs have gained international recognition as a systematic approach for capturing existing toxicological knowledge to transparently link mechanistic data to toxicity endpoints. Nevertheless, most AOPs are qualitative and not directly suitable for quantitative risk assessment. Quantitative AOPs (qAOP) should define the relationships underlying transition from one KE to the next sufficiently well to allow quantitative prediction of the probability or severity of the AO occurring for a given activation of the MIE. We have started developing a Bayesian Network (BN) model to quantify a recently proposed AOP, which links the mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol (DCP) to adverse outcomes in the aquatic plant Lemma minor. The BN model is based on data from a laboratory experiment exposing *L. minor* to DCP in 8 concentrations with 3 replicates. The measured response variables include OXPHOS (oxidative phosphorylation), ROS (reactive oxygen species), ETR (electron transfer rate), Fv/Fm (maximum quantum yield of photosystem II), LPO (lipid peroxidation) and number of fronds (leaves). The proposed AOPs a network consisting of three chains with the same chemical stressor (DCP) and AO (fronds number). All AOP components are defined in the BN as nodes with discrete states. Each node is quantified by a probability distribution across these states. The causal links (Key Event Relationships) are quantified as conditional probability tables (CPTs), which determine the probability distribution of a child node conditionally on the probability distribution of the parent node(s). The CPTs are calculated directly on the data. The blocks can then be used in silico to predict causally related key events triggered by the blockade of LTCC. The CPTs are calculated directly on the data. The BN was developed using the BNT toolset of the GeMS platform.

**TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effectopedia**

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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 Cytotoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelial cell (Beas2B). Beas2B cell was exposed to CMT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis lead 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. Acknowledgment: This work was supported by a grant from the Korean Ministry of Environment through ‘Environmental Health R&D Program’ (2017001370001).
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: tachykynin 3a and tachykynin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (for the inhibitory neurotransmitter GABA and various drugs), synaptogatinum 10 (integral membrane protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelinization 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 tachykynin 3a and tachykynin 3b, GABA a1 receptor and synaptogatinum 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream from the sewage discharge, but this gene expression was significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603477.

**MOPC02**

Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model

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The alcohol 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 overpass the availability of some elements for the plants. 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 waste water from different sources. Aquatic macrophytes, which not only accumulate pollutants directly in their tissues but also enhance the breakdown of organic material, are very effective catalysts for detoxification reactions that usually, occur in the rhizosphere of plants, they 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 (*Gobiodes broussonnetii - Gobidia*) from one of the most productive estuaries in Brazil

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The Paraná–Paraguay–Paranapanema (São Paulo–Cananéia–Iguape –near Cananéia, 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 (*Gobiodes broussonnetii - Gobidia*) 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. broussonnetii* the studied area. Fishes were sampled near Cananéia, Subaúma and Iguape in winter (2016) and summer (2017). The animals were anesthetized, 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 hepatic and renal GPs and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxic effects (the mutation and chromosomal aneuploidy). The contaminants may interfere in the cytochrome P450. The expression of anachorotic 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 biomarkers

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The Aachen Water Fractions project is an 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 in the city of Aachen (North Rhine-Westphalia, Germany) and releases its effluent to the Stream Wurm. At medium and low water levels the stream runs around 70 % treated waste water. To elucidate the impact of the additional waste water treatment on this river the *status quo* was recorded before the implementation of this treatment step. After the installation of the ozonation the WWTP as well as the Wurm will be monitored for two years. Besides numerous *in vitro* and *in vivo* experiments also *in situ* conditions will be considered. The caging experiments with juvenile rainbow trout (*Oncorhyncus 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 water 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, micronucleus 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 Soest” 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
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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, in particular pesticides, have been identified with in vitro models. Two key studies identified 66/200 and 37/134 pesticides tested as anti-androgenic. However, due to the absence of medium-throughput in vivo assays for androgen axis disruption, the effects of many of these pesticides have yet to be confirmed in vivo. We developed a transgenic medaka line harbouring a portion of the spg110 gene promoter driving expression of GFP. We have previously demonstrated that this line is capable of correctly identifying androgens and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic life stages we developed the Rapid Androgen Disruption Adverse outcome Reporter (RADAR) assay. Extracts of Danube River water from sites upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia was analysed. Comparison of our results to previously published data from four in vitro assays carried out on the same extracts indicated that the effect observed in vivo was two orders of magnitude higher than the in vitro effect, suggesting additional mechanism(s) of action present in vivo in addition to androgen receptor activation indicated by the in vitro assays. Application of the RADAR assay for effect-directed analysis was demonstrated for the rapid in vivo confirmation of androgenic 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 to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput test 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 (Oncorhyncus mykiss) and liver cell line RTL-W1
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New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (PC)

MOPC07
Optimization and Automation of Raman Microspectroscopy for Microplastic Analysis
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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) and nanoplastics (NP) have been identified as a major environmental concern. 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.

MOPC08
Preparation of model small microplastics and nanoplastics
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Pollution with plastic debris and plastic fragments has recently been recognized as a major water quality problem in fresh and marine water systems. Degradation of plastic debris in the marine environment leads to the formation of microplastics (5-500 µm) and potentially nanoplastics (< 1 µm). Recent investigations show that the microplastics can interact with the marine biota. The impact of the interaction on the exposed organism depends on the nature and size of the particles. To acquire more knowledge on these impacts and to optimize analytical procedures, model particles of different sizes and nature of polymers are necessary. However, in the smallest range (< 10 µm), particles of only a few types of polymers are currently available. For this reason, most toxicity tests were realised using PS beads whereas polyethylene (PE) and polypropylene (PP) fragments are by far the most common in the aquatic environments. In addition, commercial micro and nanobeads have surfactants at their surface which may enhance their toxicities. Here, we present a simple methodology that allows one to prepare small microplastics of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE pellets in toluene at high temperatures that was then emulsified in water and ultrasonicated. After removal of the solvents particles were recovered as powders that could be re-dispersed in water. Besides providing particles of small size, the advantage of the presented methodology is that it is possible to produce these particles without any surfactant. However, to obtain significant yields it is necessary to add a surfactant. Several types of surfactant were tested (Tween60, Tween80 and a biosurfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed. These
particles are currently used to optimize strategies of identification by Raman microscopy for particles smaller than 1 µm.

MOPC09 Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
S. Huppersberg, V. Zilles, Hochschule Fresenius University of Applied Sciences; T. Kocher, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology

Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradability allows plastic as a vector for accumulation of plastic particles in the environment. Plastics can be found in various sizes in the environment, large items were found as well as small particles or debris, which are referred as microplastic (MP) in a size range from 5 mm to 1 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 adsorption of soluble components are factors affecting the sorption of MP-particles. (I) Huminic substances are a complex mixture of breakdown products of biologic matter, representing about 50% of dissolved organic in surface waters. 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 majority of them sorbs to sediment which is present in excess. The results of this study should provide a tool for predicting sorption behavior of MPs in environmental freshwater samples. Therefore, different parameters presumably affecting the sorption were investigated or are still under investigation to identify their impact on the sorption of organic pollutants in freshwater systems.

MOPC10 Micronized tire rubber: abundance and distribution within microplastic litter of the Charleston Harbor Estuary, South Carolina, USA
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Microplastics (2are present on shorelines worldwide. A previous survey of Charleston Harbor, South Carolina, USA reported an average of 591±103 microparticles/nm² 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 microplastics, 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 microplastics, three major tributaries of Charleston Harbor—the Ashley River, Cooper River, and Wando River—were surveyed. Intertidal sediment (n=6), subtidal sediment (n=3), and sea surface microalgal samples (n=3) were collected from three sites (upstream, midstream, downstream) along each of the rivers and were analyzed for microplastics (63-500 µm). Intertidal sediment microplastic abundance ranged from 3-4375 particles/kg wet weight. Sea surface microalgal abundance ranged from 3-36 particles/L. Microplastic abundance in intertidal sediments and subtidal sediments differed significantly among rivers (p<0.0001 (intertidal), p=0.02 (subtidal)), while microplastic abundance in the sea surface microalgal did not differ significantly among rivers. Blue microplastic fibers and micronized tire rubber were present in the human urinary sediments and microplastics observed, constituting 26.2% and 17.1%, respectively, of total microplastics collected. Furthermore, micronized tire rubber was collected at every sampling location and in every environmental sample type (intertidal sediment, subtidal sediment, sea surface microalgal). These results suggest that microplastics in Charleston Harbor originate primarily from non-point sources and that micronized tire rubber is a significant contributor of microplastic litter in Charleston Harbor. These results are the first to report on the abundance and distribution of micronized tire rubber as microplastic litter in a southeastern U.S. estuary and contribute to the understanding of the worldwide environmental presence of micronized tire rubber.

MOPC11 Crumb rubber in sports fields - Advances in environmental chemistry
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Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
S. Huppersberg, V. Zilles, Hochschule Fresenius University of Applied Sciences; T. Kocher, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology

Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradability allows plastic as a vector for accumulation of plastic particles in the environment. Plastics can be found in various sizes in the environment, large items were found as well as small particles or debris, which are referred as microplastic (MP) in a size range from 5 mm to 1 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 adsorption of soluble components are factors affecting the sorption of MP-particles. (I) Huminic substances are a complex mixture of breakdown products of biologic matter, representing about 50% of dissolved organic in surface waters. 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 majority of them sorbs to sediment which is present in excess. The results of this study should provide a tool for predicting sorption behavior of MPs in environmental freshwater samples. Therefore, different parameters presumably affecting the sorption were investigated or are still under investigation to identify their impact on the sorption of organic pollutants in freshwater systems.

Environmental Technology
In Norwegian coastal communities, rubber microplastic granules (≤ 5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the composition, degradability and ecotoxicological impacts of these rubber granules from locations in northern Norway and Svalbard. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wild life through direct ingestion, especially at the base of the marine food chain, but may also provide an exposure route for toxic additive chemicals present in tires to marine organisms. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants already present in the marine environment. Arctic marine environments present special abiotic conditions for the degradation of these particles, with cold water temperatures and long periods with unlimited sunlight. During a 12 months period, rubber crumbs were placed out in the ocean in stainless steel containers and sub-sampled continuously for the measurement of persistent organic pollutants, metals and additives. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, bisphenols, 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 pyroGC/MS, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure to demonstrate the detection of nanoparticles in environmental matrices we analysed samples obtained from the north 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 nanoparticles samples from marine but also all other environments.

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

MOPC12 Nanoparticles analysis with Nano-FTIR
M. Meyns, Alfred Wegener Institute; S. Primpke, G. Gerpts, Alfred Wegener Institute / Polar Research Institute Shelf Sea Systems

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 10³ kg⁻¹ for particles with diameters of 0.5 µm. This circumstance raises concerns as particles may be found in 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 nanoparticles in environmental matrices we analysed samples obtained from the north 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 nanoparticles samples from marine but also all other environments.

MOPC19 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 project was to identify the concentration 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 Polyfam Organic Chemical Integrative Samplers (POCIS) was the principal monitoring technique. To correct for the effects 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 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. Statistic, 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 and an Agilent 1100 HPLC. Nine NNIs were detected, but the concentrations varied widely from 2.5 to 4.6 μg/L. Fluorinated compounds were 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

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This study provided the first and comprehensive data on the occurrence and removal of twenty-one target antibiotics and antinicrobials 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 E2s 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 time. The elimination of antibiotics and antinicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antinicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIPX), clindamycin (CLI), azithromycin (AZT), clarithromycin (CLAR), oxytetracycline (OXY), trimethoprim (TMP), and sulfamethoxazole (SMX) were produced while 4 minor concentrations. Venlafaxine and carbamazepine were 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. Ziriaustu, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; M. Irazola, University of the Basque country UPV/EHU / Research Centre for Experimental Marine Biology and Biotechnology (PIE); M. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; M. Olabe, O. Zuloaga, University of the Basque country UPV/EHU / Plentzia 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 aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofilms (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 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 piperaZin ring (in 2 BPs) and the cleavage of the piperazinyl 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 piperaZin ring, also suffered the glycine conjugation. 14 of the previously observed BPs were plus 10 new BPs were annotated in water in the presence of fish. Compared to the BPs annotated in the absence of fish, oxidative deamination and both glycine and glutamine conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPRO metabolites were searched in gill-head bream liver, brain, muscle, gill, plasma and bile, BPs were only detected in bile. 5 BPs were found and none of them was detected in seawater. While defluorination and oxidative deamination gained importance in bile, neither glycine nor glutamine conjugates were observed in bile BPs. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CMT2014-56628-C3-1-R. H. Ziriaustu 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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The Ebro River Delta, located in northeastern Spain, is one of the largest wetland areas of the Mediterranean region. It is an area of high ecological and economic values, where wildlife shares the territory with intensive rice growing and other agricultural activities and seafood production. The objective of this work was to investigate the occurrence of different classes of medium to polar pesticides and transformation products in irrigation and drainage ditches at the Ebro Delta in summer, when application of pesticides is more intensive in the area, and to assess that these contaminants may have an impact on local ecosystems and seafood production activities, and eventually on human health. To this end, an analytical method based on on-line solid-phase extraction–liquid chromatography–tandem mass spectrometry (SPE-LC–MS/MS) was developed and validated for analysis of over 50 pesticides, including various neonicotinoid and organophosphate insecticides, as well as herbicides pertaining to the classes of triazines, phenylureas, sulfonylureas, miscellaneous, chloroacetanilides, acidic herbicides, oxadiazoles, carboxamides, benzothiadiazines, nitriles, dipheryl ethers, and carbamates in water. This methodology, which offers various advantages for its routine use in the analysis of medium to polar pesticides in the different water compartments, allowed the quantification of most of the target analytes at levels below 10 ng/L, and with a high reliability of results that stems from the use of an automated and highly selective analytical technique and the use of deuterated analogues of the target compounds as surrogate standards for their quantification. Benzatone followed by propanil presented the highest average concentrations in the analyzed samples, being in the μg/L level. Oxadiazon, acetamiprid, imidacloprid, and triallate were also found at
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 BESAGS (grant number: CTM2016-75857-C2-2-R), and to Merck for the gift of LC columns.

**MOPC22**
Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montagudo, University of Castilla-La Mancha; H. El-taliawy, Aarhus University / Department of Environmental Science; A. Duran, J. San Martin, University of Castilla-La Mancha; K. Bester, 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 was performed 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 S$_2$O$_4^{2-}$ (with no generation of the very effective SO$_4^-$). Sulfate and hydroxyl radicals were involved in the main reaction pathway of diclofenac. Diclofenac amide and three hydroxy-diclofenac isomers (3-hydroxydiclofenac, 4-hydroxydiclofenac and 5-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 Biogeosciences - Fate, Effects and Policy (PC)**

**MOPC23**
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks D. McLagan, University of Toronto Scarborough / Chemistry; C. Mitchell, University of Toronto Scarborough / Physical & Environmental Sciences; F. Monaci, University of Siena; Y.D. Lei, University of Toronto Scarborough / Department of Physical and Environmental Sciences; F. Wanza, University of Toronto at Scarborough / Physical and Environmental Sciences

The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce time-averaged concentration data over long deployment periods and are therefore particularly well suited for mapping gaseous Hg concentrations, identifying and locating unknown Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (GTA) in Canada and the Monte Amiata 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 at two spatial scales: a 0.56 km$^2$ square covering the eastern slope of Mt. Amiata. Both squares were divided into a 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 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.75 km$^2$ square comprising the former Abbadia San Salvatore mercury mine and a 41.6 km$^2$ square covering the eastern slope of Mt. Amiata. Both squares were divided into a grid of 7x7 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 6 2016. The coarser spatial resolution grid was sampled for an extended period from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km$^2$ square covering the eastern slope of Mt. Amiata. Both squares were divided into a 7x7 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 6 2016. The coarser spatial resolution grid was sampled for an extended period from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km$^2$ square covering the eastern slope of Mt. Amiata. Both squares were divided into a 7x7 cells and a sampling site was selected within each of the 49 cells. The results demonstrated that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as diclofenac from wastewater.
photodemia 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 cloud and precipitation frequencies and thus lead to browning of freshwaters and further inhibition to the photodemia pathway at the base of MeHg reduction.

MOPC27
Polymer inclusion membranes followed by X-ray fluorescence analysis as a new analytical method for mercury monitoring in natural waters at low concentration level

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At present, there is 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 overcoming these problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide plasticity. 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 triosicylate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were dissolved and the remaining concentration of the metal was measured by the energy dispersive X-ray fluorescence (EDXRF) system and were directly analyzed. A good correlation was found between 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 µg 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. Once Hg was extracted, they were 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 modulator of Hg bioavailability to phytoplankton

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Mercury (Hg) is a priority toxic 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 mercurial complexing by 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 Suanwannee River humic acid (SRHA) and in natural water rich in DOM from Onega Lake, Russia. Water was sampled from five sites representing the DOC gradient from River Shuya to open lake. Bioavailability was quantified by determining the adsorbed and intracellular mercury concentrations by Direct mercury analyzer on freeze-dried pellets. Concentrations of Hg in the exposure media were measured with the MERX Automated Total Mercury Analytical System. Chemical speciation of Hg in the absence or presence of DOM was computed with WHAM/model VII. The results showed that adsorbed and intracellular Hg concentrations decreased as compared with exposure in the absence of SRHA only at 0.1m Hg, when the ratio between the reduced sulfur concentration and Hg 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 DOC was found. In the DOC-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 DOC 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
Overview on the risks from fungicides for aquatic organisms

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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 organisms (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 have been observed as antimicrobial toxic mode of action when fungi are used in the aquatic risk assessment for fungicides. A toxicity database was created 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 effects and exposure duration proposed by the EFSA Antimicrobial 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 (Pimephales promelas, Oryzias latipes, Oryzias latipes 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, myxids 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 standard test species under the specific test conditions. These findings indicated a marked antimicrobial toxic mode of action of the evaluated substances was not identified.
Fungicides are used in agriculture to control fungus, such as all pesticides. They are used in the management of vegetated buffer strips. This mitigation fungicide exposure by retaining runoff water and providing sites for adorption as well as degradation. Under field conditions, however, vegetated systems can slow asymptotic and erosion rills utilizing 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 pesticide 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 hydrophobic, 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.

TUPC06 Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems?

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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 (gonad and SSD) and tier-3 (micro/mesocosms) approaches. The consistency of this tiered approach has previously been evaluated for insecticides. In the present study, results of different tiers are compared for fungicides. To this end, laboratory toxicity data and microcosm/mesocosm data were compiled from open data sources supplemented with data from confidential studies conducted for the industry. RACs for tiers 1, 2 and 3 were calculated following the guidelines described in the EFSA Guidance Document. This presentation will discuss i) the consistency of the tiered effect assessment approach for fungicides as proposed in the EFSA Aquatic Guidance Document; ii) the predictive value of acute and chronic laboratory toxicity estimates for observed responses in microcosm/mesocosm tests; iii) problems in using the Geometric Mean approach in the acute effect assessment for fungicides with a biocidal mode-of-action; and iv) the taxonomic groups that should be represented in species sensitivity distributions for fungicides with a biocidal mode-of-action.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, 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 1 of the Directive (EU) 91/414, a data package was developed to assess the ecotoxicity of these yeastlike fungi. Back then no methods designed for the evaluation of microorganisms as active substances did exist. Methods were based upon certain parts of OECD methods (Section 2) and some advice 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 findings with earthworms were available. Whereas EFSA identified data gaps, the European Commission decided to include Aureobasidium pullulans to Annex 1 without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized 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 microorganism are able to proliferate, depending on the local environmental conditions in their micro-niche (influenced by climatic factors as well as microbial population dynamics), it is hardly possible to simulate all these complex conditions in laboratory trials. Therefore, a quantitative assessment does not seem to be a
Biocidal products may allow development of some generic testing recommendations. 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 microorganisms are also highly dependent upon environmental conditions, however, microbial active substances are significantly more complex with 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 utilities to advise more appropriate and adequate testing for microbial active substances.

**TUPC08**

Eco-toxicological and risk assessment consideration for microbial active substances

E.A. McVey, J. Wassenberg, Ctbg

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 microorganisms are also highly dependent upon environmental conditions, however, microbial active substances are significantly more complex with 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 utilities to advise more appropriate and adequate testing for microbial active substances.

**TUPC09**

Human and environmental risk assessment for microorganisms - to what extent?


Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (2009/128/EC) 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 covers the scope of the data required above, and outlines the approval. Series of guidelines published by OECD, SANTE, or EFSA are available for testing of substances used in plant protection. Many of these guidelines are not adapted for microorganisms. Risk assessment for biopesticides to enter the European market is described in the Uniform Principles, Commission regulation EU 546/2011 Part II. Risk assessment approaches for plant protection products show acceptance’s of data formats that are not developed for microorganisms. Thus, no consistent approach is available in the different member states. This leads to uncertainties and non-acceptance of submitted data. We will discuss the current challenges in interpretation of the data requirements and propose solutions for the risk assessment of biopesticides based on microorganisms.

**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/infectivity 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, lead to negative effects of parent(s) (i.e. spores or co-formulants like kaolin) on the test organisms which are not related to the active substance and are difficult to interpret. Differences between OECD and OCSP (former OPPTS) guidelines, and requirements of the analytical verification in the test medium are addressed as part of the development of alternative ecotoxicological testing approaches. The findings of our ecotoxicological expertise presented in this poster can be considered as basis for further discussions in proposing different test designs addressing mBCA and mBCP requirements.

**TUPC11**

Microbiological Quantification Methods for MPCA - Applicability to a Range of Microorganisms and Different Substrates

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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/3030/09 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 validated for each specific compound. 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

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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 threat 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 straight-forward 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

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This study investigated distribution and trophic magnification of emerging persistent organic pollutants (POPs), including PCBs, 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 Peninsula in King George Island, Antarctica. From December 2013 to January 2014, and included Antarctic cod, notitfish, limpet, amphipods, rapeal 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 were calculated based on the ratio of stable isotope nitrogen of the fish. Two archipelago included the possible confounding effects of age and body mass on the contaminant levels. The present study was to investigate how differences between years, locations and age and diet. As nestlings develop and grow, concentrations of maternally derived PCBs and PCNs are present in the diet. After the nestling stage, 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 gull 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 Dechlorane, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechlorane, 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
Biocoaccumulation as the predominant mechanism for fish PCB contamination in alpine lakes.
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Biocoaccumulation and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator-PCB concentration and lipid content of fish filet were measured in European whitefish (n = 89) and arctic char (n = 55) from 2013 to 2016. Potential explanatory variables for differences in PCB contamination levels in fish were chosen to identify the impact of living and feeding habitat (using d13C) and the influence of trophic parameters using d15N and body size. Results showed a decrease of PCB burden in fish after the clean-up of the major input source of PCB in the lake and a steady situation since then. Arctic char was found to be significantly more contaminated than whitefish with a mean concentration of 254±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 d13C) was not also correlated with intra-species contamination variabilities for 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=10⁻⁴). 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 bioconcentration process. A lower clearance rate due to changes in physiological parameters (lower gill/body weight ratio, lower metabolism and/or excretion rate) could also be involved.

TUPC20
The role of diet and age: organohalogen accumulation in an avian top predator.
M.E. Losseth, The Norwegian University of Science and Technology / Biology; N. Briels, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Exeter / Biosciences College of Life and Environmental Sciences; G.C. Paull, University of Exeter / Biosciences College of Life and Environmental Sciences; G. Mullerian hormone (amh) and Mullerian (amh) and Mullerian hormone (amh) and Mullerian hormone (amh) and Mullerian hormone (amh) and Mullerian hormone (amh) and Mullerian hormone (amh) and Mullerian hormone (amh). Reproduction was quantified over time, and embryos from each treatment group were then exposed to a range of BPA concentrations from 0-72hpf to measure their susceptibility to BPA exposure. There were no effects on reproductive output under our exposure conditions. However, at the transcriptional level, anti-Mullerian hormone (amb) was significantly down-regulated only in females receiving the highest exposure to BPA (100-100). In addition, embryos originating from adults which received a pre-exposure to BPA (100-100) were significantly more tolerant compared to embryos originating from...
naive adult males 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 hypothesize that these effects may be due to physiological changes or epigenetic memory between the first and second exposure period, and we will now analyze the promoter DNA methylation of amh1 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 even fewer assess 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, mono2-ethylhexylphthalate (MEHP) and ionizing radiation. We employed state-of-the-art techniques to assess effects in multiple generations of zebrafish embryos and larvae at all epigenetic layers, but most extensively on DNA methylation. Following early life exposures to 5AC and MEHP, many changes of DNA methylation were found in Vi and V2, 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 were found in the parental generation such as DNA damage. Follow up analysis in the second and the third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP, 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

WEPC03  
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?  
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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. The transcriptional set up of the plants can be changed 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 screened for the well established photosynthetic 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 grown under high and medium radiation levels. The level of total DNA methylation could not be linked to the radiation gradient present in the field but rather 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/jgeneration).

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 paleontological, palaeoecological, 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 rest egg produced by Daphnia species (Crustacea: Cladocera) as a result of unfavourable environmental conditions are archived in sediments and can be dated and hatched to produce clonal lineages (i.e., same genotypes) of historical populations. This talk will present an overview of the evolutionary tools available and their current and potential relevance in toxicological investigations. Additionally, we will present our preliminary research, which examines how genotypes of clonal lineages of Daphnia species from single populations, separated through generations of evolution, differ in their response to exposure of stressors. Results will provide insight into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolve in response to changes in the ontogenetic niche. Furthermore, evolutionary change in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clones of Daphnia to temperature changes in combination with exposure of contaminants. Taxonomic 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  
P. Inostroza, University of Gothenburg / Direct Effect Directed Analysis; I. Véra-Escalona, Dalhousie University / Biology; A. Wicht, Eberhard Karls Universität Tübingen / Chemistry; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Direct Effect Analysis; H. Norf, Helmholtz Centre for Environmental Research GmbH - UFZ / River Ecology Aquatic Ecosystems Analysis and Management

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, reducing genetic diversity of species to altered genetic structure or increasing mutation rates. Genetic material pollutants 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 anthropogenic stressors 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. Klawucha, 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 are preferentially hazard pictograms in accordance with the Regulation on Classification, Labelling and Packaging (86%), reports in the media (80%) and information printed on the products (77%) to learn about harmful substances in consumer products. Surprisingly, smartphone applications (≤10%) and information by authorities (14%) were not indicated as frequently used information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%) as trustworthy. Interestingly, the respondents considered legislators (94%), consumers (75%), manufacturers (71%) and environmental and consumer organizations (61%) as responsible for risk reduction. It is alarming that many of these ‘best-case’-participants assumed that food (up to 62%), products with an environmental label (36%), natural personal care products (36%), homeopathic products (30%), natural pharmaceuticals (20%) 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 risk communication instruments they need support to understand which products might contain harmful substances, they need support to detect 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 reclassification 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 presentation will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments.

WEPC09
Roadmap for the unknown
M. Luitwieler, M. H. Wagemans, Bioclear earth

The main environmental themes have been addressed in the last decades. Think about acidification, nutrients and bulk industrial chemicals for which environmental guideline values have been derived within legal frameworks. Changes are ongoing in the scale level at which environmental problems are regarded as well as the scale level of industrial production. In the past large volumes of bulk chemicals were produced, now and in the future lower volumes of more specialised compounds are and will be produced. That means that more and more compounds will enter the environment in low volumes. Also time-market of new developments and technologies decrease which leaves less time for a thorough risk assessment. Last but not least, techniques for measuring compounds are improving. More and more compounds can be measured in increasingly low concentration while the risks of these compounds in low concentrations are not known or just being studied. For the Province of Groningen en the Water Company Groningen there are the reasons to develop a policy for emerging contaminants in the environment with the main question: What to do when emerging contaminants are found in soil or water. Bioclear earth has developed a roadmap for policy and/or actions by the province, municipalities, water company and water boards for emerging contaminants in the soil-water system. Our framework was: compounds and organisms that enter the environment or can be spread by human actions and that consequently have a negative effect on humans, nature or agriculture and for which no guideline values have been derived within the Soil Law, Water Law (Water framework directive) and Drinking water decree. The first step in the roadmap is to determine if a compound or organism in the environment can cause an actual or large risk. If no risks are present, no further investigation is needed. In all other cases, the roadmap needs to be followed. In the presentation we will describe the process that has been followed to come to this roadmap and as well the background information. In the roadmap we describe the role of different stakeholders, including communication, enforcement, measurements to further prevent contamination or spread. In the presentation these roles will be further highlighted. Additionally we will organise a workshop regarding to discharge in January for province, municipalities, water boards, water company and RWS. The results of this workshop will also be highlighted.

WEPC10
EVOKE: enhancing the value of climate data - translating risk and uncertainty utilizing a Living Labs approach
A. Ding, Norwegian Geotechnical Institute / National Geotechnical Institute / Natural Hazards; L. Van Well, M. Zetterlund, Norwegian Geotechnical Institute; G. Ellen, R. van der Brugge, DELTARES; J. Koerth, B. Vollstedt, Christian Albrechts University of Kiel

The impacts of climate change are broad and although much focus has been on disaster risk reduction and coastal management, climate change will also have consequences for environmental management where the transport of contaminants, organism accimation and vulnerable communities will be important to consider for future human and ecological risk assessments. In this context it is useful for environmental scientists to be familiar with the concept of climate services which are defined as the transformation of climate-related data into products, trends, assessments, best practices) in relation to climate that may be of use for the society at large. Since the climate service sector is relatively new, there is a need to engage knowledge providers, users, and translators to identify improvements to climate services through co-design, co-development and co-evolution. The EVOKE project aims to address this challenge by re-framing the risk and uncertainty associated with climate data into knowledge products more understandable and useful for end-users concerned with risk mitigation and adaptation. The project team will engage end-users in a Living Labs approach to ensure a user-contribution innovation methodology at established case study sites in Norway, Sweden, Germany and the Netherlands. The Living Lab methodology has emerged in recent years as a form of experimental and potentially inclusive mode of urban planning. Although the scope and character can vary depending on the issue at hand, the international model and the core of the problem, the general idea is to involve a range of committed stakeholders in a real-life “laboratory” setting to test and develop alternative solutions for complex challenges, such as climate adaptation. The first activity for the Living Labs at each case study site will be a co-design process to encourage stakeholders to share their perceptions of risk and uncertainty. Since there are many different definitions and interpretations of risk, understanding these perceptions of risk is a prerequisite for communicating risk. Thus, EVOKE supports the development of the field of climate services to improve our capacity to manage climate-related risks.

WEPC11
Communicating monetary values of environmental impacts - case studies related to ISO 14044
B. Steen, Chalmers University of Technology; K. Hallberg, AkzoNobel; P. Hanarp, Volvo Group; J. Lindberg, IVL Swedish Environmental Research Institute; E. Rise, Essity; M. Romare, IVL Swedish Environmental Research Institute;

501
SETAC Europe 28th Annual Meeting Abstract Book
WPC14 Improving transparency, consistency and efficiency of ecotoxicological teaching and learning. Using interactivities, animations and technology.

J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; M. van Straten, Vrije Universiteit Amsterdam / Department of Ecological Science; T. Hamers, VU Amsterdam University, Institute for Environmental Studies (IVM) / Department of Environment and Health; S. Moe, Vrije Universiteit Amsterdam / UBVU; M. Kraak, University of Amsterdam / IBED-FAME; J. Parsons, University of Amsterdam / IBED-ELD; S. Droge, University of Amsterdam/IBED Institute / IBED; J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; M.G. Vijver, CML Leiden University / Conservation Biology; N. van den Brink, Wageningen University / Dept of Toxicology; A.M. Ragas, Radboud University / Department of Environmental Science; A. Löh, F. van Bellighem, Utrecht University.

Although several textbooks are available, teaching environmental toxicology in general seems to suffer from a lack of a well-elaborated, up-to-date and consistent textbook that covers all aspects of the field. As a consequence, every university is developing its own training materials in addition to a textbook, but only little of this material is available online. And if materials are online, they are not consistent, lack novelty or do not cover the entire field. A Dutch consortium therefore took the initiative to develop an open online textbook on Environmental Toxicology that should cover the field in its full width, including aspects of environmental chemistry, ecotoxicology, toxicology and risk assessment. The initiative is sponsored by the Netherlands Ministry of Education. The project aims at developing an online open access book on Environmental Toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way, with each module having a clear teaching goal/learning 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 10-12 ecotoxicological and chemists from six Dutch universities, does not possess all expertise to cover the width of the field. Therefore solicitation 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 online book will allow continuous updating of the book, providing a possible role of SETAC in sustaining the book.

WPC15 Policy learning through professional forums in the field of environmental toxicology: What role for the Society of Environmental Toxicology and Chemicals (SETAC)?

M. Mondou, McGill University - Macdonald Campus / Dept Natural Resource Sciences; G. Hickey, McGill University - Macdonald Campus / Natural Resource Sciences; S. Maguire, McGill University; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences.

Leveraging more than a hundred years of experience and knowledge (Gallo 2008), modern toxicology has crystalized in a set of highly codified and standardized practices that are used by industry and regulatory agencies internationally to assess the risk of chemicals to the environment. Toxicity testing methods using whole animal studies have long provided the general framework of instrumental beliefs concerning the most appropriate way to pursue the goals of environmental toxicology. While such in vivo methods are useful for determining the acceptable levels of single chemicals in the environment, they have a number of limitations that are broadly accepted within the profession. Most significantly, conventional in vivo toxicity testing methods are time consuming and involve large 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 silico simulations. These methods are less resource intensive and less harmful to the animals used in traditional testing methods, while still providing valuable information on the potential effects of chemicals.
Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WEPC16
SETAC Science and Risk Communication Interest Group
T. Seiler, RWTH Aachen University / Ecosystem Analysis

We recently developed technologies. In this context, QSAR methods can be utilized in the screening of novel nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC). They have been used 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 lower kinetic release in aqueous environments compared with materials obtained without CA. 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 (Zn$^{2+}$, Cd$^{2+}$, Pb$^{2+}$, Cr$^{3+}$ and Cu$^{2+}$) and organic contaminants (e.g. pesticides, pharmaceuticals and personal care products). The predicted non-effect concentration (PNEC) of Zn$^{2+}$, Cd$^{2+}$, Pb$^{2+}$, Cu$^{2+}$ and Zn$^{2+}$ is investigated in comparison to Fe$^{2+}$ and Ge$^{4+}$ complexes. Following a first principles and adapt to emerging challenges in regulatory science.

WEPC17
Biochar-mortar composites for construction materials
S. Ohto, T. Sen, University of Ulsan / Department of Civil and Environmental Engineering; Y. Soo, University of Ulsan / Civil and Environmental Engineering

Feasibility of biochar for construction material was examined through synthesis of biochar-mortar composites and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar composites showed that 3-5% biochar inclusion did not significantly change their workability, 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 Micotox$^{\text{TM}}$ bioassay tests showed that biochar-mortar composite was not toxic. Our results suggest that biochar-mortar composites may be promising environmental-friendly materials for building and infrastructure construction area.

WEPC18
Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV)
D. Wondrousch, G. Schuurmann, Helmholz centre for environmental research - UFZ / Department of Ecological Chemistry

In recent years, the demand for strategic elements such as Indium and Germanium has increased due to strong global economic growth, especially in the realm of semiconductors. Dwinding resources and growing demand necessitates new recycling strategies and the reessment of existing repositories in the light of newly developed technologies. In this context, QSAR methods can be utilized in the development of chelating agents designed towards 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$^{3+}$ and Ge$^{4+}$ complexes. Following a first principles approach, both Density Functional Theory and higher levels of theory have been used for the calculations, also addressing bulk solvation effects. The study focuses on both affinity and selectivity. General trends in binding affinity to selected ions are investigated. The results suggest that Zn-Al LDH is a promising eco-friendly engineered nanomaterial.

WEPC19
Cellulose Nanofibers as building blocks for innovative materials for remediation
A. Fioratti, INSTM local unit / Politecnico di Milano / Department of Chemistry. Materials and Chemical Engineering G. Natta and INSTM Local Unit; A. Graziano, L. Melone, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grasso, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Pastori, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; C. Punta, Politecnico di Milano

From the point of view of circular economy cellulose is one of the most interesting biopolymer since it derives from renewable sources which, thanks to its peculiar structural properties, it is widely used in the design of simple and advanced materials for different applications. Recently, cellulose nanofibers (CNF) were proven to be versatile building blocks for many preparations. The regioselective oxidation of the C6 primary hydroxyls of the anhydrideglucose 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. We recently report the synthesis of sponge-like nanostructured materials by cross-linked TOCNF and branched polyethyleneimine (bPEI). These gels were fully characterized from a chemical, structural and mechanical point of view. Quantitative information on their inner microstructure were collected by Micro-Computed Tomography ($\mu$CT) analysis. 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 pN3-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective adsorption of fluoride anions. Furthermore, the addition of citric acid (CA) as co-crosslinker enhance the mechanical and structural performances. 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 lower kinetic release in aqueous environments compared with materials obtained without CA. 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 (Zn$^{2+}$, Cd$^{2+}$, Pb$^{2+}$, Cr$^{3+}$ and Cu$^{2+}$) and organic contaminants (e.g. pesticides, pharmaceuticals and personal care products). The predicted non-effect concentration (PNEC) of Zn$^{2+}$, Cd$^{2+}$, Pb$^{2+}$, Cu$^{2+}$ and Zn$^{2+}$ is investigated in comparison to Fe$^{2+}$ and Ge$^{4+}$ complexes. Following a first principles
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 loose fibres being released during washing. Washing was performed with a standard synthetic clothing program (3 washes, 60 °C, 3 hr., 40 °C). Weights inside the washing machine assured same mass for each material assessed and a consistent water flow went 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 adhered to or shedded. To improve the accuracy of the results, the two washing procedures were repeated in triplicate. A rinse cycle was run between each test wash to ensure removal of any remaining microfibres from the system. The hoses connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighted filters were allowed to dry before the mass of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighed sub-sample of the microfibres. Preliminary results show that ~80–90% of fibres in the effluent water are trapped by the 300 µm filter. Furthermore, the fibre release declines with successive washings. A detailed study of the underlying mechanisms is currently ongoing and the results will be used as a basis for ranking.

WPEC22 Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)
F. Schwab, Adolphe Merkle Institute / Materials Science; M. Maceroni, Adolphe Merkle Institute / BioNanomaterials; A. Petri-Fink, B. Rothen-Rutishauser, Adolphe Merkle Institute / BioNanomaterials Group
Nano-agochemicals promise higher efficiency than conventional pesticides, but much has to be learned about the gain of efficiency compared to conventional products, and the risk of directly applying such new types of yield enhancers on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO₂-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO₂-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO₂-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substances for conventional pesticides, the broad-spectrum fungicide tebuconazole was tested. Seed germination and infection tests, and a plant growth test were conducted. The Si was quantified by inductively coupled plasma – optical emission spectroscopy (ICP-OES). Beneficial effects of SiO₂-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)₄) acting as a phytostimulating micronutrient. The use of silica in nanoagochemicals promises to reduce the organic pesticide burden of agricultural soil and crops. Acknowledgement - The authors thank the Swiss National Science Foundation (http://p3.snf.ch/Project-168187) and the Adolphe Merkle Foundation for the support and funding of the study. We thank Laura Rodriguez-Lorenzo, Dimitri Vanhecke, and Sandor Balog for helpful discussions regarding ICP-OES analytics, electron microscopy, and dynamic light scattering, respectively.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (PC)

WPEC23 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, a series of 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 manufacturers, supporting this with an instrument aimed at: Setting up and validating the development processes of product group-specific rules (PEFCR), including the development of performance benchmarks; Testing different compliance and verification systems, to set up and validate proportionate, effective and efficient compliance and verification systems; Testing different business-to-business and business-to-consumer PEF information systems in collaboration with stakeholders. The secretariat sees the PEF pilot as a big opportunity for the pasta sector since there are some pasta producers that already measure and communicate the environmental impacts through voluntary certification schemes. A methodology promoted by the European Commission can encourage other producers to communicate the environmental footprint of their pasta, making PEF a tool able to increase competitiveness with important benefits for sustainable agriculture and food production. This approach would be good also for consumers. Giving people reliable and comparable information about the environmental impacts and credits for production, and organisation, can make it possible for them to choose the most resource efficient and environmentally-friendly products. During the PEF pilot, an average impact value, representative of the category of dried pasta has been obtained to allow the environmental performance comparison among different products in the same category. This benchmark impact highlighted the process hotspots as cereals cultivation, pasta production and cooking phase. All advanced rules and hypotheses in the PEFCR document have been established due to the maximum clarity in order to increase the suitability and robustness of the LCA implemented in the PEF method for pasta sector. The main difficulties noticed during the pasta pilot were about the hotspots management, when the producers do not directly manage those processes.

WPEC25 Life Cycle Assessment of applying Algal Oil in salmon aquaculture; challenges for methodology and tool development
H. Bosch, DSM Nutritional Products; A. Wojceichowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH; F. Ziegler, RISE Research Institutes of Sweden
Algal Oil was found by the joint venture Veramaris® to be a new Algal Oil based omega-3 fatty acid source for aquaculture. This intracellular oil is produced in a biotechnological manufacturing process using non-marine resources. The rationale for this development is that the capacity to generate omega-3 fatty acids through fish is not sufficient to fulfill the dietary requirements of a growing population, and that many fish species used as feed in aquaculture are either fully utilized or overfished, leaving little room for expansion. Algal Oil reduces the dependency of salmon aquaculture on marine fatty acid production and fish stocks, by replacing marine ingredients with algal oil and crop-based ingredients. To illustrate the environmental impacts and potential tradeoffs of this new product, a Life Cycle Assessment (LCA) was performed. Indicators developed for application of LCA to fisheries were used in an LCA to assess the marine ecosystem impact of replacing fish meal and fish oil by Algal Oil in salmon feed. The analysis had to be performed in a separate calculation outside the LCA software, because the software does not include the required data and methods. The study demonstrated that the use of Algal Oil as a source of omega-3 fatty acids leads to a considerable reduction of impact on marine ecosystems of farmed salmon. This improvement is accompanied by an increase in impacts associated with agriculture. Current LCA methodologies do not allow weighting of these opposing effects. However, to make informed choices between the available options this would be required. Because the availability of natural marine resources is limited, the strong growth expected in salmon aquaculture requires innovative feed solutions decoupled from limited fish stocks to meet future requirements for omega-3 fatty acids. Veramaris® Algal Oil in combination with vegetable crops enables growth of salmon aquaculture that is independent of limited fish stocks. To support the choices discussed in this presentation, and similar choices, implementation of fishery impact assessment methods in LCA tools and development of weighting methodology is essential. Just as for other biotic impacts, there are also challenges of non-linearity and temporal and spatial variability connected to fishery-specific impacts, which are of a more local nature than global-scale life cycle impacts.

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. 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 increased Algal Oil risks such as low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in the example of whole grain consumption. Results show that for individuals under-consuming whole grains (less than 125 grams daily), for every 1 micro disability adjusted life year (µDALY) increase in production impacts, there is a health benefit of 141 µDALYs. Similar results were found for all
dietary risk categories in which under-consumption of a particular food group was considered a dietary risk. In cases where overconsumption poses a health risk, as is the case in certain meats, sodium, and sugar sweetened beverages, a 1 μDALY increase in production impacts is associated with increases in health impacts to varying degrees, ranging from 1.2 μDALYs for red meat up to 36.8 μDALYs for sugar sweetened beverages. This study found that for most of the dietary risk categories, health impacts due to consumption far outweighed the environmental impacts (measured in terms of μDALYs), however this study did not include environmental impacts as they are related to other impact categories such as ecosystem damage and resource depletion, which must also be considered to fully capture food production impacts.

WEPC27
What not to waste? Improving decision support for Food Loss and Waste (FLW) mitigation by considering food security and environmental sustainability
F. Sessa, Quantis; M. Ruth, World Business Council for Sustainably Development (WBCSD); D. Pollard, Nestlé; K. Cooper, A. Cairns, World Business Council for Sustainably Development (WBCSD); X. Bengoa, S. Humbert, M. Vargas Gonzalez, A. Ernstoff, Quantis
LCA-based methods provide evidence of the largescale environmental impacts of food production. Nearly a third of food produced is lost or wasted, meaning production impacts occur with little to no societal service. The primary focus of response e.g. the UN SDG 12.3 has been on avoiding food loss and waste (FLW) 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
ARIADNE 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 corresponding 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.
Accumulation.

Aquatic toxicity.

Ammonia.

Accumulation.

Bioavailability.

Bioconcentration.

Biomonitoring.

Bioresolution.

Biodegradation.
Uncertainty.

Weight of evidence.

Wetlands.

Water quality.
Yaghmaei, Emad. TH227
Yallop, Marian. WE316
Yamada, Naofumi. TU159
Yamada, Ohr. TU375
Yamada, Takashi. MO164, MO192
Yamaguchi, Akemi. MO173
Yamamoto, Hiroshi. MO164, MO192, TU067
Yamane, Masayuki. TU284
Yamazaki, Kunihiko. TH046
Yang, Congqiao. 334, TU354, TU369
Yang, Jiangua. TU032
Yang, Jie. TH264
Yang, Yi. TU016
Yang, Ying-Fei. MO354, TH205, TU020, TU311, TU398
Yao, Chunhe. TU407
Yao, Yuan. TH095
Yargeau, Viviane. WE089, WE416
Yasuda, Takamasa. TU159
Yau, Jason. MO012
Ye, Tao. WE297
Ye, Xiyuan. TU321
Yen-Potin, Frances. MO369
Yeung, Katie Wan Yee. MO012, MO013
Yeung, Leo. 640, 649, WE126
Yi, Hui. TU403
Yin, Tingru. MO354, TH205, TU020, TU311, TU398
Yin, Xiao. 509
Ying, Guang Guo. TU373
Yohannes, Yared. WE246
Yoon, Seokjoo. TU134
Yoshida, Olga. MO388
You, Jing. MO204, WE186
You, Luhua. 467, MO308
Young, Graham. 354, MO368, TU212
Young, Steven. 318
Youghamroui, Nisrine Carmen. TH228
Zacchi, Flávia. MO064, TU127
Zaffagnini, Valeria. TH233, WE162
Zahn, Daniel. 141, 371, TH101
Zak, Michael. MO329, WE080
Zalouk-Vergnoux, Aurore. TU195
Zaaraoui, Nisrine Carmen. TH228
Zampa, Alessandra. 622, TU237
Zamagni, Alessandra. MO247
Zampettì, E. TU410
Zampetti, Emiliano. MO335
Zampetti, Giorgio. 421
Zampa, Luca. 194
Zanardi-Lamardo, Eliete. MO018
Zanardi, Elisabetta. 188, TU245, TU247, TU366
Zanchi, Laura. 622
Zani, Claudia. TU353
Zaninetta, Luciano. TU259
Zanini, Gabriele. 285
Zanon, Francesca. WE075
Zarrilli, Christiane. 283, TH017, TU173, TU411, WE134
Zaric, Nenad. TU368
Zarrini, Daniele. MO163
Zattini, Giorgio. TH304
Załęska-Radziwiłł, Monika. WE318
Zelenyuk, Alla. 289, TU400
Zelić, Luca. TH300
Zeng, Eddy. TU391, TU396, TU414
Zeng, Yan-Hong. TU276, WE251
Zener, Armin. MO248, WE378
Zervou, Sevasti-Kiraxi. 592, TH181
Zetterlund, Miriam. WEPC10
Zetzmann, Marion. TUPC11
Zeumer, Richard. 37, 39
Zhai, Yawei. MO205
Zhai, Yujia. WE414
Zhang, Gan. TU408
Zhang, Han. WE011
Zhang, Hui. MO439
Zhang, Jing-jing. TU403
Zhang, Liang. 77, 82, MO290
Zhang, Weihong. 520, 521
Zhang, Lin. WE062
Zhang, Lulu. 273, TU085
Zhang, Panwei. WE130, WE139
Zhang, Qiangqian. TH150
Zhang, Xianming. TU360
Zhang, Xiaoohun. 578, TU032
Zhang, Xiaojin. MO389
Zhang, Xiaotian. WE180
Zhang, Xiaowei. 598, 599
Zhang, Ya-Qi. TH152, TU094
Zhang, Yan. 107
Zhang, Yang. 82
Zhang, Yaxin. TH096
Zhang, Yi Min. WE313, WE315
Zhang, Zhen. WE045
Zhang, Zifeng. TH290
Zhao, Fangyuan. 585
Zheng, Jie. TU403
Zheng, Liping. TH144
Zhong, Guang-Jie. MO012
Zhong, Huaidong. WE130
Zhong, Ji. WE290
Zhong, Jun Feng. TU391
Zhong, Junying. TH121
Zhong, Yan. TH144
Zhoud, Yuan. WE290
Zhou, Bo. 8
Zhou, Haifeng. WE130
Zhou, Jun. WE290
Zhou, Junying. TH121
Zhou, Junying. TH121
Zhou, Yu. WE414
Zhou, Zhong. MO012
Zhou, Zheyu. WE094
Zhu, Fengxiao. WE151
Zhu, Yong-Guan. 518
Zhu, Zewen. WE043
Ziari, Shima. 646
Ziarrusta, Haceza. 389, MOPC20, TU133, WE287
Zicari, Arnaud. TU045
Zidar, Primoz. TU184
Ziegler, Friederike. WEPC25
Ziegler, Michael. TU329, WE080
Ziegler, Susan. MOPC26
Ziegler, Friederike. WEPC25
Ziegler, Michael. TU329, WE080
Zigg, Michiel. 207, 358, TH286, TU093, WE267
Zikova, Andrea. TH017
Zilles, Victoria. 371, MOPC09
Zillgens, Birgit. 2
Zimmer, Elke. 153, 302, MO357, TU213
Zimmer, Karin. TH298
Zimmer, Malte. TU346
Zimmermann, Lisa. 647
Zingari, Laura. TU316
Ziółkowska, Elżbieta. 91
Zivkovic, Igor. 123
Zlabek, Vladimir. MO247, WE090
Zoeter Vanpoucke, Mechtild. TU257
Zoh, Kyung-Duk. WE131
Zonja, Bozo. 139, 22
Zorita, Izaskun. MO007
Zuberb, Jochen. TU023, TU028, TUPC01, WE105, WE176
Zuccarello, Pietro. TH180
Zucchi, Sara. MO163
Zuloaga, Olaz. 389, MOPC20, TU133, WE287
Zumbier, Ulrich. TU350
Zupanic, Anze. 415, 472, 600, WE307
Zwart, Nick. 632
Zweers, Patrick. 322
Zwienen, Christian. 395, TU264, WE134
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