How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

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This book compiles the abstracts from the platform and poster session presentations at the 28th Annual Meeting of the Society of Environmental Toxicology and Chemistry - Europe (SETAC Europe), conducted at the Rome Convention Centre La Nuvola, Rome, Italy, from 13 – 17 May 2018.

The abstracts are reproduced as submitted by the author and accepted by the Scientific Committee. They appear in order of abstract code and alphabetical order per presentation type. The poster spotlight abstracts are included in the list of poster abstracts. The presenting author of each abstract is underlined.

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

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

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

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

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

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

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

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

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

What does RRI entail in practice, for researchers, innovators and policy-makers? How could RRI principles 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 Ujl, EFSA, Italy

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

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

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

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

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

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

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

Antibiotics are vital in the treatment of infectious disease in both livestock and human health and they are entering the environment continuously. In freshwater antibiotics can reach concentrations up to mg/L, but more commonly they occur in the low to sub µg/L range. They selectively target bacteria and thus there is an increased likelihood for impacts on environmental bacteria populations at levels well below that for effects on aquatic vertebrates. However, current environmental risk assessment (ERA) frameworks of antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of cyanoabacteria 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 environmental should be included in ERA but there is currently no standard experimental methodology or framework to address this. Recently, a theoretical approach that makes use of minimum inhibitory concentrations (MIC) of clinically relevant bacteria (CRB; using the European Committee on Antimicrobial Susceptibility Testing (EUCAST) database) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species and: 3) how a 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.
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 standardised 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. Being aware of the variation in study designs and the consequent difficulties with interpretation there is a clear motivation to develop a more detailed and tightly defined protocol to support future research efforts. This presentation will summarise the database and efforts to develop and test a protocol to support further research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have focused upon evaluations of two models that have been used within a regulatory context in the EU: IDEFICS and the SSAU Arable Crop Spray Drift Model. This presentation will report on model assessment efforts, potential future improvements in process representation and consider options for regulatory scenario development. Flexibility in risk mitigation An earlier workshop (SETAC MAGPie) compiled a toolbox of risk mitigation measures in use in Europe and recommended development of communication tools to support broader and more effective implementation and encourage certification and testing harmonisation. This presentation will summarise the efforts underway in SETAC DRAW to realise these objectives through the creation of a platform to support exchange on scientific, technical, professional, and legislative or regulatory aspects of the toolbox, to further develop its accuracy and effectiveness (https://www.spraydriftmitigation.info/).

2 Plant uptake in regulatory environmental exposure assessment: Refined modelling based on experimental data

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

3 Work of a SETAC Group to Develop the Scientific Basis for Guidance for Regulatory Groundwater Monitoring of Crop Protection Products and their Metabolites in Europe

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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 has been 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 potential designs 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-SFO leaching system

J. Boesten, Wageningen Environmental Research

A model used in the EU-conceptual assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with first order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstone of the EU regulatory leaching assessment. This assessment is based on the FOCUS groundwater scenarios which use weather series of tens of years and include crop development and heterogeneous soil profiles. The sensitivity of the FOCUS leaching concentration (evaluated at 1 m depth) to the parameter describing the curvature of the Freundlich isotherm (i.e. the Freundlich exponent N) as derived from simulations with these models shows a sharp decline with decreasing Freundlich exponent with the concentration going down to a submolecular level. This is counterintuitive and difficult to understand. 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 experiments 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 influent features which may act as preferential flow pathways. In 2015, 70 sites were installed across France, Germany, Italy, Lithuania and the United Kingdom. Each site consisted of three shallow wells installed around the field perimeter. The 70 sites represent all EU FOCUS groundwater scenarios except Jokioinen. The sites have all had a minimum of two pinoxaden applications before 2016 with groundwater levels an average of 2.9m below ground level. Sampling began in 2015 from 84 down gradient hydraulic wells. Of the 871 samples collected between June 2015 and July 2017 from these 70 vulnerable sites, the average for each site never exceeded 0.1µg/L. Only minor residues of metabolites have been detected since sampling began. Monitoring is to continue until Q4 2019 to ensure a thorough assessment of groundwater vulnerability is made. The modelling approach should allow for 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 ecotoxicological risks exerted by pesticides. For this, reliable trend indicators of pesticide exposure and risk are inevitable. Based on this demand we designed a long-term trend indicator of aquatic pesticide risk for Germany. It uses pesticide 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 promising 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 EXPOSITE/eva (R²: 0.38), followed by the more complex models FOCUS STEP 2 (R²: 0.36), SYNOPS-TREND (R²: 0.24), and GERDA (R²: 0.24). (ii) The translation from toxic response to pesticide risk was implemented by applying the field based and validated exposure – response relationship SPEARreset. 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. Celis, Queens University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemetry

The objective of this presentation is to set out the conditions under which chemicals of high hydrophobicity experience significant delays 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 delay. The rate constant format commonly applied to fish biotropakate from water of concentration C_w is L/k_Cm.C_w where k_Cm is the bioconcentration factor. The characteristic time for uptake and loss t is L/k_Cm/k_C_w. Slower uptake and loss will occur if the partition ratio k_Cm is large, and the fish must contact k_Cm 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 bioptake model for fish. Due to the very high hydrophobicity (log KOW=10 for D5) and very low water solubilities C_CW, C_w will be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be ~2000 days, to get C_w=2 mol/m³ 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 approached when log KOW=4 [4] developed an empirical equation for the 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 log KOW=5. 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] Environ 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 chlorinated paraffins and 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 (K ow). Bioaccumulation of D. magna was observed after 48 hours under different exposure concentrations. APCLI-QTOF-MS was used for CP quantification. Both silicone-water and organic-carbon-water partition coefficients 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 – Huels 70C. We demonstrate that increasing average chlorine content of each CP mixture significantly increases the Log KOW, and Log K ow. 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 SCCPs. K ow 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
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The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk. These compounds are used in consumer products such as 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, 2,3,3',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard
methods involving feeding guild, trophic guild classifications, and the stable isotopes of nitrogen ($^{15}N$) and carbon ($^{13}C$) to estimate trophic position/carbon flow. The aquatic food web consisting of two benthic macroinvertebrate species and 15 fish species was evaluated for trophic magnification of cVMS materials and PCB-180. Lipid-normalized concentrations of D4, D5, and D6 were greatest in the lowest trophic levels and significantly decreased going up the food web, with the lowest concentrations being observed in the highest trophic levels. TMFs measured for the three cVMS materials were 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 biologically magnify 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

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

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

C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); M. Maclleod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry. Essential oils are fragrance materials that are registered as natural complex substances (NCS) under the European REACH legislation. One of the categories of information required in a REACH registration is information about the potential for bioaccumulation of NCS by fish. Determining the bioconcentration factor (BCF) of essential oils can be complicated, requiring a standard flow-through uptake/deposition experiment. Previously, we demonstrated that a single dietary exposure coupled to the benchmarking technique could be applied to an artificial mixture for measuring the in vivo BCF. Here, we report an application of our proposed BCF-determination methodology on a real essential oil – pine oil. Fish (rainbow trout) were dosed with a mixture of the pine oil and a suite of benchmark chemicals via a one-time exposure test. The bioconcentration factor ($k_{in}$) in the fish soma (without GIT) for the key pine oil constituents are 0.134 d$^{-1}$ ($\beta$-Caryophyllene, BCP) – 1.41 d$^{-1}$ (BAc) and they were 0.0709 d$^{-1}$ (HCB) – 0.517 d$^{-1}$ (DCB) for the reference chemicals. The test compounds depature faster from the soma than the GIT, making estimated whole-body depuration slower (conservative) compared to the soma only. HCB was the chemical most resistant to depuration via all the test compounds. Benchmarking to HCB reduced the standard error of measured $k_{in}$ from the soma for most of the chemicals, with $k_{in}$ ranging from 0.001 d$^{-1}$ (PCB52) to 2.98 d$^{-1}$ (BAc). The apparent BCF (BCF$_{app}$) values in soma for the key components in pine oil and the reference chemicals were in the range of 98.2 L kg$^{-1}$ (BAc) – 1030 L kg$^{-1}$ (BCP) – and 267 L kg$^{-1}$ (DCB) – 1730 L kg$^{-1}$ (HCB), respectively; while for the benchmarked BCF (BCF$_{ref}$) in soma, they are 46.3 L kg$^{-1}$ (BAc) – 2570 L kg$^{-1}$ (BCP), and 208 L kg$^{-1}$ (DCB) – 197000 L kg$^{-1}$ (PCB52) respectively. We conclude that a single dietary exposure coupled with the benchmarking technique is a feasible experimental approach for measuring the BCF of NCS in fish.

12 ROLE OF ADIPOSE TISSUE RESPONSIBLE FOR ECHOLOCATION IN THE BIOACCUMULATION PROCESS OF LIPOPHILIC COMPOUNDS IN HARBOUR PORPOISES

I. Schaar, Utrecht University; L. Gross, The University of Queensland / School of Environmental Sciences; G. Coia, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; T. Bouveroux, OCEAMM; F. Demaret, University La Rochelle / Observatoire Pelagis; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); M. van den Berg, Utrecht University / Institute for Risk Assessment Sciences; L. Wejs, Griffith University / Australian Rivers Institute. 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, melon and mandibular fat, and 2) Physiologically based toxico-kinetic (PBTK) modelling of PCB 153 and PBDE 153 to compare bioaccumulation of lipophilic compounds in 11 in lipid-rich tissues with different lipid composition and purpose (echolocation versus insulation) across the whole lifespan of male harbour porpoises. Overall, POP analysis and PCB 153 modelling for male harbour porpoises reveal that despite differences in lipid composition and lipid types, lipophilic pollutants bioaccumulation patterns are similar in blubber, mandibular fat and melon with increasing age. Nevertheless, the model showed the highest levels of PCB 153 in mandibular fat, followed by melon and blubber. From these results, mandibular fat can be considered as a sink for PCB 153 and a better proxy for lifetime exposure than blubber, which can be both a sink and source of lipophilic pollutants. PBDE 153 PBTK modelling reveals that bioaccumulation differs in lipid composition and lipid type, whereby bioaccumulation predominantly occurs in echolocating tissue during juvenile stage and in blubber during adulthood.

**Keywords:** Echolocation, life time bioaccumulation, biomonitoring, PBTK modelling, POP

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

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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 is preferred in the case of shared processes between the product alternatives compared, are sampled in different MC procedures resulting in different data sets for this shared process for both product alternatives. Dependent sampling implies that process data for the product alternatives compared are sampled based upon one and the same random drawing of parameter values resulting in identical data sets for this shared process; correlated data points: a transport process input of diesel is, for example, related to a process output of CO$_2$ (emission); if the process consumes more diesel for the same amount of transport, the CO$_2$ emission will also increase. The first interpretation of ‘correlation’ has been addressed in earlier work by Henriksen et al. and recently again by Mendoza et al. The second interpretation of ‘correlation’ (between data points) has recently been addressed by Groen et al. We present an overall framework integrating the different methodological choices with respect to correlated sampling in LCA studies. In addition, we show the possibilities and limitations of also including data correlations into LCA uncertainty assessments. Practical application of this
framework in the daily practice of LCA practitioners needs further work, including implementation in LCA software programs and particularly data.

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

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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 their modelling choices (or epistemic uncertainty). Parametrical uncertainty can be systematically addressed with parametrical uncertainty analysis, while epistemic uncertainty can be addressed with scenario analysis. However, the communicability and usefulness of LCA results can only be guaranteed if both such analyses are carried out separately, dividing the interpretation of the results in two separate channels and potentially limiting the value of LCA as a decision support tool. This study presents a novel method that aims at combining uncertainty 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. Parametrical uncertainty analysis was necessary for carrying out discernibility analyses across background conditions, allowing obtained useful insights on the changes in sensitive parameters induced by the change in background conditions. The discernibility analysis results allowed obtaining a clear quantification of the probability measure of each waste management option to provide a better environmental performance than another, for each of the assessed impact categories and investigated background conditions, and in a manner simply conveyable to the users and final receivers of the LCA.

Which impact categories are relevant for LCA results interpretation?
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LCA is intrinsically a multi-criteria approach comparing (almost) all the potential environmental impacts of human activities. However, multicriteria decision processes pose challenges as a wide range of environmental impacts results may lead to unclear conclusions. Based on their relevance, a choice among the impact categories may be necessary. It can be carried out by examining how the information given in the Life Cycle Inventories (LCIs) is used by the impact categories. The Representativeness Index (RI) proposed by Esnouf et al. was initially used to compare the adequacy of Life Cycle Impact Assessment (LCIA) methods regarding LCIs. Here, the RI is used to explore the impact categories belonging to a given LCIA method. Thus, the present study focuses on how the interpretation of the LCA results can be undertaken given the choice of relevant impact categories. With a geometrical standpoint, LCIs of the ecoinvent database and impact categories of the ILCD method are standardized and localized within the same R² vector space. This vector space is generated by all the dimensions (i.e. elementary flows) from which the LCIs of the database are derived. The RI is a proximity measurement between standardized LCI vectors and standardized impact category vectors, corresponding to the cosine of the angle between two vectors. This measurement does not assess the relevance of the environmental model behind impact categories, but rather translates the main elementary flows from an LCI based on how they are represented by the impact categories of an LCIA method. Two inventories referred the variability. Life Cycle Inventory (LCI) regionalization deals with investigating the geographic representativeness modelled in LCI. Life Cycle Impact Assessment (LCIA) regionalization deals with geographic representativeness modelled in LCI Life Cycle Impact Assessment (LCIA) regionalization deals with regionalized uncertainty that accounts for the spatial variability of the receiving environment. Regionalized characteristic 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 sectoral recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. Those recommendations are meant to help 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 prioritization, it confirms that inventory should be spatialized in priority for regionalized impact categories. This methodology allows providing different recommendations specific a sector to refine data collection in order to reduce uncertainty and enhance results interpretation. To our knowledge, this is the first time that an uncertainty analysis discriminating IC and LCA phase ranking is performed.

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

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

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

19 Unravelling longitudinal pollution patterns in freshwaters by non-target screening and cluster analysis

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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 Holzmee River (Saxony-Anhalt, Germany), whereas the first sampling in the national park marked a reference point for pristine conditions. Chemical screening was performed on an UltiMate 3000 LC system (Thermo Scientific) coupled to a hybrid quadrupole - Orbitrap MS (QExactiveTM Plus, Thermo Scientific) with a heated electrospray ionization source. MS/MS analysis was performed in a full scan experiment (100-1000 m/z) at a nominal resolving power of 140,000 at m/z 200. Peak extraction including peak picking, gap filling, componentization and target annotation was implemented in R. Cluster analysis was performed using the R package ‘kmL’. Four clusters were suggested for the data set representing A: EOCs from treated wastewater input of the two wastewater treatment plants (WWTP), B: EOCs specific for first WWTP due to specific local emissions, C: EOCs from diffuse (i.e., agricultural and urban surface run-off) and small point-source input (e.g., rain sewers and creeks) and D: low continious 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 WWTP). Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

20 Tracing sewage-derived contaminants from mainland towards the ocean by high resolution mass spectrometry

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The Ganges River estuary is the ultimate sink of most of the organic synthetic compounds produced and consumed by humans. Among the different pollution sources affecting this environment, discharge of treated and untreated sewage from mainland is of high relevance due to its continuous input, high volume and poor efficiency of conventional wastewater treatment plants (WWTP) to remove many potentially harmful substances. Even after dilution, some of these contaminants may still be detected at low concentrations (ppt level), especially in coastal waters, and their effects over marine biota are still widely unknown. This work focused on identifying a wide range of polar and semipolar chemicals that can be detected in both WWTP influents and effluents, as well as in the receiving waters (rivers and estuaries) and even in the open ocean. In order to do this, we carried out several monitoring campaigns in the Gulf of Cadiz (Atlantic Ocean, SW Spain), sampling wastewater from one of the biggest local WWTPs in the area (Jerez de la Frontera, 250,000 inhabitants), adjacent surface river and coastal waters, and oceanic waters at different depths (down to 400 m) taken up to 50 km away from the coastline. Solid phase extraction followed by liquid-chromatography high resolution mass spectrometry were used in combination with statistical tools (e.g., principal component and cluster analyses), specific vendor and open-access software, and other tools such as software to tentatively annotate compounds. In addition, the identification of compounds features persistent enough to be also detected in oceanic waters. These compounds included different classes of surfactants (e.g., linear alkylene 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

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Pharmaceuticals and personal care products (PPCPs) and artificial sweeteners (ASWs) are environmental contaminants of emerging concern. In this study, we investigated the occurrence and distribution of 15 pharmaceuticals and personal care products (PPCPs) and five artificial sweeteners (ASWs) in surface and groundwater of the Ganges River Basin in India. The Ganges River Basin is the largest river basin in India and home of about 7% of the total global population. PPCPs and ASWs were ubiquitously present in the river and groundwater. Most frequently detected compounds were caffeine, DEET, ketoprofen, cyclamate and sacralose. Except caffeine and DEET, concentrations of other PPCPs and ASWs in river water were found to be higher in densely populated areas. Concentrations of PPCPs and ASWs in the groundwater were lower but on same order as detected in the river water. Similar to river water, elevated concentrations of PPCPs and ASWs in groundwater were detected in middle and lower reaches along the Ganges River. PPCPs and ASWs concentrations were lower than those in developed countries, still, their instantaneous loads in the Ganges River were comparable to those in rivers from developed countries. The presence of PPCPs and ASWs in the surface and groundwater can be interpreted as a consequence of inefficient wastewater management in the basin, which pose a concern for human exposure.

22 Data-dependent fragment ion search for detection of sartans and related compounds in wastewater and surface water

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Presence of polar contaminants like angiotensin II receptor antagonist pharmaceuticals (sartans) in the aquatic system is directly linked to human impact. Like other xenobiotics, they can be metabolised in the body with enzymes such as cytochrome P450 (CYP), UDP-glucuronosyltransferase (UGT), and glutathione-S-transferases (GST) which are present in the human liver at high concentration. Due to biological and/or abiotic processes that the contaminants undergo from 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 TPs have been isolated in real cases that they are actually searched for in real aquatic samples to report their presence. Here, we propose an alternative approach, based on data-dependent fragment ion search, where real-world samples are initially screened for plausible TPs, metabolites or related compounds. The starting point here was a suspect screening of a list of all marketed sartans in wastewater effluent and surface water samples, which were extracted with a generic solid-phase extraction method using four cartridges with different chemistries. Out of the compounds detected, five of them had an identical core structure, and it was postulated that this sub-structure would fragment identically in all compounds. Following a series of experiments with different MS parameters modified, a list of hit compounds was obtained using fragment ion search. After all of the compounds investigated, available human metabolites and internal standards were purchased, a set of 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 bioaccumulate. For the detection of sartans and related compounds, an approach is presented using antibodies as selectors to pre-concentrate, enrich and identify the compounds detected in wastewater and surface water fractions pre-screened by ELISA.

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

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High-Resolution Mass Spectrometry has its benefits but still wastewater samples challenge the analyst on the quest for “unknowns”, metabolites and transformation products of emerging organic contaminants (EOCs). Their detection requires non-target analysis which involves not only costly instrumentation but also scientists with the time to plough through the enormous amount of data collected. An approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and antidepressant, 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 considerable ionic reactivity to CBZ-10,11-epoxide (ca. 70 %) or 2-hydroxy-CBZ (14 %). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30 – 40 min. run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were reconstituted in 50 μL of reconstituted sample extract and 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 N4-acetyl sulfamethoxazole, an SMX metabolite which is present in the samples. With estrone, interferences by polar matrix compounds eluting early could be identified.

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

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Drinking water utilities heavily invest in monitoring occurrence of chemicals in drinking water sources and produced drinking water. Worldwide, drinking water regulation prescribes drinking water limits for a limited number of chemicals, the EU Drinking Water Directive (EU DWD) for example lists drinking water limits for 26 organic and anorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and bioanalytical methods. The EU DWD stipulates that drinking water monitoring is performed in a more flexible way, provided protection of public health is ensured. Compared to surface water, groundwater is less intensively studied and monitored. However, groundwater can be highly influenced, by anthropogenic activities related to the land-use above the groundwater, by infiltrating surface water, by historical contamination as well as by activities in the sub-soil. The susceptibility of the groundwater aquifers to these pressures depends on soil type and groundwater hydrology. Chemical properties such as persistence and mobility and their retardation during groundwater flow are reflected in the spatio-temporal patterns of the chemicals. Treatment technology applied, such as filtration and sorption techniques, determines removal efficiencies during drinking water production for specific compounds. Water utility Vitens services drinking water in a large area in the Netherlands, mostly using groundwater as a source. Their set of chemical parameters in the monitoring program tripled in the last decade. The water utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We present here is the development of a risk-based monitoring program for all 43 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 vivo as well as in vitro toxicity information. We analyse full scale removal efficiencies by the treatment technologies applied. Finally we propose a risk based monitoring program.

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

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

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In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial amphibian life stages from (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and bioconcentration modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD₅₀) from standard acute test values (96-h LD₅₀) for fish and bioconcentration factors (BCF) in fish. Where possible, fish BCF values were corrected to 5% lipid and to parent compound. Then, BCF values were adjusted to an exposure duration of 96 h, in case steady state took longer to be achieved. The derived correlation equation is based on 32 LD₅₀ values from acute dermal toxicity experiments with 15 different species of anuran amphibians, comprising 15 different plant protection products. The developed ICE model can be used in a screening approach to estimate the acute risk to amphibian terrestrial life stages from dermal exposures to plant protection products with organic active substances. Applying this method has the potential to reduce unnecessary testing of vertebrates.

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

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Concerns have been raised that the current risk assessment schemes may not sufficiently cover the risk for amphibians and reptiles exposed to intended uses of plant protection products (PPP). To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2019; 17:1720. The opinion suggests that approved PPP options for amphibians and reptiles were developed to address the general protection goals for non-target organisms and biodiversity in Regulation EC 1107/2009 [2]. When proposing SPG options, the endangered status of a great proportion of amphibian and reptilian species was taken into account, as well as the importance of amphibians and reptiles as drivers of valuable ecosystem services in agricultural landscapes. The analysis of literature data reveals that amphibians and reptiles occur in agricultural landscapes, where they may be exposed to PPP in the in- and off-field areas, and that unacceptable, adverse effects on their populations may occur. It was concluded that the current risk assessment scheme does not fully cover all relevant life stages and thus might not protect the persistence of amphibian and reptilian populations in the long-term. The EFSA working group proposes a general risk assessment framework based on a tiered approach and adapted to assess local and landscape-level risks for amphibian and reptilian populations. Identified knowledge gaps regarding amphibians and reptiles concern on the one side the exposure assessment, with e.g. a lack in data about size and location of ponds inhabited by amphibians. On the other side, central issues are missing for risk assessment, including the impact of oral and dermal exposure routes. Informed 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 would 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/eafa.20YV. [2]EF. 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 309/1 2009.

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 dell’Ambiente; I. Caliani, M. Giannetti, L. Marsili, D. Coppola, N. Bianchi, T. Campani, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Physical Sciences, earth and environment; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment Caretta caretta is the most common sea turtle in the Mediterranean Sea. The UICN 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 to investigate biological end point potential of this species. We used an invasive protocol to assess the impact of oral and dermal exposure routes. Informed 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 would 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/eafa.20YV. [2]EF. 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 309/1 2009. SETAC Europe 28th Annual Meeting Abstract Book
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 CYP1A, 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 higher ecotoxicological 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 Suckling clams or hunting seals - consequences to walrus health
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The walrus (Odobenus rosmarus) is an ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and chlordanes, in walruses that likely feed on seals are very high - similar to levels observed in polar bears, whereas pollutants concentrations in walruses feeding on benthos are lower. Although multiple studies have associated contaminant exposure to adverse health effects in polar bears and other marine mammals without a clear contaminant exposure, there are very few 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 at Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ15N values in red blood cells and in whole walrus meat positively correlated with δ15N values for Baccalaurin 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 concentration of TCS. In conclusion, our study supports the hypothesis that persistent pollutants can affect the health of walruses feeding in the Barents Sea.

29 Triclosan-induced embrittlotoxicity in the yellow-legged gull
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Triclosan (TCS) is a chemical compound extensively used as synthetic and antimicrobial agent in a wide range of personal care products. Because of its hydrophobic nature and its discharge in the sewer system, TCS accumulates in settled sewage sludge and surface water, contaminating aquatic and terrestrial ecosystems. How the disturbance on the fitness and ecotoxicity of TCS towards wildlife species is very scarce. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the food web and relative long life-span. Their eggs are a useful tool to monitor the levels of environmental pollutants and their potential adverse effects because these chemicals can be maternally transferred to the offspring. However, such information on TCS is lacking. The aim of this study was to explore, through in ovo injection, the potential embrittlotoxicity of TCS in the yellow-legged gull (Larus michahellis). In a within-clutch experimental design, 150 ng/g egg weight of TCS were injected into the egg yolk and the effects on embryo morphology, oxidative stress and genetic damage in embryo liver were investigated. Specifically, we assessed effects on embryo body mass, tarsus length and head size, as well as liver and brain mass. The amount of oxidant species (e.g. ROS), enzymatic activities (SOD, CAT, GST) and the levels of lipid peroxidation (LPO) were measured as biomarkers of oxidative stress, while levels of DNA fragmentation were measured as genetic damage endpoint. To check for the reliability of the injection method, we quantified TCS concentration in the yolk of unincubated eggs, while to assess its transfer to the embryo, we measured TCS in residual yolk and in the liver and brain. TCS concentrations in yolk from unincubated eggs were similar to the nominal ones (158.9±33.5 ng/g wet weight), while lower concentrations were found in residual yolk soon before hatching (2.9±1.1 ng/g wet weight). TCS was also detected in the liver (2.3±1.1 ng/g wet weight) and limitedly in the brain (0.2±0.1 ng/g wet weight). TCS treatment did not show any effect on embryo morphology, body mass and organ weights. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genetic damage. Thus, these findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

30 Egg overspays with herbicides and fungicides reduces chick survival in red-legged partridges
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Toxicity characterization in pesticide risk assessment for birds is derived from oral exposure of adults. However, for ground-nesting species, a temporal and spatial overlap of egg laying and incubation with pesticide applications may result in direct exposure of the eggs. Using formulations commonly applied to cereal crops in spring, we conducted two experiments to test the effect of 2,4-D and tebuconazole on embryonic development and post-hatching survival. Chicks were weighed and measured (tarsus length), and body condition calculated, at hatching and at days 8, 16, 24 and 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 can affect reproduction. The results of these experiments suggest a need for further research to determine the effects of pesticides on embryonic and chick survival of different species, elucidating their mechanisms of action, and quantifying the potential risk of these pesticides to avian species.
medicines and the role of veterinary medicines in driving AMR in the environment and its potential consequences and mitigation. The session will feature successes, current issues and developments in improving the guidance on the assessment of veterinary medicines in the environment; and will reflect on the future challenges and difficulties faced by the regulators and industry alike. This paper will acknowledge the significant continuing contribution made by the Environmental Risk Assessment Working Party (ERA-WP) of the CVMP.

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

In an Environmental Risk Assessment (ERA) the General Protections Goals need to be translated into Operational Protection Goals in order to achieve efficient and robust ERAs. Not doing so hinders the process of Risk Management in those cases where a risk is identified. In the current regulatory framework of ERA of Veterinary Medicines Protection of “terrestrial plants” (e.g. direct and indirect effects on ecosystem level as well as on ecosystem level (e.g. direct and indirect effects on ecosystem functions as primary production). In addition, mesocosm studies provide data on the fate of test substances under realistic outdoor conditions, which can be used to test the prediction based on laboratory studies. While for the risk assessment of Plant Protection Products (PPP) mesocosm studies are an established higher tier approach and are considered as the surrogate reference tier, the use of mesocosm studies for risk assessment of biocides, veterinary medicines and chemicals under REACH is rare, although mesocosm research from the German PPP 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 mink farms R.G. Ovesen, Danish Environmental Protection Agency; H. Bækgård, Kopenhagen Fur

Biocides are regulated in EU by the BPR [1]. To evaluate if an active substance (a.i.) or product may be authorised, an assessment of the environmental exposure is required. For insecticides used in stables an Emission Scenario Document (ESD) [2] is used covering application methods and a range of animal categories. The ESD does not cover biocides used in mink farms. A scenario has therefore been developed, where emission of a.i. from mink farms is calculated based on either amount applied or measured concentration in straw. Default values have been estimated from regulation and general practice in mink production in the Nordic countries, where Denmark has the highest production of mink in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are treated. Each mother will bear 5.5-5.5 cubs/year according to Danish regulation [4]. The number of “breeding females” (BF) is 1 mother±5.5 cubs. The number of nest boxes that is treated/BF may be calculated as follows: 1 animal/nest box before separation and 6.5-6.5/2 animals (3.25-3.25) nest boxes after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw may be from up to 50 BF per hectare (ha) per year based on regulation in the Nordic countries. Emission according to application pattern: \[ Y = \text{Q}_{\text{m} \text{a} \text{straw}} \times \text{a} \text{.i.} \text{per ha} \times \text{b} \text{.i.} \text{per ha} \times 10^3 \text{kg/ha} \] (Eq. 1) Where \( Y \) is emission of a.i. in kg/ha/year, \( \text{Q}_{\text{m} \text{a} \text{straw}} \) is amount of product/nest box in g, \( \text{a} \text{.i.} \) is concentration of a.i. in the product, \( \text{b} \text{.i.} \text{per ha} \) is number of treatments before separation of adults and cubs. Emission from manure/straw applied to the field: \[ Y = \text{Q}_{\text{m} \text{a} \text{straw}} \times \text{a} \text{.i.} \text{per ha} \times \text{b} \text{.i.} \text{per ha} \times \text{c} \text{.i.} \text{per ha} \] (Eq. 2) Where amount of straw used per BF is 15-10 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? S. Wreek, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; O. Olsson, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; K. Kümmerer, Leuphana University of Lüneburg / Institute of Sustainable and Environmental Chemistry

The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources include products from different product groups, e.g. facial care, which is 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, icaridine, OIT, pipercymol butoxide (PBO), triclocaran, tetrabenazine, tetramethrin 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 CMIT, DCOIT, PBO and tetramethrin, 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 icaridine were measured in all samples. The results show...
that washing and cleaning agents are important sources for preservatives such as BIT and OFF, while triclosan was apparently mainly emitted through personal care products. The mosquito repellent substances DEET and icaridine were found throughout the whole year, with highest emissions in summer and autumn. C12-benzalkonium chloride concentrations were associated with the inventoried disinfectants. Material preservatives such as terbutryn, diuron, tebuconazole or cardiovascular drugs 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 biological products when it comes to the reduction of biocidal active substances in wastewater.

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

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

Manufactured nanomaterials (MNMs) and especially Ag- and TiO₂-NPs are processed in daily-use 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 with Ag-NPs 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 N. Oberdoerff, School of Biological Sciences, Plymouth University; D. Boyle, Plymouth University; R. Handy, University of Plymouth

Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has had little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomeration and sediment, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. 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. Homogenised test diets were prepared for rainbow trout and rainbow trout were used to assess bioaccumulation potential of pristine (Ag NPs) and environmentally aged (Ag 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 were exposed by filling the hamen with one of four solutions: physiological gut saline or saline spiked with 1 mg/L Ag as AgNO₃. Ag NP or Ag₂S NP. Following a 4 h exposure, tissues were cut open and the mucosa was separated from the underlying musculature, through scraping via a microscope slide. For the in vivo chronic dietary exposure, fish (n = 150) were graded into tanks (n = 3 tank/treatment). Fish were fed either a control (no added Ag), 100 mg/kg as AgNO₃, Ag NPs or Ag₂S NPs. Fish were sampled each week (1, 2, 3 and 4; n = 2 fish/tank/time point). Following this, all tanks were placed on the control diet for another two weeks to measure Ag elimination. During sampling, the mid and hind intestine, liver, gallbladder, kidney, spleen, gills 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 Ag₁₂S NP compared to AgNO₃, but no difference between ENM treatments. The in vivo experiment demonstrated significantly more Ag in the mid and hind intestine of Ag NP and Ag₁₂S-NPs compared to AgNO₃. Silver from all the exposures were able to pass the gut epithelium and cause total concentrations in the liver to rise, despite the form being unknown. In conclusion, the ex vivo gut sac method can be used to rapidly screen the bioavailability of Ag NPs and Ag₁₂S 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 R. Zeuner, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism; B. Knopf, Fraunhofer Institute for Biochemical Medicine and Environmental Toxicology (IBMT); R. Lein, Institute for Molecular Biology and Applied Ecology IME / Ecological chemistry; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro, V. Galhano, Department of Biology & CESAM - University of Aveiro / Biology (dBio); M. Monteiro, Aveiro University / Biology, S. Loureiro, Universidade de Aveiro / Biology; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism

Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the wastewater are significant and may show 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 302. 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) uncontaminated 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 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 uncontaminated effluents with AgNPs, fish in the acute toxicity testing per adult daphnia showed a significant increasing 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.

40 Uptake and elimination kinetics of pristine and aged silver nanoparticles in freshwater benthic organisms P. Silva, Universidade de Aveiro; C. van Gestel, Vrije Universiteit Amsterdam / Processing and elimination of NMs. Freshwater systems are important sinks for NMs, especially considering the sediment phase, where benthic organisms can be exposed through both water and sediment. Considering this, the aim of the present study was to determine the uptake and elimination constant rates of pristine and
Transformation of silver nanomaterials by ubiquitous zinc finger peptides


In biological systems, chemical and physical transformations of engineered silver nanomaterials (AgNPs) 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 responses. Spokane et al. (2003) described a small library of zinc finger peptides; the stoichiometry of Ag(I) binding is dependent on the primary sequence. Additional studies using fluorescence spectroscopy to monitor Ag(I) binding to the zinc 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 zinc finger peptides can mediate AgENM transformations within eukaryotic cells. In turn, for the zinc finger peptides studied here, Ag(I) is the thermodynamically favored metal despite the known high Zn(II) affinity of zinc finger domains. This works suggests that Ag(I)-substituted zinc finger domains might be relevant in the context of both silver toxicity mechanisms and silver-responsive transcription factors.

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

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The increase in production and use of Ag and TiO2 nanoparticles has lead 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, nanoComposix) 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 along with the parent and transformed NPs 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 (RTgull-W1 cell line, effects on metabolic activity, epithelial integrity, ROS formation, gene expression). The extent of the observed effects was dependent on 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 a series of microbial bioassays, giving initial indications 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)

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

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Oil spill emergency response plans (OSRP) are required as part of permitting for offshore operations. An OSRP typically includes risk assessment and detailed plans for responding to different types of oil spill accidents involving shipping, pipelines, platforms, and/or subsea wells. The owner/operator must demonstrate to state and federal regulatory authorities that the company’s OSRP for offshore exploration and production operations conform to all applicable regulations and international standards and practices, and further demonstrate that the necessary equipment and trained personnel are in place to respond quickly and effectively to an oil spill accident. In the event of an oil spill accident, the priorities for oil spill response (OSR) are to protect people, prevent or mitigate environmental damages, and prevent impact to affected communities. Spill Impact Mitigation Assessment (SIMA) is a science-based framework evolved from Net Environmental Benefits Analysis (NEBA) to broaden the focus from consideration of mitigation of ecological impact to include mitigation of socioeconomic and cultural impacts, as well. SIMA is a method for identifying and comparing the socio-environmental and -economic benefits of alternative OSR options, with the goal of selecting options that best mitigate the consequences of spilled oil and impose the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill- specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and when new technologies and best practices emerge that need to be adopted into safety, health and environmental management programs. This paper describes a spill impact mitigation assessment framework using recent examples of OSRP worked 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.

Adapting the SIMA Process to Assess Offshore Decommissioning Options


For several decades, the oil and gas industry has used the Net Environmental Mitigation Impact Assessment (SIMA) is a science based framework evolved from Net Environmental Benefits 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) of oil spills to support effective decision-making. This paper describes the SIMA process to carry out a detailed 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 ecological impacts is to employ multiple response options. This will require consensus between key stakeholders and the various decision-makers on the benefits and
drawbacks of each option, thereby developing response strategy. Similarly, oil and gas operators are faced with complex options for decommissioning offshore installations as part of their decommissioning plans. There is a need to evaluate these options in a scientifically-defensible and consistent manner, while adequately assessing risks that can be challenging to assess. An adapted SIMA process could be a valuable tool for fostering collaboration between operators, stakeholders and regulators, all while ensuring a transparent review of engineering studies and available decommissioning options in a meaningful way. This paper evaluates the use of the SIMA process in a hypothetical decommissioning of an offshore platform to determine if this process lends itself to this purpose. It describes the challenges encountered when trying to conduct this comparative risk assessment, originally intended for oil spill response, to the task of decommissioning. Finally, it proposes adaptations to the SIMA process that might enable its use in the future as a credible tool in assessing environmental risks for oil and gas decommissioning.

45 Detection and quantification of oil contamination in vegetated areas using hyperspectral remote sensing
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The Deepwater Horizon Oil Spill (DWHOS) in 2010 is the largest and most studied event with use of the Deepwater Horizon oil spill as a case study
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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
S.M. Mudge, NILU - Norwegian Institute for Air Research / IMPACT

47 Oil spill combat effects in the Arctic coastal environment; self-cleaning potential and in situ burning
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Key issues investigated include the behaviour and fate of oil in deep spills, the 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 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 about the environmental effects of DWHOS that we recently published in Marine Pollution Bulletin.
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 253 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time PCR was used to confirm the results obtained from miRNA 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 involved in pathways related to 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 variation of in vitro hepatic activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fishes due to the narrow range between essentiality and toxicity. Although several studies have reported developmental toxicities in early life stages of fishes, fewer studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to increasing selenium concentrations (0, 1, 3, 9, 27, 81, and 243 µg/L SeMet) over 90 days at 26°C on a 16:8 h light:dark cycle. Lipid metabolism, metabolic processes, TCA metabolism and calcium 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 view, identification of the correlations between fish and mammalian metabolism and potential clinical implications is of fundamental importance. Including sublethal endpoints of aquatic ecosystems and the potential for adverse effects to occur in human consumers suggest that more research on selenium toxicity is necessary.

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

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Sediments are a well-known sink for a large variety of organic pollutants that may cause distress to benthic and pelagic species in case of their remobilization to the water-phase. Risk assessment of complex mixtures may involve component-based approaches applying chemical analysis together with measured or predicted toxicity data of individual components and mixture risk modeling or whole mixture approaches using models that are composed of both approaches using chemical and bio- analytical tools for characterization for example of sediment contamination is expected to provide a more comprehensive picture of toxic risks to aquatic organisms. One of the most promising organisms for diagnostic *in vivo* testing of sediment may be zebrafish embryos (*Danio rerio*) being a versatile *in vivo* model suitable for high-throughput analysis while keeping several advantages of *in vitro* approaches (i.e. low-cost, sensitivity, short duration of the test). The fish embryo test (FET) with *Danio rerio* has been considered as a good surrogate for the acute toxicity fish test and was successfully used in several studies for the detection of toxicity and neurochemistry 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 (1) to validate a screening approach for sediment of samples (2) to offer a first *in vivo* toxicological profile of sediment from three different polluted sites from Gulf of Bothnia.

52 Proteomics based screening tool to detect molecular responses following aromatization 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 end-point relevance and molecular responses for each of these MoA has become crucial for analyzing, accessing and determining chemical effects. Proteomics, therefore, show appreciable promise as a molecular screening tool for identifying specific alterations between exposures and controls, which is therefore imperative in discriminating endocrine disruptors from substances with a non-endocrine MoA. Such tool waits the need for elongated higher-tier testing. The study measures the alteration of biological pathways 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:dark 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, vglt5 and lamin1, 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 research leads to the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary extensive testing.

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

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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 considered a living model system 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 transformation products differ and metabolites exhibit different mode of action. This implies that fish embryos are a versatile species to study sublethal and genotoxic effects of chemical exposure.
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
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Toxicology research is essential to improve the understanding of the global public health burden of fine particulate matter (PM$_{2.5}$) exposures. However, research groups use differing filter extraction methods to prepare PM$_{2.5}$ and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM$_{2.5}$ constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single high-volume PM$_{2.5}$ filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM$_{2.5}$ 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 (PM$_{2.5}$ filter portions undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM$_{2.5}$ solutions were used for chemical constituent analysis of polycyclic aromatic hydrocarbons (PAHs, n=120) and elements (n=20). Significant increases in mortality were observed for PM$_{2.5}$ 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 PM$_{2.5}$ 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 PM$_{2.5}$ solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify contaminants that are driving toxicity and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM$_{2.5}$ 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 PM$_{2.5}$, and provides a path that will ultimately promote improved understanding of PM$_{2.5}$-associated health effects.

Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

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

56 Nanotechnologies for the conservation and connected risks
M.I. Mosquera, University of Cadiz

Most products commonly employed in the restoration and conservation of cultural heritage materials have not been specifically developed to preserve such elements. In addition, they are plagued by limited performance and structural drawbacks such as low adhesion, poor penetration, and cracking. Another disadvantage is the requirement for most products to be dissolved in volatile organic compounds (VOCs), which produce environmental and human health risks in their use. In this lecture, I will review the most meaningful achievements of my group in this field. We have developed an innovative sol-gel route for preserving Cultural Heritage building materials. Specifically, a surfactant-assisted sol-gel synthesis to produce, in-situ on the building, crack-free nanomaterials to be used as long-term consolidants. Additionally, hydrophobic, water-repellent, self-cleaning, and biocidal properties can be incorporated into the product by innovative chemical modifications of the proposed synthesis route. Finally, I will summarize the future challenges of our group related to conservation of historic concrete in the framework of the Horizon 2020 project “InnoVacConcrete”.

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

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

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

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

60 Biogenic residues formation from pesticides - an overview
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Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biodegraded by microorganisms and, volatilised leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesise their biomass compounds, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigate the turnover of different pesticides (2,4-D, glyphosate, metamitron, bentazon, bromoxynil and clodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into AA, FA, and their fate over time. An agricultural soil and water-sediment were incubated with stable isotope labelled respective herbicide in the dark and at constant temperature (20°C). Soil and sediment samples at the respective sampling date were analysed for the amount and isotopic composition of AA, FA, CO$_2$, solvent-extractable parent compound and metabolites and total NER. The presented data indicated that easily biodegradable herbicides e.g. glyphosate, 2,4-D or metamitron were utilized as a carbon (and
nitrogen) source and the NER were mainly biogenic. The major formation of biogenic residues is supposed to be relevant for easily biodegradable contaminants under significant CO₂ formation. However, in the case of more recalcitrant pesticides like bentazon, the incorporation of C into microbial biomass, although reported to be very low, cannot be completely excluded.

61 Derivation of a foliar wash-off factor for FOCUS modelling based on literature research
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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 dissipated substance depends on several factors. An EC/PlantHealth group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24h time interval between pesticide spraying and 10 to 20 min 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 proposed wash-off in literature was reviewed for the availability of data suited for the calculation of a wash-off factor, reflecting a variety of different investigation types in terms of time of (artificial) rainfall after application, rainfall amount and intensity, formulation, crops under investigation, etc. Published experimental wash-off studies are usually not conducted according to the standardized experimental procedures. Thus, only a limited number of the published studies are suitable to derive a wash-off factor for modelling. The outcome of the literature review presented herein suggests that a meaningful default wash-off factor should be well below 1 cm⁻¹. Keeping the existing default value of 0.5 cm⁻¹ retains a sufficient protection level while at the same time avoids a large number of unnecessary refinement studies.

62 Application of a dynamic aquatic food web model for FOCUS exposure assessment
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In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substances in aquatic organisms is evaluated with simple screens on the basis of a substances’ log Kow, where typically a value greater than or equal to 3 indicates concern. However, this criterion may lead to false positive identification, because it does not account for biotransformation of the chemical in the organism or biochemical diversity 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 food web models for time-varying concentrations in terrestrial and aquatic ecosystems. Modelling results included both the daily time series predictions of organism concentrations for the six trophic levels and the uptake and elimination rate constants calculated from organism sub-models. In total, nine FOCUS scenarios were simulated and compared (five drainage scenarios with MACRO and four runoff scenarios with PRZM) and dominant organism uptake pathways were identified. The approach may be used to refine log Kow-based screening bioaccumulation and biomagnification evaluations for regulatory purposes.

63 Improved assessment of pesticide peak exposure in cultivated mountain watersheds
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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 many environmental scenarios, such as small mountain watersheds, where runoff fluxes are particularly rapid due to side slopes, exposure peaks can be shorter but much higher. Monitoring campaigns are often inadequate or too expensive to be carried out and modelling tools are therefore vital for exposure assessment and their use is encouraged by current legislation. However, currently adopted models and scenarios (e.g., FOCUS for PPPs) are often too conservative and/or “static” to accurately capture exposure variability, and the need for more realistic and dynamic tools is now one of the major challenges for risk assessment. In a previous work, the new fate model DynAPlus was developed to improve pesticide fate predictions in cultivated mountain basins. The model was successfully evaluated against chlorpyrifos water concentrations measured in the Novella River (Non Valley, Northern Italy), where more than 1000 ha of apple orchards surround the river and of the processes regulating their fate and transport to surface waters, ecosystems are often exposed to pulses of contaminants. The resulting peak exposure profiles were discussed to highlight the added value of such a dynamic modelling approach in providing information on exposure which could not emerge from the application of current approaches.

64 Implementation of mitigation measures and assessment of its impact under field-specific environmental conditions in the risk indicator SYNOPS-WEB for Norway
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In response to the implementation of the EU-directive on sustainable pesticide use in the EU (91/414/EC), 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 PRZM and VFSMOM 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, 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 crop data. Data was reviewed for the availability for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tillage/mulch, and cover crops. Risk assessments can be performed for a combination of mitigation measures in order to select the optimal application strategy under specific field conditions. In this presentation, we describe and discuss the mitigation measures implemented in SYNOPS-WEB, Norway, and the corresponding adjustments to the model input parameters. We provide example scenarios based on realistic application patterns, without and with mitigation measures. Aquatic and terrestrial risk indices are presented to the user as Exposure Toxicity Ratios (ETR) in the form of colour-coded tables for an easy visual appraisal of the environmental risk under different conditions. In addition the predicted environmental concentrations can be viewed on a daily basis for the selected time period.

Hydrophobic Chemicals and Mixtures: Reliable Investigations

15 SETAC Europe 28th Annual Meeting Abstract Book
on their Environmental Fate and Effects (II)

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

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

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

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

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


Higher tier biodegradation laboratory tests in soil, sediment and/or surface water systems are conducted using standard OECD guidelines. As stated in these guidelines, they are not suitable for testing volatile chemicals, however a threshold based on Henry's law is not defined, except in OECD 309. In the actual setups, incomplete mass balance is a major problem while testing volatile chemicals. Optionally, OECD 307 and 308 allow biometer-type incubation setups but it does not require any data to prove if the systems remains aerobic. In addition, the degradation kinetics in a closed test system can largely be influenced by air-water partitioning as described by Birch et al. 2017. Our objective was to design a closed incubation test set up where maintaining and measuring of aerobic conditions was possible without the loss of test chemical. Additionally, a full scale OECD 307 with two model chemicals was performed to check the reproducibility of data in terms of mass balance and to better understand the obtained degradation data. The test setup consisted of 100 ml flask with 50g soil, CO2-trap and a Tenax tube completely closed using a stainless steel lock system. Oxygen saturation in the headspace was measured in a reference sample using optical measurements without the need to open the vessel. If the oxygen saturation was < 15%, the samples was aerated with oxygen-rich air. Applying this setup, degradation of 14C-labelled Tetralin and Decane was conducted on soils with different texture, organic carbon and microbial activity. At sampling dates the headspace 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 99.29% (N=90) for Decane and 104.34% (N=90) for Tetralin with a variation (between the individual replicates) < 11% for both studies suggests that obtaining a complete mass balance with the new test setup was reproducible. It was observed that radioactivity adsorbed on Tenax (100% parent), was higher in the soils with lower OC content suggesting that sorption of the chemical affecting its volatilization and hence degradation. Thus, how to deal with the volatilized parent fraction while calculating degradation kinetics is still a part of ongoing research.

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

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Persistence assessment using standardized (e.g., OECD) tests is one of the main challenges for hydrophobic organic chemicals (HOCs). While the use of radiolabeled chemicals brought major advances, mechanistic models can still provide deeper insights in experimental results and underlying processes. In this context, the key objective of this study was to test the applicability of a unified modelling approach across the spectrum of OECD degradation tests and newly developed experimental tests for HOCs. We specifically aimed at (i) elucidating biodegradation kinetics and improving their estimation by including a new method for microbial yield calculation; (ii) determining 14C fractions (mineralized, incorporated in biomass and non-extractable residue NER) at the end of tests as persistence indicators. The unified model for sorption and biodegradation (in combination with the Microbial Turnover to Biomass growth yield estimation method) was used to predict mineralization to CO2, growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 14C-labeled HOCs (tricosan, pentachlorophenol—PCP, propargite and pyrpyroxyn). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil and in novel passive dosing setups, in an example of a single chemical and with agreement between model predictions and empirical data was shown by adjusting only the ratio v_sorption/K_w, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of v_sorption/K_w values was shown for the selected substances (0–55 m2 g-1 d-1), indicating that both limited bioavailability and intrinsic recalcitrance can explain HOC persistence. This study represents a first attempt of using a unified modelling approach for predicting biodegradation of HOCs across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including the formation of intermediate transformation products; (ii) determining (de)sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.

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

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Polychlorinated biphenyl (PCB) deposition to the north polar regions has long been recognized. Here we investigate quantitative and qualitative PCB inputs to the Lomonosovfonna glacier on Svalbard from an ice core drilled in 2009, and a snow pit from spring 2010. Lomonosovfonna is the highest-elevation ice on Svalbard at 1250 masl. It is above the tropospheric boundary layer at all times of year (maximum ~1000 masl), so all of the contaminant inputs have sources from long
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 y-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 per gram profile is dominated by PCB 110, 74, 101, 75, 95, 111, 138, 156, and 153, followed by PCB 180 and 149, which were often larger than geographic differences in characterization factors 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.

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Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas
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Organic UV stabilizers are of emerging environmental concern due to their large production volumes and potential endocrine disrupting properties. UV stabilizers are widely used in plastic products, paints and coatings to improve the product stability against UV light. Furthermore, some UV stabilizers are approved as ingredients in personal care products like cosmetics and sunscreens. The pathways into the marine environment are either indirect by wastewater treatment plant discharges or direct by recreational activities like bathing and swimming. Four benzotriazole UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be 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 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 methodology in a global perspective: Status and outlook (I)

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Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia
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The development of spatially differentiated life cycle impact assessment (LCIA) methods and their use in regionalized life cycle assessment (LCA) has intensified in the past few years. However, it has been less investigated whether spatial differentiation leads to more correct decisions based on the LCA, in addition to just more accurate and realistic LCIA results. The aim of this work was 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 when compared to site-generic scores and (iv) irrespective of the geographic locations, regionalization of impact scores did not lead to site specific impact scores. 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 statistically significant difference in impacts of best performing villages in terms of total damage to human health and ecosystems, although village performing worst with regard to total damage to human health changed. There was a general tendency that biochar production using both Kon Tiki and Adam retort kilns performed better than earth-mound kiln, and furthermore biochars brought largest benefits where no-biochar agricultural production systems were based on inorganic fertilizers. This rather consistent ranking was mainly due to relatively large geographic differences in life cycle inventories between villages, which were often larger than geographic differences in characterization factors between site-specific and site-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.

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Considering space debris related impacts within the LCIA framework
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The space sector is a new area of development for LCA studies. The European Space Agency (ESA) has been working since 2012 on environmental issues for space activities through its Clean Space Initiative. ArianeGroup, which is the prime contractor for the development of the new Ariane 6, is currently performing an LCA of this launcher in exploitation phase (ESA’s contractual requirement). However, the current studies adopt a Cradle-to-Launch pad approach due to lack of relevant modelling for use and disposal phase. In addition, a rising sustainability concern is occurring in the space sector particularly regarding impact of space debris: 29,000 human-made objects, larger than 10cm, are orbiting the Earth but only 6% are operational spacecraft, being today a significant and constant danger for all space missions. Consequently, considering end-of-life management during the design of space missions becomes a subject of major concern. Given this situation, there is an opportunity to make the link between space debris concern and eco-design of spacecraft (satellites & launchers) using the LCA methodology. A focus should be put on the comparison of several missions & post-mission disposal scenarios to study potential trade-offs between typical impact categories (e.g. toxicity and climate change), but also with regard to the growing issue of space debris. Hence, our challenge is to integrate, via a dedicated additional indicator, space debris related impacts within the LCIA to broaden the scope of LCA for space systems. The Area-of-Protection Resources has been identified to reflect the depletion of available orbits by the potential generation of space debris. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s different missions. Volume occupancy by debris and dead space debris leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

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Implementing ozone formation effects due to poplar plantations for biomass production: An LCA study in Europe
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Poplar trees are known to emit volatile organic compounds, among them isoprene, which enhances tropospheric ozone formation. Ozone exposure, in turn, causes adverse effects to human health and ecosystems. In the context of a energy transition, it has been proposed to plant poplar biomass in Europe as a source of renewable energy. The goal of this research was to determine country specific characterization factors (CFs) for ecosystem damage due to ozone formation from isoprene emissions caused by poplar tree plantations in Europe. CFs were defined as the change in potentially affected fraction of plant species (PAF) due to a change in the country-specific poplar plantation area (in km²/year/km² poplar) and consists of a fate factor and an effect factor. To determine the fate factor, changes in Accumulated Ozone over a Threshold of 40 ppb (AO40) in all grid cells connected to isoprene emissions resulting from additional poplar plantations on 1% of agricultural land in each country were estimated with chemistry transport model.
84 Relative potency approach for using in vitro information for calculating human effect factors in LCA

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Although manufactured nanomaterials (MMMs) offer several advantages compared to their bulk form, several concerns have been raised on their environmental and human risk. The LCA methodology is a valid tool to assess the environmental and human impact of nanomaterials. However, LCA studies of nanomaterials and nanotechnology are currently affected by a gap of knowledge regarding the exposure and toxicity of MMM releases into the environment during different life cycle stages. Within the LCA methodology, the human toxic effect (EF) is evaluated based on Edi extrapolated by in vitro studies or human studies. In vision of the “Toxicity Testing in 21st Century”, the in vitro tests are expected to be replaced by in vivo tests. Also, for emerging materials such as nanomaterials, still a scarce number of in vivo data are available in literature. Given the expansion of in vitro testing, there is probably a potential to use outputs from such in vitro testing in order to derive Edi values for the use in LCA studies. Here, we propose to integrate in vitro data in the assessment of the human toxic potential using a relative potency (RP) approach. The RP approach has been widely used by toxicologists for ranking chemical, to calculate the equivalent dose of one chemical that produce the same response as another at a specific dose or to define toxic equivalence factors. In vitro tests have been developed for nano-CuO, nano-Ag and nano-ZnO in combination with a relative potency (RP) approach. Until more comprehensive toxicity data (i.e. Edi) as well as more a sophisticated method to convert in vitro to in vivo data become available, we can consider in this study applied procedure as the good approximation in order to make use of the already large and continuously increasing body of in vitro toxicological studies on nanoparticles and like this allow their use in the field of LCA.

75 Integrating endocrine disruption into life cycle impact assessment

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Converging lines of evidence suggest that exposure to ‘endocrine-disrupting chemicals (EDCs)’, i.e. chemicals with the ability to interfere with and alter functions of the endocrine system, is linked to multiple adverse effects on humans and wildlife (e.g. diabetes and reproductive dysfunctions). Currently, life cycle impact assessment (LCIA) models targeted at characterizing toxicity-related impacts of chemicals do not make use of the EDC toxicity. This study proposes a new approach to include endocrine disruption (ED) as a new impact pathway within LCIA and establish two new impact categories (Human ED and Wildlife ED), thereby capturing adverse endocrine-mediated effects on humans and ecosystems separate from other toxicity-related impacts. Relying on the USEtox model, the calculation of fate and exposure factors remains unchanged, while the effect factor is determined using effect data on several ED-sensitive toxicological endpoints, thus reflecting the spectrum of endocrine mechanisms by which an EDC is known to act (e.g. estrogen receptor antagonism or interference with thyroid pathways) and the resulting mosaic toxic effects. To overcome potential data constraints in finding sufficient toxicological effect data for the thousands of chemicals suspected to exhibit endocrine-disrupting characteristics, data provided by the United States Environmental Protection Agency on the basis of in-vitro high-throughput screening assays for the endocrine bioactivity of more than 1,000 chemicals is examined for its suitability to be used in the proposed approach. New characterization factors for a set of known EDCs will be provided to directly enable characterization of EDCs and their adverse effects within future life cycle assessment studies.

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

K. Bester, Aarhus University / Environmental Science; M. Escolà Casas, Aarhus University / Department of Environmental Sciences; U. Bollmann, Aarhus University / Environmental Science; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; E. Toresi, Kruger A/S; H. EI-taliawy, Aarhus University / Department of Environmental Science; L. Zhang, Aarhus University / Department of Bioscience; G. Ooi, K. Tang, DTU Environment; H.R. Andersen, Technical University of Denmark / Department of Environmental Engineering; M. Christensen, Anox Kaldnes Pharmaceuticals and other compounds need to be removed from wastewater. This contribution will give an overview on the possibilities of removing micropollutants with biofilms. Biofilms occur in nature, but are also increasingly used in technical installations to remove micropollutants from water (wastewater and drinking water), porous media biofilm systems (sandfilters), moving bed biofilm systems (MBBRs). Biofilms can remove considerably better than suspended bacteria: diclofenac is recalcitrant in sludge systems, while it can be degraded with half-lives of 2-4 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 degradations. It was found that BOD supply has massive impact on the removal: On the one hand high BOD loads led to enhanced growth of biofilm, resulting in high turnover and reaction rates also of the respective micropollutants. On the other hand the biomass related reaction rate constants are considerably higher with low BOD loads. The highest reaction rate constants and biomass related reaction rate constants were found for systems with intermittent BOD loading. The switch from aerated to denitrifying conditions, however only gives effects for a chosen few compounds like ibuprofen, while reaction rates usually are similar. So the redox conditions as such are obviously not critical. Biofilms have often proven to have unique degradation pathways leading to hitherto strange metabolites. On the other hand compounds that were believed to be recalcitrant (like diclofenac) could easily be degraded in relatively short time periods. For single compounds degradation pathways for biofilm systems are discussed and compared to other systems. – While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfation 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 anti-oxidation pathways in the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diclofenac.

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

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Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g. algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one anticonvulsant using laccase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,2‘-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS), as a mediator. The experiments were conducted in MilliQ water at different pH values, with different ratios of laccase and mediator, under aerobic and anaerobic 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 radiation experiments on other antibiotics will be discussed in this conference presentation. The identification of transformation products of the antibiotics using high resolution mass spectrometry, and the microbial activity of the transformation products, will also be presented. This study provides a better understanding of the biodegradation of emerging organic contaminants and their transformation products. Further work can be done in assessing the possible health and environmental risks associated with the re-usage of treated wastewater, for applications such as irrigation and groundwater replenishment.

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

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The aim of the present study was to investigate the transformation of three prominent representatives of macrolide antibiotics (azithromycin – AZI, clarithromycin – CLA and erythromycin – ERY) in model biodegradation and ozonation experiments. The study included determination of the degradation kinetics of the parent compounds, identification of transformation products and ecotoxicological evaluation of transformation processes using two different end-points. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/triple quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (Bacillus subtilis), while toxicity test was performed with the freshwater green algae Desmodesmus subspicatus. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was lower. The capability of the tested abiotic and biotic matrices to induce the formation of transformation products, as well as to inhibit the growth of model microorganisms, was analyzed. The environmental relevance of the identified biotransformation products, some of which included previously unknown linearized TPs, was proven by screening the municipal wastewater extracts for their presence. The effect-driven evaluation of the studied transformation processes, based on toxicity to algae and residual antibiotic activity, indicated a significant reduction of harmful effects, however formation of numerous stable transformation products, warrants further ecotoxicological assessment.

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

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The demand of multicomponent methods for the analysis of compounds of emerging concern in environmental matrices. Constructed wetlands (CWs) and microalgae. However, conventional techniques based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for SPE, GC-MS, 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 30 ng g⁻¹ in sludge), versatile and green. The method was successfully applied to real samples from a novel pilot scale anoxic-aerobic photobioreactor, where the influence of the organic load on the removal efficiencies (REs) of the CECs was evaluated. The three operational stages, at three different concentrations of chemical oxygen demand (COD) (690±6 mg L⁻¹, 493±1 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 82±5%, 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 propylparaben, high elimination rates (above 80%) were observed regardless the COD concentration. Oxidation, biodegradation, sorption, volatilization and photodegradation were discussed as the possible removal mechanisms of the tested contaminants. This constituted the first evaluation of CECs removal by a synergetic interaction between algae and bacteria depending on the organic carbon load.

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

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There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The capability of a second-stage sewage treatment plant to degrade pharmaceuticals from wastewaters in African countries is also not fully known. There is scarcity of information concerning the utilization of grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHL). This study therefore aimed at monitoring of the three antibiotic residues in selected surface water samples. Activated carbons from grape slurry were produced and explored for abatement of the antibiotics’ residues from aqueous solutions. An UHPLC-UV-DAD was optimized for the separation, detection and quantification of antibiotics in aqueous matrix. Solid Phase Extraction (SPE) procedure was optimized for recovery studies. Surface water samples were collected along the mainstream and the drainage stretch of the 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 contaminants by activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate the contaminated water using the activated carbons prepared from grape slurry waste. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing absorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherms studied. The biodegradation sorption, and mineralization of the antibiotics onto activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

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

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Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove these pollutants. 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 Phragmites australis were the most efficient plant species in removing ibuprofen and isoxeole. Phragmites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
plant tissue was documented. Formation of transformation products was assessed, but the mass balances were not closed. Organic micropollutants sorption to support matrix was low. Removal of different compounds was higher in summer than in the winter. Planted reactors showed higher efficiency than unplanted reactors, stressing the synergies between the plant and the microbial community. Unsaturated systems tended to be more efficient. Removal correlated with the nitriﬁcation activity and with the bioﬁlm density, suggesting that bacterial processes played an active role in the micropollutants biodegradation. The removal of the organic micropollutants in CWs is affected by several design and operational parameters. Plant uptake does occur but photodecomposition is low as the compounds can be degraded inside the plant tissues. Due to overlying effect of the plants, the extent of microbial degradation could not be quantified. Further studies on transformation products in this type of technical systems are needed.

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

83 Effects of PAH exposure on fuelling ability in a long distance migratory shorebird
K. Bianchini, University of Saskatchewan - Toxicology Centre / Toxicology; C.A. Morrissey, University of Saskatchewan / Biology
Many shorebirds are long distance migrants that stop to refuel along the journey where they can be exposed to pollutants that may impede fuelling for migration. Exposure to organic pollutants can cause potential effects on migration success, speed and subsequent population parameters since pre-migratory fuelling is correlated with reproductive performance upon reaching the northern breeding grounds. The polycyclic aromatic hydrocarbons (PAHs) found in marine oil pollution have the potential to interfere with pre-migratory fuelling physiology in shorebirds. However, a link between PAH exposure and pre-migratory fuelling has yet to be established. Our objective was to determine if PAHs or associated contaminants can affect condition and fuelling rates in a captive shorebird, the Sanderling and in the field at major shorebird stopovers. In this study, a captive population of 49 Sanderling (Calidris alba) was orally dosed with a commercial PAH mixture for 21 days at ecologically relevant concentrations (0, 12.6, 126, and 1260 PAHs). We found that PAH exposure and pre-migratory fuelling activity has significant 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 sesame bile acid concentrations, elevated sesame creatine kinase concentrations, and with high sesame 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 the largest stopover duration in the Gulf of Mexico was 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 PFAs levels, oxidative status and reproductive success in great tits (Parus major) inhabiting a contamination hot-spot
A. Lopez Antolin, Universiteit Antwerpen / Biology; T. Groffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; L. Bervoets, Universiteit Antwerpen; R. Lasters, E. Prinsen, H. Abd Elgawad, University Antwerp; M. Eens, University of Antwerp / Department of Biology
Perfluorooalkyl acids (PFAs) 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 on their effects on wildlife. We report here PFAs egg and plasma levels in wild populations of great tits (Parus major) settled along an established pollution gradient starting from a fluorochemical 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 PFAs levels in the eggs and reproductive parameters, including the total hatching success, eggshell thickness or the total breeding success. PFAs levels in blood correlated with protein damage in adult birds while in chicks they correlated with higher activity of antioxidative enzymes (GPX and CAT). The obtained data represent an important step towards the understanding of the behaviour, effects and consequences of PFAs in wild bird populations. [1] Buck RC, Franklin J, Berger J, Hites RA, Erler MJ, Cousins IT, de Voogt P, Jenson A, Kannan K, Mabury SA, Van Leeuwen SP (2011). Perfluorinated and polyfluorinated compounds in the environment: terminology, classification, and origins. Integ Environ Assess Manag 7: 513-521. [2] Giesy JP and Kannan K (2001). Global distribution of perfluoroococane sulfonate in wildlife. Environ Sci Technol 35: 1339-1342. [3] Giesy JP and Kannan K (2002), Peer-reviewed: perfluoroalcohoc 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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The ingestion of lead ammunition is the most important source of exposure to this metal in birds of prey, and consequences on their health are well-known. The objective of the present study is to improve our knowledge on the exposure to Pb in birds of prey from Spain by means of passive monitoring devices. We will compare the results of monitoring programs based on Pb analysis in blood and liver of raptors and by the evaluation of the effects on their health by using non-destructive blood biomarkers. We have performed a passive monitoring by measuring blood (n=27) and liver (n=685) lead levels in birds of prey of 16 species found dead or sick in Spain between 2004 and 2017, but also an active monitoring by measuring blood lead levels in birds (n=196) experimentally exposed to high dose group relative to controls and fuelling rates and condition were also lower in dosed birds. Higher PAH exposures were associated with reduced sesame bile acid concentrations, elevated sesame creatine kinase concentrations, and with high sesame 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 the largest stopover duration in the Gulf of Mexico was longer than in Chaplin Lake (27 versus 15 days), and that stopover duration was associated with body condition and fuelling status at capture. We also measured higher plasma PAH concentrations in birds at certain Gulf sites, suggesting that PAH exposure is associated with lower pre-migratory fuelling rates. This work will inform shorebird conservation by providing valuable insight into a potential cause of migratory shorebird declines.

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analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dry wt): 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-radius around the nest (+), distance from nest to urban areas and greenhouses (-, altitude (+) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p′-DDE levels, but decreased with embryo development. Propoxphyrin IX was the only pigment in eggshells and its concentration was negatively affected by HCB levels in egg content.

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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. Shore, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croose, The Vincent Wildlife Trust; M.G. Peretta, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hanke, National Museums Scotland; R. McDonald, University of Exeter / Environment and Sustainability Institute

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

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The threshold option, the recovery option and landscape modelling
P. Thorbek, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior

Landscapescapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivered service vary widely both spatially and temporally. In order to understand how pesticides may affect ecosystem services and biodiversity at the landscape level, it is necessary to understand both exposure and effects at the organism level, but also how life history, movement patterns and farming activities such as tillage and harvest affect population dynamics. If this has to be done for all species in all landscapes in Europe the modelling task quickly becomes unmanageably complex, and the interpretation of the modelling outputs will be challenging. Here we present a tiered system for model design to aid managing the complexity. We outline what model design features are necessary for modelling based on species mobility and whether the ecological threshold option (ETO) or the ecological recovery option (ERO) is chosen. Ecological production functions quantitatively link the service-providing units to the services delivered and are thus an essential tool as an approach to population modelling (e.g. biomass or functioning) contribute to the final ecosystem services enjoyed by the recipients. Such understanding can be used to set the protection goals for different service-providing units for both ETO and ERO. The attributes which link to service delivery can be difficult to measure at the landscape level, but by combining ecological models and ecological production functions, thresholds can be set for lower tiers of the risk assessments, which may be easier to measure. In some cases the ecological production functions are quite simple if a population directly delivers the service (e.g. for angling). However, in other cases, the link is far from straightforward and such ecological production functions have largely been ignored in pesticide risk assessment. This should be a priority area for future research.

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Understanding risk - a better approach to reduce uncertainty
M. Wang, WSC Scientific Gmbh / Dept Efate Modelling; M. Foudoulakis, Dow Agrosciences / RSRA ERS

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

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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 last decades. The current scheme of agricultural intensification resulting in landscape simplification is considered one of the main causes of this biodiversity loss, along with widespread use of pesticides. As the management of landscape heterogeneity seems to be crucial for maintaining vital populations in agro-systems, it is necessary to include the landscape component in ERA and as the important mitigation strategy. We present a methodological framework for modelling the spatio-temporal heterogeneity in agricultural landscapes. The framework has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on the population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g., forest, arable farm). 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 perennial 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 manipulation, makes creating highly realistic representations of agricultural landscapes feasible and usable for landscape-scale pesticide risk assessment. More importantly, the presented tools allow for testing in silico various scenarios of agricultural practices, including pesticide use, in differently structured landscapes. This seems at the moment the most promising strategy for elaborating sustainable agricultural practices that would allow for high productivity, whilst still protecting the agrobiodiversity. This study was supported by the National Science Centre, Poland (2015/19/B/NZ6/01939).

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Where are the Springtails? A vertical distribution model for Collembolans
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University, Institute for Environmental Research / Institute for Environmental Research

With respect to environmental risk assessment it is crucial to know where and when to protect an organism but still little is known on the dispersal of collembo1an 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 with population effect. We will present the individual-based model of the soil-dwelling collembolan *Folsomia candida* FOLCAS (*Folsomia candida* simulation). FOLCAS is a vertical distribution model simulating an agricultural soil column, which can be applied to demonstrate the effect of variations in environmental parameters on the population and its dispersal. In addition, the model features the option to evaluate the effect of a pesticide application. The model consists of two submodels: the lifecycle and the movement submodel. The movement of the individuals in FOLCAS is influenced by temperature, pore space, pH and the organic matter as a proxy for food availability. In order to assess the importance of food availability as a main trigger for movement a vertical distribution experiment was designed. In this experiment we assessed the vertical dispersal of *F. candida* in OECD soil relating to food location and time. Transparent PVC columns were filled with 350 g OECD soil up to 20 cm column height and 86 individuals of *F. candida* of different age classes were added. Each column was divided in 6 compartments from top to bottom: 0-1cm, 1-2.5cm, 2.5-5cm, 5-10cm, 10-15cm and 15-20cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (24°C temperature, 16 hr light). The dispersal of individuals and simulation results of the vertical dispersal of collembo1ans 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

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Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allow for the incorporation of individual variability, population-level interaction 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 field data obtained in Scotland. Modeled 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

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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 pathways and Bayesian networks. Now we are extending the integration of ecological endpoints, ecosystem services and human well-being from the scale of a contaminated site to that of the Salish Sea. The Salish Sea is a term applied to both the Puget Sound and its watersheds in the United States and the Straits of Georgia in Canada. Vancouver, Seattle, Tacoma, major ports, numerous refineries, paper mills, and high tech industries. The same area is also noted for intense agricultural use, outdoor recreation and the harvest of marine resources. The region is also home to more than 30 recognized Tribes in the U. S. segment and First Nations in Canada. We will use three watersheds in this region, the Skagit, the Nooksack and the Cedar as case studies. Time frames will be from current conditions to 2070 and will include climate change projections on 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 / 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±2.0±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, 6-8, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by spICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms overtime. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg-1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.

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, deposition might result in resuspension of the ENP. The fate and impact of Ag ENP in soils is still unclear. Short- and long-term column remobilization experiments with disturbed soils, short-term column percolation experiments with undisturbed soils, and long-term field lysimeter experiments were conducted. All experiments were performed with sterically stabilized Ag ENP (AgNM-300k), and a slightly loamy Cambisol (ReSoL 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag\textsubscript{diss}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation showed the highest remobilization of Ag which was below 10% of the Ag\textsubscript{diss} concentrations in the soil columns. The correlation between remobilized Ag\textsubscript{diss} and Ag\textsubscript{diss} concentrations suggests that the remobilized amount of Ag was associated to soil colloids. The breakthrough of Ag ENP in the column percolation experiments was high but incomplete in the Cambisol and the Luvisol. Particularly, columns with preferential flow pathways showed low Ag ENP retardation. In the unsaturated experiments, a nearly complete retention was found for the Luvisol that showed a clearly smaller pore size structure than the Cambisol. The horizontal displacement of Ag\textsubscript{diss} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag\textsubscript{diss} release to the percolate water (t= 480 d, control= 24 ng l\textsuperscript{-1}, Lysimeter (7 mg kg\textsuperscript{-1}) = 56 ng l\textsuperscript{-1}, DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. TNP were induced in a readilblattable packed column. No TNP were detected in the lysimeter with the lower Ag ENP concentration. All roots (wheat, canola, barley) showed a low uptake of Ag\textsubscript{diss}. All approaches showed a more or less high retention of Ag ENP in soils why soils are a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil micororganism and the root uptake (e.g. beef) needs further long-term investigations.

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

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

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

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Engineered nanoparticles in wastewater streams are effectively retained by wastewater treatment plants and accumulate in sewage sludge. Digested sludge is subsequently combusted for further volume reduction to allow for phosphorous recovery at a later stage. This study focuses on two metals Cu and Zn, as both are present in digested sludge but are also used as nanomaterials. We investigated (i) the transformation of ZnO and CuO-NP during anaerobic digestion, (ii) the subsequent transformation of Cu and Zn during sewage sludge combustion, and (iii) whether the form of Cu and Zn affects the rate during anaerobic digestion and combustion. We spiked CuO-NP, ZnO-NP, Cu\textsuperscript{2+} and Zn\textsuperscript{2+} to four aliquots of sewage sludge. The sludge was homogenized and transferred into batch reactors and stored for 24h. One aliquot was kept as control. Thereafter, sludge was combusted in a pilot fluidized bed reactor and ashes were collected. Sludge and ashes were prepared for Cu - and Zn K-edge X-ray absorption spectroscopy (XAS) measurements. The speciation of the metals was obtained through linear combination fitting (LCF) of X-ray absorption near edges spectra (XANES) and extended X-ray absorption fine structure (EXAFS) data. LCF fits of experimental XANES and EXAFS data suggest a high degree of sulfidation of both Cu and Zn during anaerobic digestion, irrespective of the spiked form of Cu and Zn. For control sludge and sludge spiked with Zn\textsuperscript{2+}, LCF results from EXAFS data suggest that ~90% of the Zn was present as sulphides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~83% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a Zn spectrum that was co-precipitated with Ferrihydrite. All LCF fits of Cu in the digested sludge indicated complete sulfidation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable from ZnO and CuSO\textsubscript{4} were returned from LCF analyses. All Cu spectra of the sludge and the ashes were very different and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn\textsuperscript{2+}. All Zn spectra of the ashes were comparable.

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

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As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-across from ionic silver to silver nanoforms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs. nanosilver were tested. The smallest silver nanoform with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~85% ZnS) with a concomitantly high fraction of ZnO (17%)). Total silver in soil, and total dissolved (0.45 μm filtration) Ag and Cu were measured by ICP. The leaching speed of the porewater was measured (ICP-MS). Toxicity of nanosilver on soil nitrification was similar to or less than silver nitrate when expressed on the basis of total Ag in soil. Total and truly dissolved Ag in porewater decreased over time after silver nitrate spiking, suggesting ageing processes. Concentrations were always higher or equal to corresponding values after nanosilver spiking. For nanosilver spiking, total and truly dissolved Ag in porewater initially increased and decreasing dissolution processes. From day 4-7 after spiking onwards, concentrations decreased over time suggesting that ageing becomes more important than dissolution. Truly dissolved Ag in porewater qualitatively explained observed toxicity of silver nitrate compared to nanosilver. The data show that soil ecotoxicity data for ionic silver are conservative for soil ecotoxicity of nanosilver.

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

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The increasing use of engineered nanoparticles (ENPs) inevitably entails emissions to the environment, raising calls for nano-specific environmental risk assessment approaches and regulations. As surface waters are the major receiving compartment, assessing risks requires understanding the aquatic fate of ENPs where, unless soluble in water, aggregation, including homo- and heteroaggregation with natural suspended particulate matter (SPM), or stabilisation by natural organic matter (NOM). Due to the omnipresence and larger size of SPM, heteroaggregation is much more likely than homoggregation. However, integration of this process into fate models and exposure assessment requires parameterisation and is still limited by the lack of simple, yet environmentally relevant experimental protocols. Such could be developed along the lines of the recently adopted OECD testing guideline 318 on ENP dispersion stability, currently accounting only for homoggregation. The principles of homo- and heteroaggregation are basically the same: the probability of particle attachment is
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from heteroaggregation is the complexity added to the system by SPM in the case of bareoaggregation. 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 bareoaggregates capable 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
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Different types of crude oil can be identified by the arrangement of constituents, or their chemical fingerprint. In addition, chemical fingerprinting can be used to associate contaminated sediments with specific spill events like the Deepwater Horizon disaster of 2010. Mississippi Canyon-252 (MC-252) source oil, the type of crude oil specific to the Deepwater Horizon event, has been fully characterized by researchers at LSU, including pattern identification of the ion 217 and 218 hopenes heteroaggregates. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shuffling regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the study region. A toxicity-effects model was 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 origin 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 intermoulnd duration in the blue crab, Callinectes sapidus, in response to oil exposure
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The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. A number of factors intrinsic to the water column, and extrinsic factors (e.g. cloud cover, time of day, seasonal variations). Tissue repair mechanisms may be sufficient to counteract some effects of photo-induced toxicity during periods of relief from UV exposure. Here, we report the results of experiments in which larval red drum (Sciaenops ocellatus) and zooxanthellae (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 latent mortality was observed in daphnia for several days following exposure to contaminated seawater and sediments. The o

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

Sponges (phyllum Porifera) are a diverse group of filter-feeder organisms present in most aquatic environments. In the marine environment, sponges perform a wide range of ecological functions including cycling of nutrients such as carbon, nitrogen and silica; and, in areas where they are present at high densities (spawning 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-hour cronic activities were included in an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. A number of factors intrinsic to the water column, and extrinsic factors (e.g. cloud cover, time of day, seasonal variations). Tissue repair mechanisms may be sufficient to counteract some effects of photo-induced toxicity during periods of relief from UV exposure. Here, we report the results of experiments in which larval red drum (Sciaenops ocellatus) and zooxanthellae (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 latent mortality was observed in daphnia for several days following exposure to contaminated seawater and sediments. The o

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

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic contaminants composed of two or more fused carbon rings and are a main constituent of crude oil. Exposure to ultraviolet radiation (UV) can exponentially increase the toxicity of photodynamic PAHs to biota, leading to adverse outcomes well below the threshold of other mechanisms of toxicity. This phenomenon is known as photo-induced toxicity and is well documented in a wide range of aquatic organisms. Consequently, laboratory tests investigating effects of PAH on aquatic biota which fail to account for potentiation by UV may significantly underestimate toxicity. The intensity of UV exposure to biota is highly variable within aquatic ecosystems, due to a number of factors intrinsic to the water column, and extrinsic factors (e.g. cloud cover, time of day, seasonal variations). Tissue repair mechanisms may be sufficient to counteract some effects of photo-induced toxicity during periods of relief from UV exposure. Here, we report the results of experiments in which larval red drum (Sciaenops ocellatus) and zooxanthellae (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 latent mortality was observed in daphnia for several days following exposure to contaminated seawater and sediments. The o

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

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

SETAC Europe 28th Annual Meeting Abstract Book
Photoenhanced toxicity is a distinct mechanism of petroleum toxicity that is mediated by the interaction of solar radiation with specific polycyclic aromatic compounds (PACs) in oil. Photoxotoxicity is observed as a 2 to greater than 1000-fold increase in chemical toxicity to aquatic organisms that have also been exposed to light sources containing sufficient quantity and quality of ultraviolet radiation (UV). We investigated the light sensitivity of teleost embryos to the weathered distillate crude oil and weathered middle distillates, and heavy and light oils to exhibit photoenhanced toxicity. These same products do not exhibit photoxotoxicity in standard test protocols because of low UV irradiance in laboratory lighting. Fresh water, estuarine and marine waters have been shown to have sufficient solar radiation exposure to elicit photoenhanced toxicity, and a diversity of aquatic invertebrate and fish species can exhibit photoenhanced toxicity when exposed to combinations of oil and UV. Risks of photoenhanced toxicity will be greatest to early life stages of aquatic organisms that are translucent to UV and that inhabit the photic zone of the water column and intertidal areas exposed to oil.

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

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

Fish model species in human and environmental toxicology (II)

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

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

108 Characterization of molecular toxicity pathways of Fluoxetine in rainbow trout and white sturgeon using RNA-Seq whole transcriptome analyses.

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

109 Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish.

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Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in adult organisms as a result of early-life exposure in ways that are biologically and environmentally relevant. Risks of studies exist of maternal fish species, such as Menidia beryllina, a euryhaline fish with short generation time that is found throughout North America and is demonstrated to be sensitive to contaminants. As such, we exposed Menidia beryllina embryos (8 hpf) until 21 dph to dexamethasone (a rodent EDC) and ethinylestradiol (EE2) (5 ng/L), with consequences for multiple life stages, and species. Due to the similar changes observed in species, and effects on the mid-brains of male mice, we sought to confirm the altered dopamine concentrations in P. promelas brain in a higher vertebrate species. Metabolomics was performed on the mid-brains of male mice (Mus musculus CD-I) exposed to similar concentrations of dietary MeHg for 30 days. Changes in dopamine concentrations of the telost brain were mirrored in the mid-brains of male mice, and several other significant changes to the mouse mid-brain metabolome were detected. Collectively, these results suggest current environmental exposure scenarios to MeHg are sufficient to induce a number of molecular-level changes that are associated with costs to whole organism fitness, with consequences for multiple life stages, and species. Due to the similar changes detected in mice, there is increasing evidence to suggest teleosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.
F1 generations demonstrate that exposure to EDCs increased growth in the parental larvae, and that androgenic treatment groups (Levo, TB) maintain this growth through the subsequent F1 generation. In the F0 adults, differences in immune response are apparent between bifenthrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifenthrin-exposed individuals relative to controls. Bifenthrin-exposed parental females have increased atretic 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.

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

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 (Oncorhyncus mykiss) yolk sac larvae were exposed to sublethal concentrations of PAHs that act via different mechanisms of toxicity: Retene, an AhR agonist causing dioxin-like toxicity; pyrene and phenanthrene, weak AhR agonists causing toxicity independently of AhR; and fluoranthene, a CYP1A inhibitor interfering with PAH metabolism. Also the effects of a mixture of retene and fluoranthene were studied. Information was gained at multiple levels of biological organization to reveal the mechanisms of toxic action. Changes in cardiac transcriptome, proteome and metabolome were explored over time. Physiology and function of the heart were also studied. At the whole organism level, growth, yolk consumption, and developmental defects and abnormalities were monitored. Each PAH caused a unique pattern in OMICS analyses, and the mixture of retene and fluoranthene caused a different transcriptomic profile from that of each of the single compounds. Retene differentially regulated genes involved e.g. in muscle contraction and ion metabolism (ion channels). Retene and phenanthrene impaired cardiac function in larval rainbow trout. Both caused bradycardia, and phenanthrene caused 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 cardiotoxicity of retene, but the cardiotoxicity of phenanthrene seems to involve a direct effect on cardiac ion channels.

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

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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 biodiversity and the use of water resources for various industrial, agricultural and urban activities, with many focal points of point and diffuse contamination along its main axis, in addition to a high degree of modification of land use associated with the basin. The high degree of intervention and fragmentation of this river has affected the biota and water quality mainly in its lower third, due to the convergence of complex chemical mixture and anthropic interventions in the main course. The objective of this study is to determine how the development associated with this river impacts the physiological/reproductive state of the native species Percilia irwini (n = 66) in situ. Different sublethal responses were evaluated through biomarkers at different levels of biological organization (Biochemical, cellular, and individual) and environmental parameters (pH, temperature, conductivity and total dissolved solids). The results obtained indicate an increase in the Hepatic EROD activity (ethoxyresorufin-O-deethylase) towards the lower third of the river. The Gonadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a 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 Poster spotlight: MO248, MO249, MO256

Mercury Biogeosciences - Fate, Effects and Policy

119 Rethinking Atmospheric Mercury Chemistry

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

Mercury (Hg) is 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 and binds 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-RRAS), and an 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 2-13 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. Frantzén, B.M. Nilsen, A. Dunker, National Institute of Nutrition and Seafood Research / Contaminants and biohazards; L. Madsen, National Institute of Nutrition and Seafood Research / Seafarers in modernisation; M.S. Bank, Institute of Marine Research / Contaminants and biohazards; A. Maage, NIFES / Monitoring Programme

Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effects of Se against Hg have been addressed in several studies although consensus on this issue is still widely debated. Here we evaluate Se:Hg molar ratios across a latitudinal gradient in the Northeast Atlantic Ocean (NEAO) fish communities to assess species variation and spatial trends. In this study, the concentrations of total Hg and Se in 17 teleost fish species were measured using ICP-MS following microwave digestion/Julshann, 2007 #72) and the Se:Hg molar ratios were calculated. Marine fish samples (n = 8525) were collected from the Barents Sea, Norwegian Sea, North Sea, Skaggerak, North Atlantic and Norwegian fjords and coastal areas between 2006-2015. The mean Se levels ranged from 0.27 to 0.78 mg kg⁻¹ wet weight (ww) in Atlantic cod (Gadus morhua) and Wolffishes (Anarhichas spp.), respectively. The mean Hg levels ranged from 0.40 to 0.77 mg kg⁻¹ ww with the lowest level in Atlantic mackerel (Scomber scombrus) and the highest in blue ling (Molva draco), leading to variation in the mean Se:Hg molar ratios from 1.9 in blue ling to 43.2 in Atlantic mackerel with Hg levels contributing most to the variation. In general, pelagic species had the lowest Hg levels and the highest Se:Hg ratios whereas deepwater demersal species had the highest Hg levels and the lowest Se:Hg ratios. Most species had a large portion (more than 50%) of specimens with a Se:Hg ratio exceeding 5 except for tusk (Brosme brosme) (4% less than 1, 53% between 1 and 5) and blue ling (19% less than 1, 80% between 1 and 5). Se and Hg levels showed weak positive correlation (R from 0.24 to 0.70) in 13 of 17 species. The Se:Hg ratio was negatively correlated to fish length and Hg levels. Mean Se:Hg molar ratios varied across offshore areas for all species and a gradual decreasing trend was found for all species from north to south due to increasing Hg concentrations. The EU maximum level of Hg and Se:Hg molar ratio above one, we emphasize that fish from NEAO are generally safe regarding Hg contamination. Less than 1% of the total analyzed specimens had Se:Hg molar ratio less than 1 and the surplus Se may ameliorate the toxic effect of Hg to some extent.

121 The interaction of mercury and selenium across environmental media

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

Both mercury (Hg) and selenium (Se) can bioaccumulate within aquatic ecosystems and are toxic to organisms when found at high concentrations. Individually, high concentrations of both Hg and Se are toxic to organisms. Yet, despite this important link, little is understood about the effects of Se against Hg. The protective and antagonistic effects of Se against Hg have been addressed in several studies although consensus on this issue is still widely debated. Here we evaluate Se:Hg molar ratios across a latitudinal gradient in the Northeast Atlantic Ocean (NEAO) fish communities to assess species variation and spatial trends. In this study, the concentrations of total Hg and Se in 17 teleost fish species were measured using ICP-MS following microwave digestion/Julshann, 2007 #72) and the Se:Hg molar ratios were calculated. Marine fish samples (n = 8525) were collected from the Barents Sea, Norwegian Sea, North Sea, Skaggerak, North Atlantic and Norwegian fjords and coastal areas between 2006-2015. The mean Se levels ranged from 0.27 to 0.78 mg kg⁻¹ wet weight (ww) in Atlantic cod (Gadus morhua) and Wolffishes (Anarhichas spp.), respectively. The mean Hg levels ranged from 0.40 to 0.77 mg kg⁻¹ ww with the lowest level in Atlantic mackerel (Scomber scombrus) and the highest in blue ling (Molva draco), leading to variation in the mean Se:Hg molar ratios from 1.9 in blue ling to 43.2 in Atlantic mackerel with Hg levels contributing most to the variation. In general, pelagic species had the lowest Hg levels and the highest Se:Hg ratios whereas deepwater demersal species had the highest Hg levels and the lowest Se:Hg ratios. Most species had a large portion (more than 50%) of specimens with a Se:Hg ratio exceeding 5 except for tusk (Brosme brosme) (4% less than 1, 53% between 1 and 5) and blue ling (19% less than 1, 80% between 1 and 5). Se and Hg levels showed weak positive correlation (R from 0.24 to 0.70) in 13 of 17 species. The Se:Hg ratio was negatively correlated to fish length and Hg levels. Mean Se:Hg molar ratios varied across offshore areas for all species and a gradual decreasing trend was found for all species from north to south due to increasing Hg concentrations. The EU maximum level of Hg and Se:Hg molar ratio above one, we emphasize that fish from NEAO are generally safe regarding Hg contamination. Less than 1% of the total analyzed specimens had Se:Hg molar ratio less than 1 and the surplus Se may ameliorate the toxic effect of Hg to some extent.

Bioavailability and realistic risk assessment of organic
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in stagnant sediment: is multiple-thickness passive sampling the better alternative? 
D. Gilbert, NGI / Environmental Technology; A.M. Oei, Norwegian Geotechnical Inst. / Environmental Technology; N. Berrojalbiz, Norwegian Geotechnical Institute / Environmental Technology; H. Arp, NGI / Environmental Technology
Passive sampling with thin polymer sheets is increasingly recognized as a superior method allowing tool-free testing for organic risk in non-polar matrices such as 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 PRC spiked concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passive samplers of multiple thicknesses and spiked with PRCs for 5 months into contaminated sediment in the Oslo harbour. For the ex-situ study, Oslo harbour sediment and Horten harbour sediment was incubated with PRC-spiked PE under stagnant conditions at room temperature in the laboratory and samples were taken at various time points. From the PRC depletion field data, sediment porewater concentrations were modelled using the Fernandez-one-dimensional-diffusion model. In the additional field study, concentrations were modelled using a multiple thickness one-dimension model. The ex-situ uptake and release data were modelled with a one-dimensional diffusion model (uptake) and a simple exponential one-compartment model (release). The release rates showed that both in-situ and ex-situ data for uptake and release kinetics were not identical. In addition, the ex-situ experiment revealed that PRC release kinetics is also dependent on the initial PRC spiking concentration. In conclusion, the data question the usefulness of PRCs for passive sampling in sediment, as the use of polymers of multiple thicknesses can produce results that are free from biases caused by anisotropic exchange kinetics.

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

127 Implementing desorption extraction methods into bioavailability-oriented bioremediation
R. Posada, IRNAS CSIC / Agroquímica y Conservacion del Suelo; J. Garcia, Instituto de Recursos Naturales y Agrobiologia de Sevilla CSIC; M. Cantos, IRNAS CSIC / J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo
Regulators are starting to consider bioavailability within retrospective risk assessment frameworks for organic chemicals, however, implementation is not straightforward because the developments of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and their chemicals should be based on two measurable values: the total extractable concentration and the bioavailable concentration as measured with robust and reproducible chemical and/or biological methods. One of the chemical methods which has been proposed to measure bioavailability of hydrophobic chemicals (HOCs) such as PAHs is the desorption extraction with Tenax during 2h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integr Environ Assess Manag, 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retroactively contaminated land management but also prospective risk assessment applied in the approval and regulation of organic chemicals. With the aim of providing pathways for implementation into regulatory contexts, we carryout sorting extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of slow degradation pellets of PAHs) from 6 years until at least 25 years. Knowing the soil, oriented to decrease the fraction of bioavailable pollutants. The most relevant result in this study was that bioavailability increases in planted soils receiving thamnolipids, as evidenced by Tenax extraction and it was accompanied by an increased biodegradation in soil slurries. In conclusion, tenax extraction during 2h resulted a reliable and robust method to determine bioavailable concentrations in a wide set of operational conditions ranging from a different time scale to dissimilar treatments (planting, biosurfactant application, etc.).

128 Prediction of very slow biodegradation of PAHs in soil and validation in a pilot of 25 years
R. Rietra, Alkterra and Wageningen University / sustainable soil management; J. Harmsen, Wageningen Environmental Research / CALM
Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and mineral has been followed during periods up to 25 years. Biodegradation took place on real scale fields (six landfarms and one depot) within the Netherlands. On these fields degraded sediments were used as bioavailable 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 in the following 6 years at least until 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorbing fractions can be measured. Tenax applied at 20°C gives the fast desorbing fraction applied at 60°C gives the slow desorbing fraction is measured. The slow desorbing fraction in the residue represents the very slow desorbing fraction. These are the same fractions as considered in the approach of Ortega-Calvo et al., (2015). In the soil, desorption makes the PAHs bioavailable and if conditions allow biodegradation (sufficient oxygen and water), this will occur. Using results measured in stored original sediment the different bioavailable fractions were measured and using a model with three first order derations (fast, slow and very slow) the really observed degradation curve could be predicted. Moreover, the fractions measured in present soils, shows that biodegradation will continue, however with a very small slow rate. Experiments applied in the nineties of last century had already shown that risks measured with bioassays were already not measurable after 6 years of landfarming. After 25 years the PAHs concentrations were 10 mg/kg d.m. or lower which made the soil reusable within the Dutch legislation.

129 Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soils
A six-month laboratory scale experiment was carried out to assess the effect of biochar and compost amendment on the behaviour and toxicity of tar mixtures in...
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 study showed that amendment with compost had the highest percentage reduction for both soils across all metal types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the control. 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 compound and contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

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

W.J. Doucette, Utah State University / Utah Water Research Laboratory; J. Finsinger, D. McAvo, Utah State University

Reclaimed water is increasingly used in arid and semi-arid regions for irrigation. Contaminants in the reclaimed water, (e.g. pharmaceuticals and personal care products (PPCPs) and metals) could accumulate in exposed crops. Biochar is a potentially cost-effective soil amendment and contaminant sorbent that could reduce the plant bioavailability of reclaimed water associated contaminants. But its biological effects on the plants plaes remain largely unknown. Biochar undergoes 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 triclosan (TRI)), an anticonvulsant that prevents seizures and relieves nerve pain (carbamazepin (CBZ)), an antibiotic resistance in bacteria (sulfamethoxazole (SMZ) and triclosan (TRI)), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and its influence on biological properties and toxicological responses in mixed contaminated soils.

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

M. Núñez, TU Berlin / Sustainable Engineering; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Institute of Resource Management; UMR ITAP; J. Karimipour, CIRAIG; A. Boulay, CIRAIG - Ecole Polytechnique de Montréal / Mathematical and Industrial engineering; L. Scherer, Institute of Environmental Sciences (CML); F. Verones, NTNU / Department of Energy and Process Engineering; S. Pfister, ETH Zurich / Institute of Environmental Engineering

Available freshwater consumption indicators for use in LCA and water footprint studies implemented in LCA software are based on either a volumetric approach of the water consumed (what we called first generation of indicators) or on stress indicators (what we called second generation of indicators). The first generation only performs an inventory and thus a partial footprint assessment according to ISO 14046, while the second generation shows limitations in describing the consequences of a lack of water at the endpoint. To date, no LCA method comprehensively distinguishes water masses (e.g. surface water and ground water) and its influence on transport flows (to a stream) and/or on upstream habitats. The study evaluates the stress indicator of the freshwater compartment (at continental scale) after 100 years m³/100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator of adsorption processes but also of the fate of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted [kgASC/ACTgem] and represents a midpoint. It does not describe the effects of a substance on the behaviour of future generations when facing water pollution, but rather indicate the potential effect required to recover the pristine freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, long-term water supply issues (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).

132 Towards global regionalized characterization factors for water consumption impacts on instream freshwater ecosystems

M. Damian, IRSTEA Montpellier / UMR ITAP, ELSA; P. Roux, Irstea / ITAP ELSA-PACT; A. Hélias, Montpellier SupAgro / LBE ELSA; Y. Penru, SUEZ groupe / CIRSEE; R.K. Rosenbaum, IRSTEA Montpellier / UMR ITAP ELSA

Freshwater resource has been recognized as being a safeguard subject within the Arab Water Protection (AoP) framework. This has paved the way to develop regulatory frameworks and policies. Besides depletion also long-term pollution threatens the sustainability of freshwater resources, but currently no LCIA model links emissions to potential damage on freshwater as a natural resource. This study proposes a characterization model to assess the potential impacts on freshwater resources generated by persistent changes in water quality caused by chemical emissions. The relevance of this new approach regarding the methodological issues of long-term (toxic) impacts is also discussed. As recommended in the WULCA freshwater resources framework the concept of recovery period is used: when the recovery period lasts longer than a given period of time, potential impacts to freshwater resources (i.e. affecting freshwater availability for future generations) need to be considered. Based on literature review, we set the time period at 100 years, which requires a dynamic fate model. The dynamic fate model used is the dynamic version of the USEtox® model. This provides the time-integrated pollutant mass remaining in the freshwater compartment (at continental scale) after 100 years m³/100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator based on physical properties of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted [kgASC/ACTgem] and represents a midpoint. It does not describe the effects of a substance on the behaviour of future generations when facing water pollution, but rather indicate the potential effect required to recover the pristine freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, long-term water supply issues (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).

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133 Several life cycle impact assessment (LCA) models have been proposed to...
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some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of discharge limits, it is also important to decrease human footprints in the contamination is still one of the major problem which has affected the potential In addition to traditional and new generation water pollutants, microbial polymers dominated by Bacteroidia, belonging to the phylum Bacteoidetes whereas their harbors aerobic phylotypes. Free living bacteria was significantly different than living microbial communities in IN were significantly affected by the initial laccase activity and mediator attenuation processes in rivers.

Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based polymer

In a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (AER) and in the freeAttached microbial communities (ANAs) were isolated from IN 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 HRMS. Once the samples were submitted to an MS/MS, L generation of photo-TPs was studied. Several photo-TPs from 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.

Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant

in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (AER) and in the freeAttached microbial communities (ANAs) were isolated from IN 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 HRMS. Once the samples were submitted to an MS/MS, L generation of photo-TPs was studied. Several photo-TPs from 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.

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

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

Poster spotlight: MO272, MO273, MO274

Framework for building national inventories of toxic emissions to air, water and soil in Europe

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

144 Combining economic modelling and LCA to assess regional policies: key learning points from a case study on the French forestry sector
T.B. Beaussier, INRA; E. Loiseau, Irstea; S. Caurla, INRA

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

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

Keywords: Regional, spatial, biobased economy, GHG While traditional life cycle assessment is a powerful tool, for spatial applications, it is limited. With the ever increasing drive towards regional biobased circular economies, as a means of ensuring future climate change mitigation, there is a need to produce more regional and spatially representative life cycle assessments of biobased systems and bioenergy regions. “RELCA”, a Regional Life cycle inventory approach, was developed to assess the regional and spatial variation in the environmental performance of bioenergy production within a focus region. Through the use of catchment delineation, conventional geographical modelling is combined with life cycle software to assess the potential environmental burdens of regional bioenergy configurations (i.e. bioenergy plants and their biomass catchments). RELCA was used to assess the climate mitigation potential of biodiesel, for the region of Central Germany. With this approach we showed, for the focus region, that the mitigation potential changed between the different biodiesel configurations, due to their location within the region. When compared to a fossil diesel comparator (83.8 CO\textsubscript{2}-eq/ MJ), the climate change mitigation potential of the regional biodiesel ranged between 53%–62%. When the results were compared to the typical RED (Renewable Energy Directive) values, a 13-31% greater mitigation potential than the RED was observed. The latter, illustrating that regional variability cannot be captured with a simple regional average value or default value. Additionally, scenarios were used to test the mitigation potential of reduced nitrogen fertiliser application during the production phase. The results indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14-5.71 g CO\textsubscript{2}-eq/MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territoriality and geographical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.

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

The environmental performance of a wind turbine is usually calculated as the ratio of the life cycle impacts occurring during the manufacturing phase and during the use phase. The modelling of the life cycle inventory in each phase should ideally cover the temporal, geographical and technological dimensions of the product system under study. Assumptions are commonly used to simplify and handle variable aspects of the inventory. While this approach provides generic, one-size-fit-all inventories, it may disregard important characteristics of the wind turbine leading to biased end-results. As these assumptions are prone to differ from one study to another, the results become hardly comparable. With more than 1,500 wind turbine models on the market and a high variability of sites and manufacture periods of the different installations, it makes the environmental assessment of wind turbine fleets quite daunting. During the LCA_WIND_DK project, the teams involved in the environmental footprint of Danish wind turbines based on systematic individual cradle-to-grave life cycle inventories using manufacturer’s data. 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 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 approach
A. Froschfetz, ETH Zurich; R. Buffat, ETH Zurich / Institute of Cartography and Geoinformation; N. Heeren, S. Hellweg, ETH Zurich / Institute of Environmental Engineering

Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur through the whole life cycle of a product and not only at the manufacture, installation, or disposal phase. Therefore, assessing environmental footprints of households is an important basis to identify environmental policies. This study aimed to develop a comprehensive regionalized bottom-up model for Switzerland that is able to assess the environmental impacts induced by individual households. The purpose of this model is to provide a virtual platform for detailed scenario analysis which shall support effective political decision making on different scales. Three existing bottom-up models were merged: a building stock energy model, an agent-based transport simulation and a household consumption model. All of them were tested and evaluated beforehand. The physically-based building energy model establishes
simplified energy balances for each residential building based on spatially and temporally resolved climate data, building characteristics and 3D-geometries. It provides estimates of space heating, hot water and electricity demand for each household. The mobility sub-model builds upon the results of an agent-based traffic simulation framework which was applied to Switzerland and reproduces mobility patterns of Swiss inhabitants in space and time. The third sub-model pursues a data-driven approach and enables the quantification of consumption of food, consumables, and other goods and services for each Swiss household by means of data mining techniques. Linking these sub-models with environmental background data allowed for computing an environmental profile for each household in Switzerland. The application of this model to the current situation of Switzerland reveals interesting differences between individual households, district regions and different location 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 household 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

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Modelling ecological scenarios for the assessment of chemical effects on stream communities
A. Gers, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change; S. Classen, K. Ladermann, Research Institute gaiac; T. Strauss, M. Hammers-Wirz, 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 as on the states, behaviours and interactions of organisms with consequences for individual life history, population responses and community dynamics. In this regard, our major objective is to suggest how to model stream ecological scenarios for ERA. We suggest to employ ecological classifications as defined within the Water Framework Directive. Here, the ecological scenario is a virtual representation of an ecosystem, which involves both abiotic components (habitat scenario) and biotic components (the functional and life history scenario). Technically, we integrate spatial explicit habitat information in form of raster maps, temporal information on abiotic factors like temperature and chemical exposure, functional trait data bases, dynamic energy budget models and process based effect models to simulate macroinvertebrate and fish assemblage dynamics. In model applications, we explore to what extent the ecological scenario will affect the adverse outcome of chemical exposure.

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

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

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Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?
K. Dalhoff, University of Copenhagen / Department of Plant and Environmental Sciences; G. Bellisai, European Food Safety Authority EFSA; E. Neira, N. Cedrægreen, 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 toxidynamic (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 TKTD-framework for synergistic interactions in D. magna can be applied to the midge larvae Chironomus riparius to describe development in survival rates and the underlying mechanisms over time when co-exposed to azole fungicides and pyrethroid insecticides. Toxicity of the individual compounds was tested using a pulsed concentration response design with an initial 24 hour exposure period followed by six subsequent recovery pulses at intervals. To assess the contribution of the azoles and α-cypermethrin were a range of tests conducted with co-exposure to 1, 3, 10, 30, or 100 µg L⁻¹ of propiconazole or prochloraz and 2.5, 5.0, or 10.0 µg L⁻¹ of α-cypermethrin. For the TK-modelling will uptake and elimination rates of the individual compounds in C. riparius be measured to parameterize the TK-model before coupling the internal entities models. To the observed interactions with the azoles and α-cypermethrin the knowledge from experts and/or previous studies, (iii) being relevant for complex model with small dataset since there is no degree of freedom, and (iv) a clear handling of uncertainties by providing distributions of parameter posteriori. These sub-models permit testing of policies and in-depth analyses of scenarios, ranging from household refurbishment programs to future mobility solutions such as autonomous vehicle systems.

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

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

The toxicokinetic-toxodynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD kinetics, and effect measurements are usually performed in the laboratory at 20°C. This approach is rather unrealistic, especially in outdoor scenarios with significantly different water temperatures over the year: On the one hand, in cases with low water temperatures during autumn and winter, the toxic effects can be reduced or delayed, while on the other hand, the degradation of the substance is reduced or delayed, while on the other hand, the degradation of the substance is increased. This has clear handling of uncertainties by providing distributions of parameter posteriori. At this end, we developed a software tool to software tools for TKTD modeling with the widespread statistical language R (JAGS and Stan). Then, we embedded those algorithms within two R packages with the core idea to be user friendly (e.g., using experiment design to define priors). A side result is to propose a step-by-step approach to perform Bayesian statistics in ecotoxicology.

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New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

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

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-TD modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stages test (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 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 review 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 on the organism, which can be derived from laboratory experiments which make them difficult to build. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teleost fish is relatively well-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 food data was tested in order to assess the relevance of the DEB model calibrated with laboratory data for sticklebacks in mesocosms. Then, the DEB-IBM was developed and calibrated and simulated endpoints of the population dynamics in control conditions were compared to the observed endpoints of the population dynamics in control conditions or exposed to BPA. We showed that the DEB model successfully predicted the growth of male and female sticklebacks for two set of experiments in control conditions. Furthermore, the calibrated DEB-IBM successfully predicted the endpoints of stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male and female juvenile frequencies, lengths and coefficient of variations) were well described and were used to compare with the endpoints of mesocosms exposed to BPA. In conclusion, simulated endpoints of stickleback populations can thus be used as a baseline to compare exposed populations to BPA in order to improve environmental risk assessment. In a second step, the DEB-IBM could be adapted in order to introduce the effects of toxicants such as BPA on the individuals and thus extrapolate the effects at the population level.

155 Atmospheric Microplastic’s: A novel method for the identification of microplastic’s in the inhalable size range. J. Levermore, MRC Environment and Health / Department of Epidemiology and Biostatistics; T. Smith, Kings College London / Department of Geography; S. Wright, F. Kelly, Kings College London / MRC-PHE Centre for Environment and Health

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 (<10μm). 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, being the 80% of these material (PM). This approach removes operator bias while allowing for the chemical identification of all microP >3μm in size in a sample. To validate RSI for the identification of microplastics ( RSI analysis was conducted using an in-house program developed by Dr. Frederic Festy (KCL). Pre-identified features unique to polystyrene (1000.9 cm⁻¹, 1030.7 cm⁻¹ and 1602.1 cm⁻¹ ) were fit to the dataset using a Pearson-based cluster analysis to indicate spatial feature intensity (ImageJ). The identification of 4 and 10μm beads was successful and an operator based particle count detected 163 particles per 100 μL; this resulted in 85% recovery rate. However, 2μm polystyrene beads were not identified as they were found to be below the limit of detection. This automated RSI protocol facilitates the identification of microP >3μm in size, 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 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.
158 Analysis of tire wear particles in environmental samples using TED-GC-MS


Tire 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 natural (polymer 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 TRWP. We performed a previously published analytical method that uses the density separation and follow-up sequential extraction of samples. Emphasis is given to the presence/absence of these in tire-free environmental matrices and in bitumen and asphalt samples. In the next step, we analyzed environmental samples and detected signals of decomposition products from tire materials. Method parameters and options for quantitative analysis will be discussed.

159 Determination of tire wear particles based on elemental composition


In this contribution we present the analytical method development based on Zn and S content and apply the analytical method to determine tire wear particle concentrations along the treatment path of road runoff. Tire wear particles have been recognized as an important environmental pollutant. Analytical methods for the quantification of tire wear particles in environmental samples are still under development and struggle with multiple sources or insufficient stability of markers. We developed an analytical method which allows quantifying tire wear particles in road runoff, sediments and surface waters. Tire wear particle quantification is based on elemental composition and distinct elemental ratios. The analytical method aims at (i) tire wear particle enrichment using density separation followed by (ii) simultaneous assisted acid digestion and (iii) elemental detection of sulfur and carbon. A stepwise method development including alternative methods and verification by determination of the rubber content is presented. In particular, S and Zn are present in characteristic concentrations in tires. Zn and S contents were determined in 30 tire samples as an internal reference. The average S content in the analysed tires was 15400 mg/kg (+6000 SD), while the average Zn concentration was 13400 mg/kg (+1700 SD). Furthermore, the developed method was applied to field samples. Samples were taken from the intake water of a treatment facility (raw water), from the sedimentation basin, the inlet of the soil retention filter as well as from the soil itself. Isolation of tire wear particles by density separation was achieved by use of a heavy liquid, sodium polytungstate mixed with MilliQ water. Separated fractions were acid digested with microwave assistance and elemental analysis was conducted by ICP-MS and ICP-OES. Elemental content of the particulate fraction in the water samples was analysed after filtration only, since the amount of solids was too low for the density separation procedure. Acknowledgement - The authors thank the BMBF for funding the MiWa project (reference number 02WRS1378H) and BWB for provision of samples.

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

M. Wagner, Norwegian University of Science and Technology / Department of Biology; N.B. Hartmann, Technical University of Denmark / DTU Environment; A. Verschueren, BAM / Centre for Safety of Substances and Products; T. Hüffer, University of Vienna / Department of Environmental Geosciences; M. Hasselöv, University of Gothenburg / Department of Marine Sciences; R.C. Thompson, Plymouth University / School of Marine Science and Engineering

The occurrence and accumulation of plastic debris is a global environmental issue, with potential consequences affecting the economy, wildlife and human health. However, there is currently a lack of consensus on the definition and categorisation of environmental plastic debris, including macro-, micro- and nanoplastics. The lack of clarity in terminology regarding plastic debris, in particular microplastics, results in confusion and misunderstandings. This is problematic both for legislative measures as well as for general coherence and data comparability between studies. While finding a common language appears 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 categorisation 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 bicolour damselfish and mahi-mahi to olfactory cues following crude oil exposure

I. Scholz, RSMAS, University of Miami / Marine Biology and Ecology; M.J. White, James Cook University; M. Rosell, RSMAS University of Miami; J.D. Stiegltitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; P.L. Munday, James Cook University; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology

In fishes, olfactory cues provide information about predators, prey, and conspecifics that is crucial to survival; however, olfactory sensory neurons are directly exposed to the environment and are susceptible to damage from aquatic contaminants. The 2010 Gulf of Mexico oil spill overlapped with the habitat of
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolour damsel fish (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 damsels 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-chambered flameless electron capture detector, fish were demonstrated avoided a conspecific chemical alarm cue, whereas exposed conspecifics did not avoid the cue (p<0.001). Control mahi-mahi did not distinguish between seawater and crude oil, however oil exposed mahi-mahi spent a greater proportion of time in crude oil than the control fish (p<0.01). Moving forward, an electro-olfactogram technique will be used to measure the generator potential from the olfactory epithelium of bicolour damselfish and mahi-mahi to detect the response to olfactory cues following oil exposure. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

162 A wide range of endpoints are impacted by oil exposure in early and later life stages of marine fish
M. Grosell, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; R.M. Heuer, University of Miami / Marine Biology and Ecology; C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L. Schreiber, RST, OSF, exposed fish. Such reductions in cardiac output are likely related to impaired cardiac calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

163 Investigating the endocrine disruptive and genotoxic potential of crude oil samples using adapted in vitro toxicity tests
S. Johann, Institute for Environmental Research RWTH Aachen University; L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; L. Spencer, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; D. Altim, BioTrix; H. Hollert, RWTH Aachen University / Institute for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis
In case of an acute oil spill the decision on optimal response techniques to achieve the best environmental benefit is based on important knowledge about regional ecosystem function. Even adult marine fish are sensitive to brief, low-level oil exposures, showing reduced aerobics scope and swim performance. The lower swim performance in adult oil-exposed fish with a normally developed heart, is due to reduced cardiac output driven by reduced stroke volume. Work on isolated cardiomyocytes show that sarcomere shortening upon electrical stimulation is reduced by acute oil exposure which likely explains the reduced stroke volume observed in intact fish. Such reductions in cardiac output are likely related to impaired cardiac calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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

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

165 Crude oil impairs heart cell function in the pelagic mahi-mahi (Coryphaena hippurus)
P.M. Heuer, University of Miami / Marine Biology and Ecology; H.A. Shiels, G.L. Galli, University of Manchester / Faculty of Biology, Medicine and Health Sciences; G.K. Cox, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; D.A. Crossley, University of North Texas / Department of Biological Sciences

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

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

Alternative Approaches to Animal Testing for Ecotoxicity Assessments

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

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Early life stages of marine vertebrates have been scarcely used in ecotoxicity testing. The Senegalese sole (Solea senegalensis Kaup, 1858) is a common vertebrate occurring in Eastern Atlantic coastal areas. Eggs of this marine vertebrate can be obtained from aquaculture rearing facilities and used in laboratory as testing organisms. At the end of the first month of life this species completes a metamorphosis, changing from bilateral to flatten shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic contamination, including in marine environment. Organic compounds, such as pesticides and personal care products have been increasing used and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. Besides, human activities have been indirectly changing abiotic conditions, such as ultraviolet (UV) radiation. Therefore, in this work we aim to understand the effects of different stressors to early life stages of S. senegalensis, namely of UV radiation and of the organic compounds -4MBC, Carbendazim, Linuron and Triclosan, which have potential endocrine disrupting effects. In the scope of obtaining larval stages of development, while functional inhibition of the channels has been observed following exposure to oil and non-AhR activating PAHs, mechanisms associated with downregulation has not been observed. MicroRNAs (miRNA) play key roles in a number of diverse biological processes including heart development in vertebrates. To test the hypothesis whether miRNA changes may regulate ion channel genes, embryos and larvae of mahi-mahi (Coryphaena hippurus) were treated with High Energy Water Accommodated Fractions (HEWAF) made from source and weathered DHW oil. miRNAs and mRNA were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition miR-34 and 15b were also upregulated and informative analyses with miRNAs were consistent impairment of eye development (Figure 2). Ongoing analyses of dose response treatments at early hatch larval stages (48 hpf) will provide additional data that will enhance our knowledge of the impacts of oil on fish development. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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 System Biology; J. Herbert, P. Antczak, University of Liverpool / Institute of Integrative Biology; K. Schirmer, Eawag / University of Liverpool Toxicology; A. Cossins, F. Falconi, 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 these alternative methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Onchorhynchus 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.

Combining computational modelling with in-vitro cellular responses in order to predict chemical impact on fish growth

K. Schirmer, Eawag / Environmental Toxicology; H. Mottaz, R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL Swiss Federal Institute of Technology / Environmental Toxicology

A paradigm shift in chemical risk assessment is needed due to the time-consumption and ethical controversies of current chemical testing on animals. Therefore, in spite of several unsuccessful attempts and simplifications, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish. In addition, considering the simplicity, rapidity and low costs of this approach, we believe that it can be an encouraging step toward alternatives to long-term whole organism toxicity testing.

Ecological Threshold for Toxicological Concern (eco-TTC) - Applications for Environmental Risk Assessment in Various Contexts

M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; S.E. Belenger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.A. Bonnell, Environment and Climate Change Canada / Ecological Assessment Division; D.T. Chang, United States Environmental Protection Agency / National Exposure Research Laboratory; K.A. Connors, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; D. De Zwart, DdZ Ecosystem Centre for Sustainability and Innovation; A. Kienzler, European Commission / Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; S.A. Hughes, Shell Health - Americas / Shell Health Risk Science Team; A. Kienzler, European Commission - Joint Research Centre / DG Joint Research Centre IHCP EURL ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; R.R. Otter, Middle Tennessee State University / Biology; H. Sanderson, Aarhus University; P. Wilson, SANOFI The Threshold for Toxicological Concern (TTC) is well-established for assessing human safety but has only recently been explored in the ecological context. Ecological Thresholds for Toxicological Concern TTC (eco-TTC) summarize the
wealth of ecotoxicological information as Predicted No-Observed Effect Concentrations (PNECs) on diverse chemical substances in the form of probability distributions. These enable the prediction of untested chemicals based on a structural attribute, mode of action, or functional use. The approach may be useful for assessing chemicals at early tiers of the risk assessment process, providing hazard perspective on chemicals that lack QSARs, guiding product development discussions, and assisting read-across or categorization 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 compounds causing chemical risk MoAs, integration of risk assessment, mixtures, product development, criteria development). This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

171 Mode of action diagnosis by normalized multiple endpoint assessment in zebrafish embryos
E. Teixido, Helmholtz Center for Environmental Research - UFZ GmbH / Department Bioanalytical Ecotoxicology; N. Klüver, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; O. Kerkhof, Helmholtz centre for environmental research - UFZ / Department Bioanalytical Ecotoxicology; M. Leonard, IOREAL SA; T. Kießling, Scientific Software Solutions; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology

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 (ZFET) extended by various endpoints, including chemical risk MoAs. In the specific risk assessment, mixtures, product development, criteria development). This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

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. Crennic, 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. Holmen, 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 minimal environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and manageable concepts allowing an evaluation of the impacts on the ecosystem level. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, we need to cover all aspects of ‘stress ecology’ (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

183
Identifying ecosystem services-based protection goals.

J. Maithy, 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 services of portfolio 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 vs 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: 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 specific 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: (a) biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (< 7%) without robust scientific justification. The use of 7% was suggested there was no data to support it but in fact it was still a judgement, i.e. it is a hidden ‘judgement’. The suggestion that the impacts of a cumulative agricultural activity between large (>35%), medium (15-35%) small (7-15%) and negligible (3.5-7.5%) 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 based, it is recommended to conduct an expert judgement qualitative approach adapting the EFSA Ecosystem Services approach. The predicted impact of any effect of a PPP on an invertebrate/plant population should be described using expert judgement, which combines the predictions of all 4 EFSA dimensions above (attribute/nature of effect, magnitude, temporal and spatial scales of effects) as well as the number and importance (eg, keystone species) of species potentially affected, and the frequency of occurrence.

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

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

EFSA’s Scientific 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 provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, the Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds and therefore growing in the crop efficacy drill. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, we need to cover all aspects of ‘stress ecology’ (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

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

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

When designing High Tier Assessments, the underlying concept is a progression from simple and conservative laboratory exposures, towards those that more closely resemble the ‘Final Reference’ (the actual ecosystem), so that the risk assessment can be refined by reducing the Assessment Factor that accounts for uncertainty. In the aquatic environment, the focus of High Tier Assessments should be on ‘ecosystem Protection Goals’ that are defined for surface waters at risk and Ecosystem Services. Biodiversity is a common and important General Protection Goal, and Ecosystem Services, as they pertain to human health and welfare, are comprised of ‘provisioning services’ (e.g. drinking water), ‘regulating services’ (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape that conserve species and promote well-being). To this aim, EFSA Guidance requires that a surrogate system for the Final Reference (termed the Surrogate Reference Tier) scientifically underpins the assumption that the endpoints assessed at High Tier are closer to the actual objectives of the adopted protection goal. It is accepted that Low Tier assessments do not measure the SPG directly, and therefore at High Tier, endpoint assessment should rely on ecotoxicological and ecological data that are more directly related to the ‘target image’ of the aquatic community. This surrogate system should be relevant for the surface water at risk, and endpoints should account for the ecological traits of the important aquatic species at risk. The EFSA Pre-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 biotic and ecosystem communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect aquatic Protection Goals as well as ecosystem services provided by non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for 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 conserves species and promotes well-being. 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.

187
Is “biodiversity” a measurable study endpoint?

F. Phillips, Fera Science Ltd. / Cefas; L. Maltby, Y. Pan, The University of Sheffield / Dpt of Animal Plant Sciences

Biodiversity is a common and important General Protection Goal and Ecosystem Services, as they pertain to human health and welfare, are comprised of ‘provisioning services’ (e.g. drinking water), ‘regulating services’ (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape that conserve species and promote well-being). To this aim, EFSA Guidance requires that a surrogate system for the Final Reference (termed the Surrogate Reference Tier) scientifically underpins the assumption that the endpoints assessed at High Tier are closer to the actual objectives of the adopted protection goal. It is accepted that Low Tier assessments do not measure the SPG directly, and therefore at High Tier, endpoint assessment should rely on ecotoxicological and ecological data that are more directly related to the ‘target image’ of the aquatic community. This surrogate system should be relevant for the surface water at risk, and endpoints should account for the ecological traits of the important aquatic species at risk. The EFSA Pre-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 biotic and ecosystem communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect aquatic Protection Goals as well as ecosystem services provided by non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for 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 conserves species and promotes well-being. 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.

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SETAC Europe 28th Annual Meeting Abstract Book
and not a single one would capture the essence on its own. The two basic parameters involved in biodiversity measures are the number of species and their abundance. Their correct estimation is core to biodiversity assessments and their balance describes community structure in terms of e.g. dominance, evenness and diversity. Similarity indices have been developed that enable the comparison of (sub)habitats, which seems a promising lead to assessing effects on biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects on structure and function of soil microbial communities. The results showed that treatment effects are often 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.

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

188 Evaluation of plant-driven biostimulation of soil microbiota for the setup of a site-tailored rhizoremediation process in a historical PCB-polluted soil L. Vergani, University of Milan / DeFENS; F. Mapelli, University of Milan-DeFENS / Department of Food, Environmental and Nutritional Sciences; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; O. Uhlík, University of Chemistry and Technology, Prague; E. Zunino, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The Site of National Priority (SIN) 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 biochemical potential of the plant species and to plan treatments for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant-controlled plots was set up for 18 months in greenhouse conditions. Molecular fingerprinting was applied to unveil the ability of different plants/soil treatments to shape the structure of soil microbial communities. The results showed a succession over time in both bacterial and fungal assemblages. Only the diversity of the bacterial community was, nevertheless, significantly and differentially influenced according to the applied treatment. The stimulation effect on the organic matter 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 Phylatis arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest hydrolytic activity in soil samples after 3 months from planting. Moreover, soil with the 18-month biostimulated soil was inoculated with 14C-labelled 4-chlorobiphenyl, the production of 14CO2 indicated metabolic activity of biphenyl and possibly the presence of PCB-degrading populations. All the isolates were identified as Actinobacteria and were characterized for PCB-degradation and plant growth promotion. In particular, three Rhodococcus sp. strains significantly promoted lateral root development in the model plant Arabidopsis thaliana and depleted PCBs from the cultivation medium according to the results of a resting-cell assay, thus representing ideal candidates to sustain PCB-rhizoremediation through a site-tailored bioaugmentation approach.

189 Enhancement of Biological Reductive Dechlorination by in situ Adsorption Onto Colloidal Activated Carbon: from the Lab to the Full Scale Application M.P. Papini, F. Arjmand, Università La Sapienza / Chemistry; P. Ciampi, C. Esposito, Università La Sapienza / Department of Earth Sciences; M. Carboni, P. Goria, J. Birstingl, Regenesis Ltd; S. Rossetti, B. Matturro, Water Research Institute Italian National Research Council IRSACNR; M. Bacchi, P. Foglietto, Goria, J. Birstingl, Regenesis Ltd; S. Rosi, P. 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 biochemical potential of the plant species and to plan treatments for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant-controlled plots was set up for 18 months in greenhouse conditions. Molecular fingerprinting was applied to unveil the ability of different plants/soil treatments to shape the structure of soil microbial communities. The results showed a succession over time in both bacterial and fungal assemblages. Only the diversity of the bacterial community was, nevertheless, significantly and differentially influenced according to the applied treatment. The stimulation effect on the organic matter 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 Phylatis arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest hydrolytic activity in soil samples after 3 months from planting. Moreover, soil with the 18-month biostimulated soil was inoculated 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.

Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plunestop™, Regenesis) together with an electron donor to create an in-situ adsorption/biologically-reactive zone was deeply investigated and finally adopted as the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than a year appear particularly encouraging. A considerable reduction of degradation products was observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.

190 An innovative bioelectrochemical reactor for in-situ treatment of PAH-contaminated groundwater contaminated by monoaromatic petroleum hydrocarbons E. PALMA, CNR-IRSACNR; M. Daggio, 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)

A major share of world energy production, derives from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a corollary of this fact, most of the petroleum hydrocarbons are monoaromatics (e.g., BTEX) and polycyclic aromatic hydrocarbons, monoaromatics (e.g., BTEX) and polycyclic aromatic hydrocarbons, monoaromatics (e.g., BTEX) and polycyclic aromatic hydrocarbons, monoaromatics (e.g., BTEX) and polycyclic aromatic hydrocarbons. Accidental petroleum spills may result in severe environmental problems, hence reducing the development of proper in-land 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 or donors in the anaerobic oxidation of a variety of organic substrates has raised the possibility that they could be employed in-situ to accelerate the anaerobic oxidation of environmental contaminants, such as petroleum hydrocarbons in soils and groundwater. Here we describe a novel bioelectrochemical reactor configuration, named the “bioelectrochemical well”, that is suitable for in-situ treatment of petroleum contaminated groundwater. A lab-scale prototype of the 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 a project BEvERAGE - BioElEctrochemica REmediation of Groundwater plumes (2015-0195). [1] Palma E., Daggio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Microb. Biotechnol., 2017. doi: 10.1111/1751-7915.12760.

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

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a range of unexploited PAHs, including Polycyclic Aromatic Hydrocarbons (PAH), remain as recalcitrant contaminants, with a major composition in high molecular weight (HMW) compounds (four or more rings). We analyzed the active microbial processes associated with the dissipation of PAHs during a lab-scale bioremediation of a creosote-contaminated soil. Treatment under stimulated conditions resulted in an extensive reduction (93%) of the total PAH concentration. Low molecular weight (LMW) compounds (2 to 3 rings) were mostly depleted during the first month of incubation. In contrast, degradation of HMW-PAHs started thereafter following biphasic kinetics. Despite the 16S rRNA gene copy numbers (bacterial abundance) remained constant throughout the 5-month treatment period, the number of 16S rRNA gene transcripts (bacterial activity) dramatically increased (from 109 to 1010 copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rRNA gene pyrosequencing revealed distinctive profiles for the fungal and archaeal communities that evolved with time. Gene expression analysis of ring hydroxylating dioxygenases, together with changes in pyrosequencing libraries, identified members of Pseudomonas as the main LMW-PAH degraders. In contrast, dioxygenases of...
Gram-positive bacteria, associated to *Mycobacterium*, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-PAH removal identified members of the recently described order *Immundisolobacterales* and members of *Sphingobium* as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of *Immundisolobacterales* have major phytotypes belonging to the Halomonadaceae family, which are members of *Immundisolobacterales*.[1,3] 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 *Mycobacterium* 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.

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**Stable Isotope Raman Microscopy as a Surface-Enhanced Raman Scattering: Analysis of Microorganisms at Single Cell Level**

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**Chair of Analytical and Water Chemistry; R. Weiss, M. Seidel, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry.**

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microbes has been shown to reduce and in some cases eliminate the impacts of petroleum hydrocarbon vapours from contaminated soil or groundwater. The occurrence of natural attenuation in the subsurface is petrified by 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.

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**New frontiers in Life Cycle Inventory data collection and modelling**

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

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In the context of the Environmental Footprint (EF) pilot phase, the European Commission requested the development of 70 representative products/organisations (RPs/ROs) so they are consistent with the requirements of the new product environmental footprint category PEFCR and organization environmental footprint sector rules (OEFSRs). They use the prescribed EF-compliant secondary datasets and, can be made available for free to any user applying a PEFCR/OEFSR and are easily usable in the major existing LCA software tools. An implicit prerequisite is that software tools give equal results when calculating the impact of the same RPs/ROs. At the start, a document was established that defined the minimum requirements as well as the vetoes for modeling. This way, potential problems for implementability of the models in the different software tools were identified and their use was banned. Five software tools were included, GaBi, openLCA, RangelCA, SimaPro, and Umberto. The next step was to test the EF impact assessment (IA) results of all EF-compliant secondary datasets. This way, differences coming from their implementation or of the EF IA method could also be identified before testing the results of the models. Furthermore, the development of an extension to the International Reference Life Cycle Data System (ILCD) format (eILCD) format enabled importing and exporting models between software tools. Finally, the models developed for RPs and ROs will be tested in the five software tools. The problems faced in importing, calculating and comparing the results of the developed models in the different software tools together with suggestions on how to improve the models. Some claim different results in different software tools used, often generally pointing to different “software”, without being more specific. The reason may be rather bound to methodology, age, version, flow list and import-export-interface aspects, or even a combination. This work is the basis to enable the reduction of software tools and the comparability of results.
temporally differentiated LCA performed with real-time high frequency data and present a methodology for the on-line assessment of the shift in the performance of WWTPs. The implemented methodology performs a DEA-based benchmark coupled with LCA to evaluate the environmental impacts linked to the operation of a WWTP. A web application of the system is currently being developed using the Shiny R package. It will enable plant managers to calculate and visualize LCA results in real time by modifying customizable parameters.

196 Enhancing Land Use Change modelling with IO data
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Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (LUC 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 the production needs of land use trends. 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, N₂O, NO, NO₃⁻, NH₃ and resource inputs of accelerated denaturation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCIA) model. Overall, the results show that for agricultural crops, iLUC increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 50-300%, and for primary plastics 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countris in the world. It has already been applied to more than 50 LCA studies and on several product categories.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA
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WSmix is an open source framework for UMIR-ITAP ELSA; P. Roux, Istea / ITAP ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istea; G. Junqua, Ecole des Mines d’Alès / LGEI; A. Sferratore, Société du Canal de Provence; Y. Pernu, SUEZ groupe / CIRSEE; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istea / UMIR ITAP

Freshwater comes from different sources that are unevenly distributed in the world and different water uses (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 considered in LCA of products or infrastructure with long lifespans. The work aims to develop a WSmix framework for modelling current (LCIA) and prospective WSmix (WSmix P-WSmix) and an inventory database for direct use in LCA. To demonstrate the relevance of including WSmix and P-WSmix in LCI databases, case studies have been conducted. To develop the WSmix framework, system boundaries have been defined and variabilities in classification and terminology of water sources and users have been harmonized. A new database for WSmix (WSmix) and an inventory database for different users has been developed and a technological matrix has been established to link water sources to water production technologies and energy use. To develop the P-WSmix, a methodology based on algorithms enabling to obtain prospective WSmix (P-WSmix) is proposed. Data on water demand and water availability projections for different scenarios and time horizons have been used. The WSmix includes a framework, a WSmix database and technological matrix. The P-WSmix includes also a framework, a P-WSmix database and electricity mix and technology evolutions. The WSmix database covers 93 countries at different spatial scales for various users. The P-WSmix covers 73 countries at national scale for two users under different scenarios and time horizons. It has been shown that the environmental impacts of supply public water are highly dependent on the country and change over time. The inclusion of WSmix and P-WSmix in LCI databases is relevant for a more consistent water-use related impact assessment and for the LCA of infrastructures or products with a long life span.

198 The evolution of database- and tool development for Agri-Footprint
B. Durlinger, L. Kuling, Blonk Consultants

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

199 Poster spotlight: TU097, TU098

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

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
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Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and 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 tissue of fish in our study. Our results emphasize the importance 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 HGPs to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24h) and field-detected (levels of 10−10 M) concentrations of anxiolytic pharmaceuticals 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 shool 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 (chironomid 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, two diatom species, Gomphomena gracile (two different morphotype: normal (GG) and teratogen (GT)) and Planothidium 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 the nutritional quality, with a general preference for Gomphomena gracile with teratogen shape and Pseudokirchneriella subcapitata. In a second experiment (cafereria), food selectivity of chironomids was determined under similar contamination conditions during 4h: Under diuron and imidacloprid and the pesticide mixture condition altered chironomids’ movements and grazing behaviour. In these experiments, we highlighted that chironomids feeding behaviour and food preferences are impacted by pesticides. Herbicide and insecticide exposure, alone or in combination, had contrasting effects on grazing, both directly on the larvae or indirectly (food selectivity according to its quality). Our study illustrates the value of considering the impacts of toxicsan on target and non-target organisms across trophic levels to improve ecotoxicological risk assessment in an ecosystemic perspective.
indicating increased lethargy in the fluorescein birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that fluorescein-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, fluorescein causes vasoconstriction, which in birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause subtle changes to behaviour and physiology that are predicted to impair the capacity of wildlife to respond appropriately to environmental changes.

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

206 Does single compound risk assessment protect from mixture effects and multiple stress?
P. Von der Ohe, UBA - Federal Environment Agency / IV 2.2 Pharmaceuticals There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains largely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the Dutch Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as 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 ¼ of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC values. For the first time, we developed two data sets on macroinvertebrate communities where we have ¼ 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, DiD Ecotox / Centre for Sustainability Environment and Health; J. Postma, Ecowide; M.C. Zipf, RIVM / Centre for Sustainability, Environment and Health “Big data” are a potential goldmine for studying and contextualizing chemical and environmental risk assessments, as they enable relating predicted risks to observed impacts. This can confirm or challenge our chemical risk assessments, by checking whether Environmental Quality Standards provide sufficient safety, and whether or not mixture exposures cause problems not captured in the widely used ‘single-chemical plus safety factor’ approaches. Digging the goldmine asks for – first – data collation, and then: a powerful design which can be borrowed from environmental quality. We show examples for current trends of these indicators in biotic and abiotic quality of aquatic ecosystems. 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 5EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

208 How much do improvements in wastewater treatment benefit downstream macroinvertebrate populations?
A. Johnson, CEH Wallingford / Wallingford; F. Edwards, Centre for Ecology Hydrology Maclean Building; M.D. Juergens, Centre for Ecology and Hydrology / Wallingford; H. Vincent, Centre for Ecology Hydrology Maclean Building The River Ray, which is a small tributary of the Thames (UK), offers an unrivalled opportunity to examine the impact of changes in wastewater treatment on the resident aquatic wildlife. This opportunity exists because the waste from the 170,000 plus people of Swindon discharges into this small 12 km long waterbody, such that the downstream mean annual flow is composed of 65–80% treated effluent. The downstream monitoring sites showed a sustained improvement in macroinvertebrate diversity starting from 1991 onwards. This sustained improvement for macroinvertebrates coincided with a 10-fold drop in ammonia, halving of biodegradable organics, (BOD) and improvement in dissolved oxygen associated with the conversion of the Swindon plant from trickling filter to nitrifying activated sludge. There were no dramatic changes in metal concentrations over the key early 1990s’ period unlike the main sanitary determinands. 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 changes that were responsible for the changes in abundance. 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.}

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

210 The burden of being a slow-life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology
S. Saint-Hilaire, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; N. Poulet, Agence Française pour la Biodiversité / Pôle Écohydraulique, AFB IMFT; A. BESNARD, Centre d’Ecologie Fonctionnelle et Évolutive / Biogéographie et Ecologie des Vertébrés Population dynamics of aquatic species and ultimately their population growth rate (λ), must be known to properly define species conservation status and plan appropriate conservation efforts. It also serves to interpret and predict low-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-state models and fish length trends with quantile regressions. To further study correlations between fish abundance, biomass, fish-length trends and fish life traits (life history strategies, species trophic position, habitat preferences and thermal tolerance) we performed multivariate analyses. The present work demonstrates that during the last decades, 10 species 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.
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 former observed. Among the demographical 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 can explain body growth decrease, juvenile and adult survival alterations due to micropollutant exposures. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor periodic species recovery.

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

J. Sun, Antwerp university / Department of Biology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B. Hipsø, Swedish National Nature Conservation Monitoring; G. Malarvannan, University of Antwerp / Toxicological Centre; J. Sondergaard, 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 observed in the 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 isotope. 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 the Swedish and Norwegian populations. PCB concentrations from IET (\([\text{N} \pm \text{SD}]\)) were compared with model predictions (i.e., visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni²⁺] agreed very closely with model predictions. In the same defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc. Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (I)

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

C.E. Schlekat, NiPERA; K. Gallagher, U.S. EPA / Office of Water; B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology A workshop entitled "Technical Workshop on Bioavailability-based Water Quality Criteria" was held under the auspices of the Society of Environmental Toxicology and Chemistry on 3-8 December 2017 in Pensacola, Florida, USA. The goal of the workshop was to evaluate the state-of-the-science regarding metals bioavailability models and their use from a regulatory perspective. A second, but equally important, goal was to provide a scientific forum for discussions that could inform the further incorporation of bioavailability concepts into regulatory approaches for determining metal-based aquatic effects models. Findings of a SETAC 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 metal-based aquatic effects models. Findings of a SETAC 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 metal-based aquatic effects models. The workshop 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 metal 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 methods of assessing 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 Environment Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining and associated 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 (1) the source of this protective effect (2) how geographically 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 tryptophan) were titrated with Ni to determine Ni speciation. In Ni toxicity tests nickel speciation was determined in real saltwater samples of diverse geographic origin from the east coast of the United States and Canada. The divalent Ni free ion in these synthetic and real seawater samples was quantified using Ion Exchange Technique (IET) with Ni measured by Graphite Furnace Atomic Absorption (GFAA). The measured Ni²⁺ values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni²⁺] agreed very closely with model predictions. In the same defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc. 214 Acute bioavailability models for nickel: Development and regulatory application

K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology; P. Van Sprang, I. Vercaigne, ARCHE; A. Peters, wca; C. Hofstra, NiPERA; E. Thissen, NiPERA 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 methods received less attention. For aquatic invertebrates, however, 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 an important 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 accessed for analysis if acute Ni toxicity for a species was tested in >2 tests. This study confirmed that the use of acute Ni ecotoxicity data from different studies can be used to derive MAC values. Additional research is needed to develop chronic bioavailability models for Ni in freshwater ecosystems.
Acute Ni bioavailability models (3 invertebrate models, 2 algae models, and 1 fish model) were used to evaluate the ecotoxicity data. To simplify the normalization process, an “average animal” bioavailability model was developed using a weighted average of parameters for existing models. Because crustaceans are typically among the most sensitive organisms to Ni exposure, and because the fish model did not capture pH effects on acute Ni toxicity to crustaceans very well, an “average crustacean” model was developed. The parameters for the 3 crustacean models were used to construct the “average crustacean” model. Both the “average animal” and “average crustacean” models reduced intraspecies variability considerably among the available Ni ecotoxicity data. For example, the “average animal” model predicted 98% of the 193 individual acute ecotoxicity data points within a 3-fold error, and 90% within a 2-fold error. The “average crustacean” model, although this model clearly showed a better ability to predict the effect of pH on Ni toxicity to cladocerans. The models were applied to an acute Ni ecotoxicity dataset to derive bioavailability-based MAC for European water bodies with typical ranges of water chemistry.

215 Bioavailability and bioaccumulation of uranium: From lab experiment to modelling A. Husson, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Leemakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descostes, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University / Faculty Research Assistant; Aquatic Species Empirical Investigations into the Toxicity and Bioavailability of Uranium (I)

These results are compared with the proposed regulations by IRSN on uranium accumulation on the sediment (1). DGT labile uranium porewater concentrations account for 70% of the 4 mineral phases (3.3% Kaolin/ 3.3% Smectite/3.3% Ferrihydrite (9) and Smectite (8) and is the lowest for the mixed composite sediment (100%). For nanoplastics field exposure, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomid larvae Sediment to porewater partition coefficients (Kd) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Partition Coefficient (Kb) was found for toxic (10) followed by (HR) Ferrihydrite (9) and Smectite (8) and is 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 reference to experiments in the 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 IRSN on uranium bioavailable chemical species.

216 Environmental Investigations into the Toxicity and Bioavailability of Aluminium to Aquatic Species B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; W.J. Adams, Red Cap Consulting; R. Genser, GEI Consultants / Ecological Defense; R.E. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium REACH Consortium

Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: 1) the generation of large amounts of empirical toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and acidity on aquatic toxicity. This requires the development of new methods for 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 oligochaete (Aeolosoma stagnalis), a midge (Chironomus riparius), an amphipod (Hyallela 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 acute ecotoxicity tests conducted 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.


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

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

218 Closening the gap between small and smaller: Towards a framework to analyse nano- and microplastics in aquatic environmental samples P. Bauerlein, KWR / Analytical and Environmental Chemistry; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Mintenig, Utrecht University / Copernicus Institute of Sustainable Development; A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; H.M. Ohlendorf, CH2M

Detecting microplastics and determining actual concentrations and sizes of plastic pollution in the environment is a prerequisite to set up effective regulatory frameworks and to detect plastic waste in aquatic and terrestrial systems. 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 formation was observed using FTIR-microscopy which is limited to a minimum particle size of 28 µm. For nanoparticles field- flow- fractionation, that reveals information on the particle size, and pyrolysis GC-MS, that is used to identify the polymer types, are
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoparticles. The pre-concentration by crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 µg L\(^{-1}\) in aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional characterization of the analysis with FTIR-microscopy. By this, the results of spectroscopic and thermal degradation analyses (e.g. pyrolysis GC-MS) can be combined and compared.

219 Trace particulate plastic analysis in environmental systems: synthesis and utilisation of metals, materials and microplastics and their effects on organisms

F. Schmidt, M. Schmünderer, Eawag Swiss federal Institute of Aquatic Science and Technology; D.M. Mitrano, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Risk and Management Research on particulate plastic (nano- and microplastic particles and fibers) and their distribution in the environment has intensified in recent years; but truly quantitative analysis, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic, chemically entrapped tracer can provide a robust way to more easily, accurately and quantitatively detect particulate plastic in complex environmental and biological media. In this study, a suite of methods to synthesize a variety of particulate plastics of various sizes (100 nm to 1 mm), surface morphologies/charges and polymers (polystyrene, polyolester, polypropylene and low density polyethylene). Each variant has an embeded 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 under ultrafiltration 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 synthesised were spiked into soils in batch experiments where 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 effluents. Beyond the case study specifically highlighted here, these metal laden plastic particles are the fundamental building block of the synthetic plastics and can become associated with organisms at trace concentrations. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

220 Detection of polymers in treated waste water using TED-GC-MS

C. Geodecke, K. Altmann, Bundesanstalt für Materialforschung und Prüfung; C. Bannick, Umweltbundesamt; E. Köber, Technische Universität Berlin; M. Ricking, UBA Umweltbundesamt; T. Schmitt, Berliner Wasserbetriebe; U. Braun, BAM-Forschungsgesellschaft für wasserreine Gewässer; P. J. D. Cooney, University of Manchester. The presence of large quantities of plastic waste and its fragmentation in various environmental compartments is 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 quantitify microplastic in urban water management systems. At first a fractional filtration system for sampling and the analytical tool, the so-called TED-GC-MS (thermal desorption gas chromatography/mass spectrometry) were developed. The developed method is a two-step analytical procedure which consists of a thermal extraction where the sample is annealed and characteristic degradation 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-GC-MS 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), polyethylene (PS), polyethylene terephthalate (PET) and polyamide (PA). The results of the study revealed that the polymers PE, PS and PP were detected in the effluent, and PE and PS were found in the raw waste water of the sewage treatment plant in Ruhleben, Berlin. Differences in polymer types and amounts were detected at different sampling dates and within different sieve fractions. Much higher amounts of polymers were observed in the raw waste water. The peak areas of the decomposition products, used for quantification of the polymers, were adjusted using so-called response factors since the TED-GC-MS method is more sensitive for PP and PS than for PE. It has been shown that PE is the most dominant polymer in the samples. Comparing the masses of polymers in the effluent and in the raw sewage, a removal of 97 % of the polymers in the water treatment plant can be assumed. These results are consistent with the literature where removal rates between 98-99 % were described [6-7].

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

R. Hurley, NIVA - Norwegian Institute for Water Research; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; M. Olsen, Telemark University College; L. Nizzetto, NIVA There is very little existing information 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 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 of samples from 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 oxidised PET and PC and KOH treatments were not effective in sufficiently reducing organic material whilst peroxide oxidation and Fenton’s reagent removed the majority of organic material. Based on these results, Fenton’s reagent was identified as the optimum treatment and was further optimised. Phase 3 tested revealed high extraction efficiencies for this protocol. This study is an 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 plant performance

J. Toorman, KULeuven, M. Schmiedgruber, Eawag, U. Berrojalbiz, NIVA, 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. Samples 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 – 8371) 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. Polystyrenic particles were the most common (30.5%) followed by polyethylene terephthalate (26.7%) and polypropylene (20.3%). 62% of plastics were extracted during the low density (1 g cm\(^{-3}\)) separation steps and 38% were extracted at high density (1.8 g cm\(^{-3}\)). Results between WWTs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment technologies. Based on this study and details on the application of sewage sludge in Norway, it can be estimated that approximately 446 billion microplastic particles are spread on agricultural soils, 27 billion microplastic particles are added to green areas and 112 billion microplastic particles are sent to soil producers per year. This equates to over 584 billion microplastics that are released into the environment via sewage sludge application each year in Norway.

223 The Influence of Weathering on the Sinking Behavior of Microplastic in Freshwater and all Surface Waters

H. A. NgI, Environmental Technology; L.B. Olsen, D. Issler, NGI, N. Berroalbz, 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
processes may cause changes in the density and shape of individual plastic particles, or aggregates. This can be a driving factor for the ultimate fate of microplastic, as it could cause floating microplastic to sink or be suspended below the water surface. However, the factors controlling the buoyancy or sinking velocity of different microplastic are not as well-known as they are for other particles/particles, like phytoplankton and sedimentary material. Herein we present the results of sinking experiments on microplastic, covering different shapes (spheres, fibres, irregular), microplastics in situ and on the properties of water, considering a range of ambient conditions (temperature, salinity and turbulence). The microplastic were compared before and after exposure to weathering processes in the lab and outdoors. The results obtained in this sinking experiment were compared to theoretical expectations, based on literature equations that describe the relationship between the sinking coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastic.

Air Pollution, Biomonitoring and Human Health (I)

224 Particulate matter in indoor academic environments: chemical composition, sources, infiltration front and outdoor

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We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM2.5 and PM10) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and weekends during a 6-week winter period and a 4-week summer period (Special Observation Periods – SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-term Sampling) consists in twelve 1-month PM2.5 samplings carried out by using very low flow-rate samplers. It was envisaged to obtain a general picture of the effect of the above parameters during a whole calendar year. Both sampling schedules were applied to six indoor and four outdoor sites, all inside or around the same building. At each site and for both schedules the sampling were simultaneously carried out on Teflon, quartz and polycarbonate filters. Teflon filters were used for the determination of the collected mass (by gravimetry), of the elemental content (total content by energy dispersion X-ray fluorescence, bioavailable and residual fractions by inductively coupled plasma mass spectrometry), of anions and cations (by ion chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). The composition analysis was performed on each of the six indoor sites and on each of the four outdoor sites. 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 PM2.5.2 in urban sites under industrial influences in northern France

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PM2.5 have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The North of France is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of 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. The results obtained in this study were compared to theoretical expectations, based on literature equations that describe the relationship between the sinking coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastic.

226 Estimating the contribution of deposition in the total exposure to PAHs in order to derive safe 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 safe deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Exp 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 (PM10) in Belgium. The conceptual model implemented, included inhalation, soil and dust ingestion as well as dietary exposure via the consumption of vegetables, meat and dairy products. Toddlers were chosen as the receptor as they are considered a vulnerable group. Dietary exposure to PAHs via crops was modelled using a plant uptake model representing leafy vegetables, fruits and grain, respectively. A cattle model taking its inputs from a grass and maize model was used to calculate concentrations in meat and dairy products. Concentrations in fish were modelled as an external fixed food source. The calculated concentrations for all these food categories were matched to Belgian consumption data in order to calculate dietary exposure. Estimation of the contribution of deposition in the overall exposure was done by comparing a baseline exposure scenario based on recent atmospheric measurement data with a scenario where dry and wet deposition fluxes were arbitrarily set to zero. Save deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). In case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were run for 16 priority EPA - PAHs + benzo[α]fluoronanthene. For only 4 PAHs sufficient measurement data are available in the EFSA database to perform a reality check of these 4 carcinogenic PAHs, the only 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 bioassy-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air pollutants contamination

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Air quality is currently assessed by monitoring a few pollutants involved in the development of several human diseases. However, it remains difficult to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposition to many bioactive micropolutants, 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 humans, especially indoors where they spend 80 % of their time. By using cellular bioassays, we have previously shown that bioactive EDCs tend to concentrate indoors, especially in the gaseous phase. The concomitant chemical analysis of a wide range of their identification of sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using Digietal D A80 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). PM2.5 composition was analyzed for major elements, trace elements (Si, Fe, K, Ca, Mg, Ti, Mn, Cr, Co, Zn, P, As, Pb, Cd, Cu, Zn, Mn, Co, Ni, Cu, Cr, Zn, Pb, Hg, As, Sb, Se, Rb, V, Br, Sr, Pb, Bi, Ba, Co, Sb and Tl) only correspond to 0.30% to 0.45% of the PM2.5 mass according to the sites. The CW-NMF model identified 8 common source profiles at the 3 sites: secondary nitrates, residential and road traffic, secondary sulfates, fresh and aged sea-salts, heavy fuel oil combustion, non-exhaust traffic and crustal. In addition, 4 industrial source profiles were identified in Dk and/or showed temporal differences and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM2.5, such industrial sources were the main contributors of metals at the two sites.
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 the negative effects of urban/industrial hotspots.

228 The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health

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As energy efficient buildings and communities continue to grow, energy retrofits and new designs need to be made in concert with improvements in indoor air quality (IAQ). Although thermal renovations may decrease heat loss and reduce energy expenditures, increased indoor air pollution (IAQ) can impact infiltration and air exchange rates, and magnify the effects and intensity of internal air pollutants. In this context, a pilot study was conducted to evaluate the human 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 were selected to represent a range of conservation districts, which is situated downwind of major industrial point sources. Indoor and ambient measurements of particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>), black carbon, ozone (O<sub>3</sub>), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO<sub>2</sub>), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of defects on lighting and aged mechanical systems had on indoor air quality are distinct; however, the countereffects of findings implied that green and naturally ventilated buildings underperform when compared to some of the conventional buildings within our study. The CO<sub>2</sub> 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., PM<sub>2.5</sub>, O<sub>3</sub>, NO<sub>2</sub>) before increasing outdoor air volume. Natural ventilation systems may apply 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 indicate a complex relationship (i.e., VOC 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, validated during an indoor study focused on the concentration of PM<sub>10</sub> 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 PM<sub>10</sub> mass concentration and its main chemical components in the area of Terni, 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 biosensors 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 validate new experimental methods for the acquisition of spatially-resolved data.

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

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Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that univocally link biomarker responses to fitness impacts and finally to population level are scarce (1). This is mainly due to the discordance in time scales between toxicological and ecological responses. In previous laboratory studies exploring the effects of high contamination levels of single molecules, a relationship has been established between genotoxic impacts in 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 methylation) to physiological one (feeding rate, molting success, vitellogenesis) and life history traits (growth, fertility, embryonic survival), along with the possibility to conduct rearing culture in the lab (time to puberty about 4 months), the objective of this study was to assess whether biomarker responses recorded in adult gammarids exposed to a chemical stress could be predictive of the fitness of their progeny (i.e. transgenerational effects). For this, the consequences of an exposure in the lab of genitors to environmentally relevant concentrations of cadmium were evaluated in F1 and F2 individuals reared in 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 occurred 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) Lacaze E, Geffard O, Geyot D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cells with reproduction impairment, using the Comet assay. Environmental Research111:626-634

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

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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 and cause bioaccumulation and azole fungicides. This study aimed to investigate the species’ sensitivity to both fungicide classes and to gain mechanistic insights on potential synergistic effects of azoles on strobilurin fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strobilurin fungicide azoxystrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyallela azteca. Furthermore, we explored median lethal concentrations (LC<sub>50</sub>) of azoxystrobin in the presence and absence of prochloraz, the inhibition strength (IC<sub>50</sub>) of prochloraz, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxyanilin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg<sup>-1</sup>, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg<sup>-1</sup> in G. pulex and H. azteca, respectively. Many biotransformation products were found for both fungicides, confirming that these fungicides are metabolized in both species. The identification of the metabolites from prochloraz was performed using GC-MS and tandem MS techniques. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-methoxyacrylate group of azoxyanilin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxyanilin in both species, leading to higher internal bioaccumulation factors (BAFs) approximately 5 L kg<sup>-1</sup> in G. pulex.

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and *H. azteca*, respectively. The LC$_{50}$ of azoxysoctrin alone were 157 and 200 μg L$^{-1}$ in *G. pulex* and *H. azteca*, respectively. Prochloraz significantly decreased the LC$_{50}$ of azoxysoctrin 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* towards prochloraz effects.

232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb, *H. Arambourou*, Istrea Lyon / Freshwater system, Ecology and Pollution Research Unit, Istrea/UR MALY Laboratoire Ecotoxicologie; M. Delorme, K. Abbaci, Istrea Lyon / UR MALY Laboratoire Ecotoxicologie; P. Nouri, Istrea Lyon / Ecotoxicology; R. Tutundjian, Istrea Lyon; E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSIC / Environmental Chemistry; I. Fuertes, Institute of Environmental Assessment and Water Research IDAEA CSIC. V. Debat, MNHIN / 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 embryogenensis’s sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among the different Gammarus 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 gasturation 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 prevents 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, Helmholz Centre for Environmental Research UFZ; J.M. Becker, Helmholz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Krauss, W. Brack, Helmholz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the toxic effect on conspecífics. However, it is not known under which conditions adaptation occurs when only a low toxic pressure from pesticides is present. Here, we show that Gammarus pulex, a dominant macroinvertebrate species in many agricultural streams, acquires increased tolerance to pesticides when recolonization from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below considered tolerable acute effects showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC$_{50}$ 218 μg L$^{-1}$) compared with non-exposed populations (mean EC$_{50}$ 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 biocides in a changing world: combined effects of nanomaterials and molecular 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, Smallmalt - 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; E. Fouquet, C. Mendes, A.M. Soares, University of Aveiro / Department of Biology & CESAM; R. Calado, University of Aveiro / CESAM Department of Biology; S. Loureiro, Universidade de Aveiro / Biology The use of antifouling agents to prevent organism’s adhesion onto surfaces continues to be used worldwide. While the European Union already authorized the use of DCOIT (4,5-Dichloro-2-octyl-2H-isothiazol-3-one) biocide, data on its toxicity to non-target organisms is still scarce. Given the advances in the encapsulation of biocides in smart-releasing systems, this work aims to access the impacts of a new antifouling approach, DCOIT encapsulated in silica nanocounters (SiNC@DCOIT), toward the non-target species Sarcophyton cf. glacium, a coral that is also a model of the cnidarian-algae symbiosis found in some marine invertebrates. Elevated seawater temperatures, as predicted by global climate change scenarios, are described as a major cause of corals reef decline. Due to DCOIT photosynthesis inhibition properties, a joint effect of these two stressors (warmer seawater and DCOIT) may occur in the ocean. Toxicity assays were performed by exposing monocoral coral fragments (n=5) for seven days, at two different temperatures (present day conditions—26°C—and forecasted scenario for 2100—30.5°C), to 50 μg DCOIT L$^{-1}$ for free-DCOIT or SiNC@DCOIT and 196 μg SiNC L$^{-1}$ (nanocontainer control). A negative control was added for each temperature. Photosynthetic parameter (Fv/Fm) was measured using a Pulse Amplitude Modulated Fluorometer (PAM), with the behavioural endpoint (% polyps open) being scored and the biochemical parameters (both in animal and fractions) being measured by high performance liquid chromatography (HPLC) and mass spectrometry (MS). Results revealed a decrease on Fv/Fm values at 30.5°C, when compared to 26°C (from 0.65 to 0.60), but only in corals exposed to free-DCOIT the temperature effect was significant throughout the days. By the end of the assay the polyps were mainly open at 26°C, whereas at 30.5°C they were closed. Regarding enzymatic activities, significant increase on the GST of both animal and microalgae fractions was found in 30.5°C groups. On the controls, the raise of 4.5°C in water temperature was responsible for a two or three-fold decrease in algae and animal GST activity, respectively. The raise on temperature also induced an increment in CAT activity. Regarding LPO, high variability among samples was found. Overall, under thermal stress, the toxicity of DCOIT is enhanced and the negative impacts associated with the use of this biocide will likely be magnified in the warmer oceans.

235 Assessing interspecific variation in Imidacloprid toxicity in earthworms A. Robinson, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology; J. Short, E. Lahive, A. Robinson1, (alerob@ceh.ac.uk), S. Short, E. Lahive1, P. Kille1, D. Spurgeon1 Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK 1 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 earthworm (Eisenia fetida, Lumbricus rubellus, Dendrobaena octaedra, Apporectodea caliginosa and Amyntas 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 radio-labelled 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 predictions as affected by the amino acid substitutions present in different species receptor homologues. Finally, to assess how these interactions affect the key biological and physiologi cal 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, Greenpeace Industrial pollution is a severe threat to water resources around the world, particularly in the Global South factories release hazardous chemicals that impact our precious water resources - causing long term devastation to human health and the environment. Rivers supply vital resources, including drinking water, crop irrigation, and food. There is a critical need to support system for water quality. In the past decades Greenpeace did several investigations on persistent hydrocarbon and other emerging pollutants, which has allowed the identification of new pollutants and the monitoring of existing ones. The monitoring of emerging pollutants, such as pharmaceuticals and personal care products, has revealed an increase in the number of detected compounds. The presence of these compounds in water can have adverse effects on aquatic ecosystems, including the disruption of endocrine systems, the alteration of the microbial community, and the inhibition of photosynthesis. The effects of these pollutants can be cumulative and synergistic, leading to significant changes in the ecological balance. Therefore, it is crucial to implement effective management strategies to mitigate the impacts of emerging pollutants on water resources. The development of innovative technologies, such as advanced oxidation processes and membrane filtration, can help remove emerging pollutants from water bodies. Educating the public about the risks associated with emerging pollutants and promoting the use of environmentally friendly products and practices is also essential. Additionally, the establishment of robust regulatory frameworks is necessary to control the discharge of emerging pollutants into water bodies. The European Union has already implemented several initiatives to address the issue of emerging pollutants, such as the Water Framework Directive and the Urban Wastewater Treatment Directive. However, more efforts are needed to ensure the effective implementation of these regulations and to promote the use of sustainable practices and technologies. In conclusion, the challenge of managing emerging pollutants in European freshwater resources requires a holistic approach that considers the interlinkages between different sectors and ecosystems. It is essential to integrate scientific research, policy-making, and stakeholder engagement to develop effective and sustainable solutions for healthy ecosystems and humans.
context of Greenpeace’s detox campaign have found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polyfluorinated chemicals show that PFAS (perfluorinated alkyl substances) are widespread compounds of environmental concern. Because of their well-recognized hazardous properties, long chain PFASs have been subject to increasing regulation. In 2015 Greenpeace conducted an experiment in northern Europe where snow was taken at 10 remote high altitude sites showing that these persistent chemicals are present everywhere on the planet. In 2017 Greenpeace Italy carried out PFAS analysis in wastewaters, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and regulations are required. The use of pollution prevention control or wastewater treatment does not deal effectively with all hazardous substances, and only postpones the need for more effective measures. The problem has to be tackled at its source. The Detox campaign challenges top textile brands to work with their suppliers and eliminate PFAS and all other hazardous chemicals across their entire supply chain, and the entire life-cycle of their products. The growing concern about Europe’s massive pesticide residue goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public.


M. Helmecke, Umweltbundesamt (UBA)

Environmental authorities increasingly need to address the challenge of contaminants of emerging concerns found in the water cycle. The German Environmental Agency has assessed entry pathways, critical characteristics of chemicals and the existing legislation to derive potential measures to minimize micro-pollutants in the aquatic environment. A holistic and precautionary approach is needed that combines measures at the source, during the usage of products and chemicals as well as end-of-pipe measures. The EU Water Framework Directive and the Marine Strategy Framework Directive pose a legal frame to achieve good quality waterbodies that deliver high quality water and support human and ecological health. A critical next step will be to derive further EBT for an active regulation against human and ecological health outcomes before they can be adopted in regulatory frameworks. A collaborative EU funded project called “digital freezing” platforms (http://norman-network.com/?node=236) and NORMAN Digital Freezing Platform (http://norman-data.eu) as well as the EU 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-unknownified chemicals. Collaborative European and international activities facilitate data exchange amongst analytical data scientists and enable quick, effective and reproducible provisional compound identification in digitally archived HR-MS data. This is leading to new ways of assessing and prioritizing the new generation of “emerging pollutants” in the environment, enabling a pro-active approach to environmental management and protection.

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

E. Schymanski, University of Luxembourg / Luxembourg Centre for Systems Biomedicine (LCSB); R. Aalizadeh, National and Kapodistrian University of Athens / Department of Chemistry; N. Alygiaris, Environmental Institute; J. Hollender, Eawag / Environmental Chemistry; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect Quality Standards (EQS) are defined and used for the assessment of chemical status. Further provisions are defined in regulations specific to pesticides, biocides, pharmaceuticals and chemicals under REACH. These existing legal provisions need to be continuously developed and supplemented in order to reflect new knowledge and best available technology regarding micro-pollutants. This also includes more holistic approaches for the assessment, monitoring and prioritizing of chemicals. The review of the Water Framework Directive can provide a suitable window of opportunity in this regard as agreed by the European Water Directors in 2016. However, there are challenges regarding the inclusion of new approaches to a regulatory context.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using efbp databases

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241 Chemical gene interactions for associating contaminants with biological effects

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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 testing. When transcriptomics data are available, KAMs allow for the development of site-specific hypotheses for follow-up biological effects testing. When transcriptomics data are available, KAMs can be used with statistical approaches, such as reverse causal reasoning approaches to prioritize risk and contaminants. Two brief examples using chemical–gene interactions and KAMs will be presented. The first example used chemical monitoring data from the effluent of a local wastewater treatment plant (WWTP) to develop chemical–gene interaction networks. The networks were used to develop hypotheses about the biological effects of the effluent. To test the network predictions, targeted gene expression, using quantitative polymerase chain reaction, was measured from adult male and female fathead minnows that were exposed to the effluent. The second example described approaches to develop KAMs for detected chemicals at five locations near two WWTPs. Hepatic transcriptome data from fathead minnows exposed to site-water at each location were mapped to a chemical–gene interaction network.

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

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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). 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 forest top soils at each location were mapped to a chemical–gene interaction network. The background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and shown 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 pre-requisite for reliable and justifiable regulatory conclusions.

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

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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 Germany is of importance for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, at two of these 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 < 1.0 to 1.9 µg/kg in oak forest top soils, from 1.0 to 2.1 µg/kg in pine forest top soils, and from < 1.0 to 1.2 µg/kg in spruce forest top soils. In the selected beech forest top soils the background abundance of 124T was below 1.0 µg/kg. The background abundance of 124T in beech and spruce top soil samples taken from April 2012 to February 2013 showed fluctuations over time. These variations could not be associated to seasonal changes. Single values ranged from < 1.0 to 1.8 µg/kg in the beech top soil samples and from < 1.0 to 2.1 µg/kg in the spruce top soil samples. Overall, a background abundance of 124T could be detected in all forest top soils. However, 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.

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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, where applications of 124T-containing fertiliser and other potential sources could be reasonably ruled out. Existing wells from authorities’ or water producer’s monitoring networks were sampled in the studies, thus capturing a range of scenarios for leaching risk in real-world agricultural practice. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability. This involved in-depth 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 practice. 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.pesticideværsling.dk), which comprise five agricultural fields (two sandy and three clayey till fields). This intensive study 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 EPA classification 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 (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 DegTB50 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 15 sampling times from 0 to 360 days after application, in triplicates and in additional control plots. The soil samples were analysed for residues of 13C-TBZ, unlabelled TBZ (12C-TBZ), 13C labelled 124T (13C-124T), and unlabelled 124T (12C-124T). Residues of 13C-TBZ remained in the top-soil segments. There were no detect 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/L. The data collected in this study confirm that in many cases the origin of 124T findings is not the use of azole fungicides, but other sources. Consequently, relying on azole-fungicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage.

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

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Relevant amounts of trifluoroacetic acid (TFAA) are formed in the atmosphere by photochemical transformation of several refrigerants and subsequently introduced into the aquatic environment by wet deposition. TFAA occurs as trifluoroacetate (TFA) in the aquatic environment and is considered to be persistent and mobile. Both the acid and its potassium salt are manufactured and/or imported in large amounts in the European Union. Furthermore, TFAA is a degradation 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. Discharge of industrial wastewater was identified as the source of elevated concentrations of TFA in the Rhine tributary. Extended monitoring demonstrated that this contribution still repairs the drinking water supply along the lower River Rhine. Ozonation, activated carbon filtration, and chlorination do not allow for considerable removal of TFA. Monitoring of wastewater treatment plants (WWTP) demonstrated that WWTP also emit TFA. One WWTP showed substantial formation of TFA and ozonation of WWTP-outflows led to increasing concentrations. Tests on the formation of TFA by ozonation of the selected potential precursors demonstrated highly compound-specific TFA-yields between insignificant and ~40%. Sources and pathways of TFA may still lay hidden. As contaminated water resources cannot be efficiently treated by technical options typically applied in water utilities, this topic needs to be addressed for sustainable raw water management. Small molecules such as TFA may originate from different sources and their individual contributions may be subject of temporal and spatial variability. This must be taken into account with regard to risk assessment as well as for the regulation and authorization of chemicals.

Persistence & Biodegradation Assessment

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

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The biodegradability of a given chemical in the in the environment cannot be assessed properly without considering the chemical’s bioavailability to the degrading microbial populations. This is especially applicable to hydrophobic organic chemicals (HOCs), like polycyclic aromatic hydrocarbons (PAHs). With the aim of providing pathways for implementation into regulatory contexts, this
showed significant shift in both composition and activity at higher temperatures, in Arrhenius model predictions in the 0°C increase till 40°C. Consequently, model estimations could not accurately predict a plateau for the majority of the compounds, and just a little biotransformation rate constants with temperature was found in the 4°C characterised by high parameters were compared to model predictions. The microbial population was also plant and the biotransformation of 93 target micropollutants (6 organic compounds in aqueous media

Strategy for ready biodegradability evaluation of poorly water-soluble organic compounds in aqueous media

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The assessment of the environmental impacts of an environmental substance is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in biodegradation systems underpins our understanding of how plant performances are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arthenius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the validity of such models, by exploring the effect of short-term temperature variation on micropollutant biotransformation in an aerobic sludge community. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropollutants (6μgL−1) was monitored over time at five different temperatures (4–40°C range). The experimental kinetic parameters were compared to model predictions. The microbial population was also characterised by high-throughput sequencing to reveal community composition and activity during the biotransformations. Positive correlation of biotransformation rate constants with temperature was found in the 4–20°C range. At higher temperatures, the biotransformation potential decreased or reached a plateau for the majority of the compounds, and just a limited group showed a steady increase in biotransformation rates. The microbial model predictions did not predict rate constants above 20°C, despite major risk assessment guidelines recommend Arthenius model predictions in the 0–30°C range. The microbial community also showed significant shift in both composition and activity at higher temperatures, in accordance with the observed decrease in biotransformation potential. Contrarily, for compounds showing an Arthenius-behaviour over the 4–40°C range, the biotransformation processes may be linked to basic living cell function and be sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arthenius-based models for the estimation of chemicals fate in biotechnological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations.

Findings from an international ring test for an improved marine biodegradation screening test

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A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards prioritisations on chemical persistence. In their current guise, BSTs are ineffective as screens for persistence. They are prone to high levels of variation and produce a large number of false negatives, many of which can be considered false negatives, whereby a chemical fails a test not because of its recalcitrance, but rather because the test itself has failed. An ECETOC funded workshop to discuss improvements to marine biodegradation testing was delivered in 2015. During this workshop, methodological improvements to BSTs were discussed, in addition to clarifying guidance on testing and interpretation of results obtained from marine BSTs. Methodologically: (i) increasing bacterial cell concentrations to better represent the bacterial diversity inherent in the sampled environments; and (ii) increasing test durations to investigate extended lag phases observed in marine assessments, were recommended to be validated in a multi-institutional ring test. This presentation will report the findings from an international ring test of an improved marine BST, whereby an improved marine BST comprising inocula concentrated by tangential flow filtration, a modified marine BST comprising seawater and a standard OECD 306 closed bottle test were compared across 13 laboratories in the UK, Norway, Germany, Italy, Canada, USA and Japan. Five test chemicals including a positive reference compound (sodium nitrophenolate) and negative reference compounds (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.

Relevance of photolysis for the fate of pendimethalin in deeper water layers - results of a scale-up approach according to OECD TG 309

D. Hennemée, Fraunhofer IOME – Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IOME, 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 are direct and indirect photolysis, which are not addressed. Since biodegradation is limited in the OECD 309 study, the consequences are critical for substances which are hydrolytically stable but sensitive to light. Within pesticide regulation direct photolysis studies are mandatory, indirect photolysis studies optional. In natural waters, which have to be used for OECD 309, both processes are relevant for photolytically unstable compounds. Hence, beside direct photolysis in the upper layer of a water column, it is interesting to know until which water depth indirect photolysis might contribute to degradation since the light intensity decreases with increasing water depth. A simulation approach has been performed considering the major conditions required in OECD 309 but at a much larger scale. Stainless steel containers of 900 liter volume are filled with surface water taken from a natural lake and maintained at 20°C. The geometry of the container result in a water level of 140 cm and a surface area of 0.70 m². In contrast to OECD 309 the system is exposed to simulated sunlight and the water is not mixed by stirring or shaking. Sampling is performed in 5 different water depths using permanently installed steel tubes of different length in order to avoid mechanical mixing of the water body by the sampling procedure. A second container with same test setup but equipped with a lid of stainless steel served as dark control. The test is conducted as both pelagic and suspended-sediment setup. Test substance was 14C-pendimethalin, which is known to degrade rapidly in aquatic systems under the influence of light. The purpose of the test was to determine if photolysis is a relevant process in natural water bodies under OECD 309 test conditions and up to which water depth this can be applied.

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

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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 derive a prioritization 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 of different 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), 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) technique is used by integrating approaches to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDA is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) are different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDA with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

256 Consistent allocation using archetypes of LCA Goal and Scope definitions

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Identifying a suitable allocation procedure is always a challenge in the modellisation of LCA. This is especially true for often minor materials and products that could be used in multiple life cycles due to efficient recycling. PE International recommend how to apply allocation for the production and recycling of metals [1]. However, by recommending both partitioning and substitution for establishing the data for an attributional LCA, several inconsistencies are introduced. It becomes unclear to what research question LCA results respond if different modelling approaches are combined in a single LCA study. We developed archetypes of LCA Goal and Scope definitions – in the form of research questions – that aid in identifying a suitable and consistent allocation procedure. In order to identify suitable LCA studies and relevant environmental impacts of the product system, and scope need to be clearly defined: the topic of the LCA, the perspective, the reason to conduct the study, and potential additional functions of the product system that are taken into consideration. We present a framework that shows how the allocation procedure is dependent on the different LCA approaches that are defined in the goal and scope of the LCA. Based on this framework, building blocks are derived that are used to formulate research questions. These research questions represent archetypes of goal and scope definitions. The presented framework shows that there is a relevant difference between system expansion and substitution, and that we must differentiate between process-oriented and product-oriented LCAs, which is not common practice. Furthermore, we show that all types of LCA approaches can be used to support decision-making, which is often only ascribed to consequential LCAs. It is concluded that it is not the topic but the research question of the LCA study that determines the most suitable allocation procedure. One LCA topic (e.g. 1 kg of recycled aluminium) can already be used for at least 13 different research questions. “What is the impact of 1 kg of recycled aluminium?” is not detailed enough to identify an LCA modelling approach. This paper shows the level of detail that is required to enable this. The importance of a research question is not always acknowledged in LCA studies as the production phase of the laptop is modified to reflect a closed loop for recovered materials. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the repairability of products. The potential environmental benefits of repair after repair is investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. The post-repair scenario is evaluated by considering 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 depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site and e-waste recycling and remelting site. 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.

257 Sustainability assessment of product lifetime extension through increased repair and reuse

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The concept of circular economy is characterized by an economy that aims to keep products, components and materials at their highest useful state for as long as possible. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the repairability of products. The potential environmental benefits of repair after repair is investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. The post-repair scenario is evaluated by considering 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 depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site and e-waste recycling and remelting site. 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.

258 Building - Rooftop Symbiosis at the next level. Improving urban agriculture through circular economy strategies

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Cities food supply has become an emerging problem with consequences like greenhouse gas emissions or land occupation. In this direction, new ways of producing food within the limits of cities have arisen as potential solutions. Integrated Rooftop Greenhouses (i-RTG) have the potential of a conventional greenhouse for producing vegetables, but they are located at the top of a building,
where they can benefit from different residual flows that were previously being wasted. In ICTA-ICP building (4 floors), in the UAB campus (Bellaterra, Barcelona), a rainwater harvesting system stores rainwater on an underground tank, from which water is pumped to the rooftop to irrigate the crops with a hydroponic 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 i-RTG systems. Hence, different nutrients are to be optimized. In this sense, different literature exists that half of the currently economic 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

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Substitution of PFOS under the Stockholm Convention


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

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Experiences of "Substitution in Practice"

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

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

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

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Substitution of PFOS under the Stockholm Convention


In 2009 PFOS, its salts and PFOSF were added to the UNEP Stockholm Convention aiming at protecting human health and the environment from POPs. However, the addition contained twenty exempted uses, for which PFOS could still be produced and used. These exemptions were accepted, accompanied by a deadline to evaluate these uses at regular intervals in order to facilitate a total phase out. Besides the evaluation, the Convention provides Guidance of alternatives to PFOS, which is regularly updated and meant to facilitate the Parties to the
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CAA framework by identifying both possibilities and challenges. We conclude that the inclusion of a life cycle perspective in CAA is crucial for an informed and sustainable substitution, as lack of life cycle thinking can lead to problem shifting. We show that LCA, with its focus on function, is a tool that can identify such problem shifting as well as the key chemical properties to consider for their use in toxicity and ecotoxicological effects in such cases. This can however turn out to be difficult, especially for substances such as the PFAs as they are outside the domain of the LCIA model. In the case under study here we conclude that the DWR should be selected with three main considerations: (i) the intrinsic hazard properties of the chemistry, selecting the DWR associated with the lowest hazard but, (ii) providing the functionality as needed and, (iii) giving the garment the longest life length.

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

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Current approaches to substitute harmful chemicals could benefit from a broader perspective when it comes to the functionality they provide in consumer products. Following the concept of “functional substitution”, this study presents an evaluation of material properties of new durable water repellents (DWR) for textiles focusing on end-user requirements. Since the phase out of side-chain fluorinated polymers (SFs) based on long perfluoroalkyl moieties that were associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFAAs), a variety of new DWRs have been developed including biodegradable materials that are based on fluorinated architectures to provide hydro- and oleophobic fibre modifications. SFs based on long perfluoroalkyl chains were historically used on all kinds of different textiles applications. It is so far unclear if alternative DWRs can follow this “one solution will solve all” approach. By segmenting the textile sectors in terms of liquid repellency, this study sets out to outline the different requirements in case studies for functional outdoor clothing and occupational medical apparel. For functional outdoor clothing, a “bottom-up” strategy was chosen by using a survey to assess the consumers’ needs and expectations. For occupational medical apparel, exposure scenarios to liquids were defined based on protection needs described by the Center for Disease Control and Prevention (CDC)3. Based on these demands, relevant liquids were chosen to evaluate repellency and provided as new DWRs using established test methods and by developing a new method to determine the roll-off angle for textiles. It has been found that some non-fluorinated DWRs based on green chemistry concepts showed excellent water repellence and also a resistance towards the penetration of liquids with intermediate polarity (e.g. orange juice and synthetic blood). When it comes to liquids with very low surface tension like gastric fluid evoking a hydrophilic surface repellency, but using only the materials that protected against liquid penetration. This study of chemical substitution based on chemical and textile functionality as well as end-user requirements pointed out the opportunities and limitations for functional substitution.

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

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An analysis of the technical and economic feasibility of alternatives to lead shotgun has been prepared by ECHA as part of a REACH Annex XV Restriction Report on lead and lead compounds used in shot in wetlands. Lead has historically been used in cartridges because of its softness, low melting point, high density, relatively low price and high abundance. Because of these properties, lead is often considered to be the ideal material for use in ammunition. Steel shotgun (soft iron) is by far the most commonly used alternative to lead shotgun. The alternatives have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead shotgun. However, some adaptation is required by the shooter to use alternatives successfully, including the following: Adaptation of the shot size used as this would typically need to be increased to counter for the lower density of steel. Awareness that shotguns are a key component in wetlands. A CAA tool can be used to calculate the life cycle impacts of a given alternative shotgun. The CAA tool can be used to estimate the environmental impacts of using steel shot and lead gunshot in the hunting sector. The CAA tool can be used to estimate the environmental impacts of using steel shot and lead gunshot in the hunting sector.

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

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

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In this talk we present the soil-zoological information System EDAPHOBASE, a taxonomic-ecological database system, developed within a joined research project funded by the German Federal Ministry of Education and Research (BMBF). It combines existing taxonomical primary data on soil organisms from collections, scientific literature and reports in a data warehouse. Up to now EDAPHOBASE contains more than 500000 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 biodiversity database will be based on (1) the development of a harmonized tool for the evaluation of ecological soil quality, (2) the collection and usage of existing data from different parties all over

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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 R studio 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 (3'050'686 test results) and human toxicity data (41'381 test results) available in the IUCLID 5.5 database (as of May 2020). Data was downloaded from the European Commission's website.

This methodology is one of the first of its kind, and as such base of the ecological quality of soils and coexisting species under simultaneous exposure, whenever chronic differentiation can be achieved among the species. D counter has been mainly pointed to organisms with body sizes from 0.2mm to 3mm, but it also has been tested with larger organisms, and it can be applied either to freshwater, estuarine or marine species, being suitable in bioassays using for example, the brine shrimp Artemia salina nauplii (within 48 h of hatching) or neonates (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa nauplii. How it works? - First it is necessary to extract the characteristic signal from sets of organisms belonging to each of the species involved in the study; this is done with a software based pattern identification and recognition procedure using training sets of organisms of each species, which will provide the tools for pattern recognition in the subsequent test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of this method in bioassays does not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species. 270 Ceriodaphnia is equisensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements

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

The OECD 202 Acute Daphnia Immobilization Toxicity Test requires the use of Daphnia magna or another “suitable Daphnia species, (e.g. Daphnia pulex)”. The zooplankton Ceriodaphnia dubia is not considered a standard test species for chemical registration in Europe despite the availability of ISO and USEPA standard acute and chronic test methods and its wide use and acceptance in other countries. Standard acute assays conducted with C. dubia submitted to fulfill REACH dossiers can only be used as supporting or weight of evidence studies and not as key studies. 271 Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II)
Assessment and management of stormwater on sediment recontamination due to metal contaminants

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

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

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

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 soil conditions), 75% (to simulate floods) and 25% (to simulate droughts). Different soil moisture content combinations were tested (test soil WHC vs. control soil WHC): 1) 50% vs. 50%, 2) 75% vs. 75%, 3) 25% vs. 25%, 4) 50% vs. 75%, 5) 50% vs. 25%, 6) 75% vs. 50%, and 7) 25% vs. 50%. Porewater metal(loid) concentrations were analysed by ICP-MS in soils incubated at 50%, 75% and 25% WHC for 48 h at 20°C. Soils incubated at 75% WHC had higher porewater metal(loid) concentrations than those moistened at 50% and 25% WHC. This was more pronounced in the agricultural soil (e.g. 2-50 fold higher Mn, Ni and Pb concentrations at 75% soil WHC). F. candida did not avoid both metal(loid)-contaminated soils when tests were performed at the same moisture content in test and control soils while E. crypticus did, but only at 50% soil WHC (control soil avoidance). Variation of the soil moisture content in test and control soils the behaviour of both invertebrate species was mainly controlled by soil moisture content. F. candida had a preference for soils moistened at 50% WHC, regardless the soils were contaminated or not. E. crypticus avoided both metal(loid)-contaminated soils in all the soil moisture combinations tested (~10-100% avoidance), except when the control soil was at drier conditions than the test soils. The present study showed that: 1) porewater metal(loid) availability 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.

Manganese bioavailability in legacy contaminated soils by medieval
metallurgical wastes
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In the course of time, mining activities have been shown to influence by metal resources through mining and metallurgical activities, for instance, of lead (Pb), silver (Ag), or iron (Fe). However, they can lead to a significant environmental contamination through the emission of metal-rich particles and wastes. In the region Burgundy Franche-Comté (eastern France), iron mining and metallurgical activities were dominant over the Middle-Age period, especially in the ancient district of Bar-sur-Seine. Preliminary analyses highlighted anomalous manganese (Mn) concentrations in soils surrounding medieval slag heaps. Therefore, this study aims at assessing the origin and fate of this Mn using combined physical, chemical and biological tools. For this purpose, we carried out three interdisciplinary and complementary approaches: i) mineralogical characterisation of slags (identification and mapping of their composition by XRD and SEM-EDS); ii) chemical extractions for the assessment of total and available Mn concentrations in soils and iii) environmental bioavailability of Mn using toxicitykinetics (28 days) in Contuverss aspernus snails exposed to soils from 10 ancient sites of slag deposit (dated from the 5th to the 11th century) or fed with slag fragments incorporated in their diet. We identified olivine (fayalite) as the main Mn carrier in slags where its concentration ranges 4.5 to 6% MnO. With time, slag weathering, as testified by the slow decrease of Mn7+ not present in soil invertebrates and ii) the snail ability to efficiently regulate this element. Nevertheless, when animals are directly exposed to slag fragments incorporated in their diet, the physiological mechanisms of Mn management are rapidly overloaded and internal concentrations increase up to 3000 mgMn kg−1. Extractible concentrations of Mn from soils (mainly bound to organic matter and under reducible forms) are elevated and may represent a potential toxic exposure to soil invertebrates, raising the question of Mn bioavailability in soils and slag fragments. The modeling of Mn accumulation kinetics in C. asperns snail tissues allowed to show that the slow removal of Mn from available soil invertebrates and ii) the snail ability to efficiently regulate this element.

Chemical and ecotoxicological effects of the use of residues from the pulp and paper industry for the remediation of soils degraded by mining activities
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Biomas ash and biological sludge, both residues from the pulp and paper industry, in different mixture formulations, with and without the application of mixed municipal solid waste compost (MSWC), were used to improve the quality of soils affected by mining activities (Aljustrel mine, Iberian Pyrite Belt). The experiments consisted of i) the slow decrease of Mn7+ not present in soil invertebrates, lead, Rodriguez, Universidade de Aveiro / CESAM & Departamento de Química

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 both aquatic and terrestrial ecosystems. 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 Aguiarica, 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 PE-enriched particles were 64:26:10, 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 Aguiachica and Estareja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (−1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential 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
M. Hess, LANUV NRW / Water management, water protection; C. Lofarsch, University of Bayreuth; P. Diehl, State Environment Agency Rhineland-Palatinate; H. Imhof, University of Bayreuth / Animal Ecology I; M. Loeder, University of Bayreuth; J. Mayer, Hessian Agency for Nature Conservation, Environment and Geology; H. Rahm, North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection; W. Reifenhäuser, Bavarian Environmental Agency, Wielenbach; I. Schrank, University of Bayreuth; J. Stark, State Institute for Environment, Measurements and Nature Conservation Baden-Württemberg; J. Schweiger, Bavarian Environmental Agency / Aquatic Toxicology and Pathology Plastics are an indispensable component of our daily lives due to their diverse applications. In consequence of improper handling or disposal, plastics can enter surface waters and persist over a long period due to their low degradability. About 4.8 to 12.7 million tonnes of plastic waste are released into the oceans each year. Rivers and wastewater discharges may contribute significantly to the contamination of the marine environment. Despite an obvious causal link between the (micro)plastic load of inland waters and marine ecosystems, European rivers have been investigated for the presence of microplastics (MPs) only recently. However, the analytical results of different studies are usually not comparable among each other due to different methods of sampling, processing and analysis of microplastics. In Germany, five federal states initialised monitoring programmes to get a first overview on the microplastic load of inland water systems: Baden-Württemberg, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was carried out as part of the Active Monitoring and Proactive Response project (AMPRA) under the umbrella of the MMIP. The programme comprised microplastic sampling 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 Manta-Trawl and analysed by FTIR spectroscopy. About 4.8 to 12.7 million tonnes of plastic debris, could be clearly 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. Excepts of the study, focusing on particle number, distribution of size classes, particle shapes and polymer types at the water surface of rivers in western and southern Germany will be presented.

280 Exploring the relation between plastic concentration and river discharge in an urban river
S. Wagner, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Environmental Geoscience; P.E. Kölecker, Helmholtz Centre for Environmental Research GmbH - UFZ / Analytical Chemistry; C. Schmidt, Helmholtz Centre for Environmental Research GmbH - UFZ / Hydrogeology; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry

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

281 Microplastic pollution in upstream river catchments
T. Stanton, M. Johnson, P. Nathanail, The University of Nottingham / School of Geography; R.L. Gomes, The University of Nottingham / Faculty of Engineering; W. Macnaughton, The University of Nottingham / School of Biosciences

Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally. 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 according to England’s Midlands, as well as in atmospheric fallout. FTIR analysis of particle number was 10.8 particle/L, while the other 6 ponds ranged from 0.07 to 2.45 particle/L. For MP mass the highest concentration was 1.2 µg/L while the other 6 ponds ranged from 0.06 to 0.4 µg/L. High-density polymers were also detected in some of the ponds, this is likely due to the resuspension of sediment by wind and traps of MPs by organisms. Sediment samples are still under processing and will be included in the final presentation. Nevertheless, the water samples have shown that stormwater pond do not retain all MPs, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

283 Towards a more realistic assessment of microplastics as pollutant transporter: a combined experimental and modelling study
S. Seidensticker, C. Zarfl, O. Cinpka, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience

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

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 is aimed to perform a source apportionment of PM10 collected simultaneously in four sites located in the Puglia region (South-Eastern Italy). The
sites are located in the area surrounding the “Federico II” coal-fired power plant. The studied area included the territory of the Province of Brindisi, close to the coal-fired power plant “Federico II”, and in the territory of the Province of Lecce at about 26 km SSE of the power plant. The Lecce site was included to assess the impact of the power plant emissions at middle distances. The measuring sites are Lendinizio (LN), Cisternino (CN), Torcariarlo (TR) and Lecce (LE). The Lecce site is located in the Province of Lecce for Air Quality Observation Network (OAS-CN) of the Global Atmospheric Watch (GAW-WMO) program. Daily PM$_{2.5}$ samples were collected at the different sites during measurement campaigns in different seasons (summer, autumn and winter) between 2013 and 2016. Specifically, three measurement campaigns were performed simultaneously at the four sites in 2016 and the dataset was enriched with previously available data collected in 2013 and 2015 at the sites in the province of Brindisi (LN, CL, and TR) and the Lecce site (LE) for a total of 457 daily samples. Collected samples were chemically analysed to determine 19 species: the carbonaceous components (EC and OC); the water soluble ions Cl$^-$, NO$_3^-$, SO$_4^{2-}$, Na$^+$, NH$_4^+$, K$^+$, Mg$^{2+}$, Ca$^{2+}$; the elements AI, Si, Ti, V, Mn, Fe, Ni, Cu and Zn. Measured data was used for source apportionment of PM$_{10}$ based on a receptor-oriented model approach that integrates the results obtained using Positive Matrix Factorization (PMF) and Source-oriented receptor model for Aerosols (SOURMIX) (CMB), with those obtained using the CALPUFF dispersion model. This approach allows to estimate the primary contribution of the power plant to PM$_{10}$ and to obtain an estimation of its contribution to secondary sulphate.

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

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287 Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM$_{10}$ in different Italian towns

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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 mechanisms of action of air pollutants on human health. These studies worked mainly in vitro or in vivo models exposed to PM$_{10}$ 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 extracted PM in comparison to airborne PM$_{10}$. 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 conditions of engineered nanoparticles or other molecules of interest. Here we report the results obtained by the application of the biological effects of PM$_{10}$ on human bronchial epithelial cells in 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 biological effects of PM$_{10}$ extracts. The PM$_{10}$ extracts were then released on the differential expression of selected genes of interest. Altogether our results show that the time is arrived to leave the warm 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 obtained under really representative environmental conditions may be more representative to understand the biological processes activated by air pollution.

Indoor and Outdoor air contamination by endocrine disruptor pollutants in the North part of France

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The atmosphere is the main environment with which humans have the most important exchanges. However, human activities (industrial zone, urban) participate (other matter) but also act as a source of contamination by a broad range of pollutants. To date, few data exist on air contamination by endocrine disrupter compounds (EDCs) in France. With the experience acquiring in Paris region in a previous research, the research team and ATMO Hauts-de-France realised two study in the North part of France about indoor and outdoor air contamination by EDCs. According to the methodology previously validated, several types of indoor environments (office, house, scholar building and day nursery) and several areas (rural/ forest, urban, industrial) were investigated over 2 years (2015 and 2016-2017). During each season, 7 or 5 sites (indoor and outdoor) were sampling during during three successive 2-week periods. The device is composed to a TSP filter system and a cartridge containing XAD resin, connected to a flowmeter and a pump. 70 EDCs were analysed by LC/MS/MS. GC/MS/MS or GC-simultaneous mass spectrometry (GC-Mass Balance - CMB), with those obtained using the CALPUFF dispersion model. This approach allows to estimate the primary contribution of the power plant to PM$_{10}$ and to obtain an estimation of its contribution to secondary sulphate.
implementing policies of public health protection.

288 Source apportionment of PM near steel plant by electron microscopy
A. Genza, University of Salento / Dep. of Biological and environmental Sciences and Technology; M. Siciliano, University of Salento; C. Malitesta, T. Siciliano, University del Salento

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 5000 particles were selected by EDS and based on the morphology and chemical composition they have been classified into the following main groups: Aluminosilicate particles; Silicium reach particles; Ca-rich particles; Biological particles; Carboxeanucous 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. In industrial, soil and secondary, particle of different groups are merged.

The source apportionment analysis performed with the single particle analysis led to the conclusion that the long range transport of polycyclic aromatic hydrocarbons (PAHs) in fine fraction in the study area remains a global threat concern as transport models continue to fall short of accurate predictions. To improve modeling accuracy the determination of chemical speciation of PAHs within PM2.5 is necessary. Secondary organic aerosol (SOA) particles sorb PAHs during formation and transport them as a large fraction of global atmospheric PM2.5, and the presence of PAH vapor has been demonstrated to increase the mass loading of atmospheric SOA. The oxidation of four PAHs were studied in laboratory-generated a-pinene SOA experiments. Dibenzo[a]anthracene (DBT), phenanthrene (PHE), pyrene (PYR), and benzo(a)anthracene (BaA) were measured along with their oxidation products in freshly formed a-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.

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

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

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

290 The role of the p38-activated protein kinase signaling pathway-mediated autophagy in cadmium-exposed monogonont rotifer Brachionus koreanus
H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

Autophagy is a ‘self-eating’ system that regulates the degradation of cellular components and particles in various physiological processes such as cellular 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 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 triclosan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus
J. Paek, J. Lee, Sungkyunkwan University

Triclosan (TCS) is an antimicrobial biocide 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 in the nauplii 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 (e.g. GST, GPx, and SOD) were significantly increased (P < 0.05) in response to TCS exposure. Furthermore, mRNA expression of detoxification (e.g., CYPs) and antioxidant (e.g., glutathione S-transferase-sigma isoforms, CuZn superoxide dismutase, catalase) genes was modulated in response to TCS exposure at different concentrations over a 24 h period. Our results revealed that TCS can reduce fecundity and induce oxidative stress with transcriptional regulation of oxidative stress-induced defense genes along with the activation of the antioxidant system in the copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP30263a and CYP307A1) 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 on 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
Y. Lee, H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

In aquatic organisms, cellular membranes act as the final physical barrier to xenobiotics, since the membranes are in constant contact with the ambient water column that contains various anthropogenic pollutants. In this respect, the efflux activities of membrane transporters can be considered as the first line of defense to xenobiotic exposure in aquatic organisms. GST, GPx, and transporters P-glycoprotein (P-gp) and multidrug resistance-associated protein (MRP) are ATP-binding cassette (ABC) transporters that confer multixenobiotic resistance (MXR) via their efflux activity, which enables a variety of xenobiotics to be expelled from cells. MXR has been proposed as the first line of defense against xenobiotics. In this study, the protective roles of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and molinate) using fluorescent substrates and inhibitors specific to P-gp and MRP. The efflux activities of P-gp and MRP in the rotifer B. koreanus were increased by biocide exposure, since the fluorescence intensities of the accumulated P-gp and MRP fluorescent substrates were lower in response to different biocides. Thus, exposure of rotifers to the four biocides resulted in increased P-gp and MRP activity. Moreover, the rotifers became more sensitive to the biocides, with reduced survival and slower population growth rates, when P-gp or MRP was inhibited. These findings suggest that P-gp and MRP are involved in the defense system in response to biocide exposure. Furthermore, the transcriptional levels of the genes encoding P-gp and MRP were examined to uncover the mechanism by which MXR is induced. Taken together, our results demonstrate the crucial 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.
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated Daphnia magna clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and another three having the transporter protein gene ABCB1 mutated. Bi- and tri-allelic del TRH mutants lack serotonin, and have their growth rates impaired. Bi-allelic indel 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 i-Verotenin 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 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. Schmidt, Helmholtz Centre for Environmental Research / Cell Toxicology; R. Altenburger, 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.

297 Toxic mixtures in time-the sequence makes the poison R. Asahauer, University of York / Environment

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

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

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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

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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 uses high data throughput and advanced statistical methods for 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-continent mixtures. Environmental quality standards that have been established for single priority pollutants may not be sufficiently protective against mixture effects. Regulatory approaches for effectively tackling the problem are missing. The advanced framework integrates all available lines of evidence (LOE) on significant risks. This includes evidence from (i) ecological monitoring (field observations on so-called biological quality elements), (ii) effect-based monitoring (in vitro or in vivo testing in the lab or on-site), (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, they shall be prioritised using risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even single component which can be demonstrated to explain most of the overall risk, so-called drivers of mixture risks. Wherever conclusive evidence on significant risks and needs for risk reduction cannot be reached because all possible LOEs are somewhat blocked by significant data or knowledge gaps, mixture components of potential concern are identified by new approaches for 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 pinpoints to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with phototoxicant biofilms (periphyton) in wastewater impacted streams. Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential ecotoxicological effects using different toxicological approaches. Based on outcome of this LOE, we hypothesized that clear ecological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community due to 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) PSI inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfresh project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

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

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF/ Ecoxtox Centre; R. Kuhl, E. Zimmer, IBACON GmbH; I. Werner, EcowaxCentre Eawag EPFL/DepartmentofAnatomyPhysiologyandCellBiology; R. Ashauer, University of York/Environment

The EU Water Framework Directive defines two environmental quality standards for assessing the chemical status of surface waters. The MAC-EQS defines the Maximal Allowable Concentration that should never be exceeded and the AA-EQS defines a concentration that should’t be exceeded by the Annual Average concentration. While the AA-EQS should account for the acute toxicity of a substance, the AA-EQS is based on chronic ecotoxicity studies. For substances with highly fluctuating environmental concentrations like plant protection products the use of the annual average is disputed. Hence, in Switzerland it was suggested to use 14-day time-weighted average (TWA) concentrations for assessing compliance with quality standards for chronic toxicity. This approach is based on the average duration of chronic ecotoxicity tests and Haber’s rule. We assess the suitability of this approach for retrospective risk assessment by applying toxicokinetic-toxicodynamic (TKTD) modelling on high resolution exposure profiles of plant protection products measured in Swiss streams. The TKTD modelling is a proxy for the actual time-course of toxicity under time-variable exposure and is based on 7 species, 7 substances and 5 exposure profiles from 5 streams. The results confirm the suitability of the time integral of 14 days. The prediction of actual toxicity for the most toxic periods is very consistent with the toxicity modeled for the TWA. The deviations are on average less than factor 2 for each organism group tested. In addition to mortality for crustaceans and fish, only a small selection of sub-lethal effects was considered, namely reproduction and growth of water fowls and larval growth in diatom populations. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is appropriate.

303 Revision of 62 Environmental Quality Standards - lessons learned

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Environmental Quality Standards (EQSs) 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 toxicokinetic and toxicodynamic models, 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 (fold change 2.5/0.06). MAC-EQSs increased in 21 cases (50/6.18) and decreased in 9 cases (22/7.24). Most EQSs were derived deterministically, using the assessment factor (AF) method. Due to an increase in data for some
304 Endocrine disrupting properties: how far and consistent they are considered deriving Water Framework Directive Environmental Quality Standards? A case study tackling French and EU EQS values

A. JAMES-CASAS, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances ETES; A. BOTHAMY, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

Toxicological assessments of chemical substances in the derivation of EQSs and MACs are based on the use of SSDs. In contrast, reference values, such as EC50 and NOEC, derived as a result of testing conducted on the basis of a single substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

305 Brining water quality benchmark derivation approaches into the 21st century


The most common method for deriving water quality benchmarks (WQBs) for toxicants is the use of a species sensitivity distribution (SSD) to estimate a chemical concentration, with an environmental protection point for setting discharge limits. Historically, water quality benchmarks (EQBs, also variously called guidelines, standards, criteria) are an internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no-one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is best, whether particular features are “arbitrary” etc. We believe that such opportunities for improvement of WQB derivation methods extend beyond just refining SSD-based approaches, to the use of non-SSD approaches and weight of evidence approaches that give consideration to both laboratory- and field-effects data. Other opportunities for improvement exist in the acquisition of data for WQBs (e.g. type and acceptability of toxicity data), as well as the application of WQBs in water quality management. Thus, it is important to identify and target the limitations that, if addressed, will yield the biggest benefits to environmental protection. Experience has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus, decrease understanding and adoption by users. This presentation will examine a variety of questions associated with WQB derivation methods. Among these are what research efforts have been undertaken to significantly evolve the way we derive WQBs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?

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

G. Merrington, A. Peters, wca; S. Kosmala, WCA Environment Limited

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 whether water quality is within a jurisdiction’s legal and other requirements and to set 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 WQG 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 is a major factor as is the incredible lack of resources available 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!

M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science; G. Merrington, wca

Environmental quality benchmarks (EQBs, also variously called guidelines, standards, criteria) are an internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no-one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is best, whether particular features are “arbitrary” etc. We believe that such opportunities for improvement of WQB derivation methods extend beyond just refining SSD-based approaches, to the use of non-SSD approaches and weight of evidence approaches that give consideration to both laboratory- and field-effects data. Other opportunities for improvement exist in the acquisition of data for WQBs (e.g. type and acceptability of toxicity data), as well as the application of WQBs in water quality management. Thus, it is important to identify and target the limitations that, if addressed, will yield the biggest benefits to environmental protection. Experience has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus, decrease understanding and adoption by users. This presentation will examine a variety of questions associated with WQB derivation methods. Among these are what research efforts have been undertaken to significantly evolve the way we derive WQBs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?
Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

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

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The Eastern Mediterranean Sea is a low-nutrient low-chlorophyll marine ecosystem [1] but some variability within the basin does exist. Indeed, several coasts are influenced by anthropogenic processes, and specifically in the Greek coasts these include industrial, harbor, agriculture, mariculture activities, urbanization and tourism [2]. Our hypothesis was that prokaryotic and viral community diversity is differently affected in contrasting coastal systems by anthropogenic pressures. We used 16S rRNA gene amplicon and whole virome sequencing at stations characterized by different chemical features based on the “National monitoring project for the implementation the Water Framework Directive (2000/60/EE) in Greece” [2]. We focused on viral auxiliary metabolic genes and the influence of heavy metals (Cu, Cd, Co, Ni, Pb, Zn, Cr and Hg). Significant differences were found at the genus level between the sampling stations. Proteobacteria were dominant in all stations, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinadies and Pataakis Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO₂-, NO₃-, NH₄⁺, PO₄³⁻, SiO₂ and chlorophyll a were found in stations influenced by extensive industrial, agricultural and maricultural activities. The 3 stations of Amvrakikos Gulf were highly variable in terms of community structure. Significantly lower relative abundance of Verrucomicrobia and Bacteroidetes in the “control” than in the “impact” station in Kefalonia (inside and outside the influence of the fish farms, respectively) was seen. Bacterial 16S rRNA analysis revealed significant differences between stations along the Greek coast, suggesting that each station hosts a different community. Analysis of viral metagenomes will show if community composition reflects the anthropogenic activities in these areas, and if lysogeny (i.e. viral integrase and auxiliary metabolic genes’ abundance) is a prevalent lifestyle. [1] Krom MD, Emeis K-C, Van Cappellen P. 2010. Why is the Eastern Mediterranean phosphorus limited?. Prog Oceanogr 85:236-244. [2] Pavlidou A, Simbou N, Roussetaki E, Tsapakis M, Pagou K, Drakopoulou P, Assimakopoulou G, Kontoyiannis H, Panayotidis P. 2015. Methods of eutrophication assessment in the context of the water framework directive. Cont Shelf Res. 108: 156-166.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments

K. Huffmon, 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. Burre, 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.Swapark, 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 open channels. Sediment was collected monthly during base rainfall (< 5mm/day) for 4 months from 3 sites within each location at increasing stormwater pollution (0, 200, 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 the chemical processes including primary productivity, community respiration and nutrient cycling. We observed major shifts in the microbial community related to exposure to legacy contaminants and new stormwater contaminant inputs. We also found trends of decreasing community respiration rates away from storm drains and lowest rates of primary production during base rainfall. The results have implications for future management of stormwater in estuaries and increase our understanding of how to conserve crucial sediment community diversity and function.

310 Drought as environmental driver on ciliates and micrometazoa communities in a multistressors scenario. An experimental approach

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Climate change will affect agriculture practices and productivity because increased irrigation frequency may induce water stress and diseases and changes in phenology, that means a future increase in the use of pesticides and, in consequence higher risk of freshwater pollution. In addition climate change will lead to higher severity of drought events and higher temperatures. Ciliates and micrometazoa in freshwater ecosystems play an important role in the processing of organic matter and as basal resource for consumer organisms. The present work aims to study how these environmental and chemical stressors, and their interactions, in a future scenario of climate change can affect these communities in freshwater sediments. To study how drought (D), warming (T) and a realistic environmental mixture of pesticides (P) can affect the communities of ciliates and micrometazoa in river sediments, we developed an experiment with a factorial design in experimental indoor channels with natural sediment from a pristine river (24 channels, 3 replicates, 1 exposure per conditioning). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoa communities was studied twice during the experiment (one week before and after 7 weeks of chronic exposure). Significant changes in community composition between pre- and post- exposure were observed for all treatments. Community was dominated by micrometazoa in all treatments in terms of density, but a trend of increasing the percentage of ciliates in these treatments with stressors was observed, indicating a possible advantage of ciliates in stressed environments. At the end of the experiment total density was significantly higher respect to control in D, DP and TDP treatments (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 both community density and organic matter reduction was the most important factor causing significant differences in community composition (PERMANOVA p<0.001). The mixture of pesticides at realistic environmental concentrations did not cause any effect on the studied communities. Our results suggest that flow reduction is the main driver for changes in micrometazoa and 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 polysaturated 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 from September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpsån and M42 than in Höje å. Ecotoxicity testing using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Höje å, causing an inhibition of the photosynthetic activity up to 63% and 53%, respectively. Cluster and principal component analyses based on pigments content, algal diversity and fatty acid profiles, clearly separated the periphyton from the three 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 eicosapentaeenoic 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 periphrystin (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 might mask pesticides effects on periphrystin quantity and quality because compensatory effects from nutrients.

312 Estrone and triclosan mixture alters soil metagenomics during degradation
D.L. Carr, Texas Tech University / Biological Sciences; E. Osuji, Texas Tech University / Biological Science

Wastewater derived from domestic use commonly contains mixture of pharmaceutical and personal product (PPCP), but its persistence and accumulation in the soil, and the consequences for soil microbial community processes are poorly understood. Estrone and triclosan are two common PPCPs of domestic wastewater. Soil microbial communities degrade a variety of PPCPs however; most studies have only addressed single compound designs neglecting the reality of their co-occurrence in nature. In this study, we examined the interaction between estrone and triclosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triclosan, and a 1:1 mixture of estrone:triclosan, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlates™. Microbial degradation rates were compared over the 90 days’ incubation period using high performance liquid chromatography. Metagenomic analysis by 16S rRNA was used to determine changes in microbial community over time. There was significant increase in substrate activity and substrate richness in all treatments. Each microbial community utilized different carbon substrates by day 90 whereas they had exhibited similar substrate utilization at day 0. Estrone and triclosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triclosan). The rate of degradation of the binary estrone:triclosan mixture was the same as the individual compounds. This 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 triclosan in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of ground water.

313 Poster spotlight: TU014, TU015, TU016

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

314 Region-specific life cycle inventories for tailings disposal in ecoinvent v3
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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 dams 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- or region-specific specific inventories based on actual site-specific 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
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Copper is widely used in modern society, finding application in traditional end-uses such as plumbing, infrastructure, and transportation, but it is also an essential material in emerging green energy technologies. Europe (i.e., EU-28) has modest natural deposits and strongly depends on imports to meet the domestic demand. In the context of efficiency, resilience and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, as copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling scenario making problems and associated life cycle assessment of products and services. With this shift, goods and services that are not durable, but are历史上 have been considered waste, can be re-used or recycled, thus generating market and economic value calculated by the total cost minus recycling and reusing costs. The DaVAT system relies on the previous model by presenting the results of an LCA of the extended import reliance and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, as copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling scenario. 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- or region-specific specific inventories based on actual site-specific 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.

316 Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piezewise 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 and associated life cycle assessment of products and services. With this shift, goods and services that are not durable, but are historically have been considered waste, can be re-used or recycled, thus generating market and economic value calculated by the total cost minus recycling and reusing costs. The DaVAT system relies on the previous model by presenting the results of an LCA of the extended import reliance and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, as copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling scenario. 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- or region-specific specific inventories based on actual site-specific 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.

317 The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax
B. Timmermans, Université Libre de Bruxelles; W. Achten, Université Libre de Bruxelles / Department Geosciences, Environment and Society

The purpose of this presentation is to provide a short insight about a study examining the principles and feasibility of a shift from Value Added Tax (VAT) or sales tax to a Damage and Value Added Tax (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 the three essential
318 Towards global guidance on LCIA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force

T. Sonderegger, ETH Zurich; M. Berger, Technische Universität Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treese Ltd.; J. Guineau, University of Leiden / Institute of Environmental Sciences; C. Hélbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHITA, National Institute of Advanced Industrial Science and Technology; I. Norbury, Monash University; S. Oldiges, 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 relation to the decrease in recoverable resources. Different impact assessment methods (e.g., stage-based, life cycle assessment based on previous studies) have been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

320 Silica coating for the control of nano-reactivity

S. Oretti, CNR ISTECC; M. Blosi, CNR; D. Gardini, CNR ISTECC; A. Costa, CNR Nano-titanium dioxide (TiO₂) and nano-silver (Ag) and are among the materials most investigated for their technological importance and consequent interest in terms of their environment, health and safety (EHS) issues. In particular these particles cause alert for their capacity to generate, transport and release potentially toxicants such as metal ions and reactive oxygen species that can induce several negative effects, responsible for cytotoxicity. In this study we investigated silica coating as technique for control two recognised toxicity drivers for nano TiO₂ and Ag that are the exogenous production of ROS and the Ag²⁺Ag total distribution. We evaluated the effect that silica coating had on physicochemical properties (size, shape and zeta potential) of particles and on their toxicity, by re-increasing the output rate when the number of highly-polluting products decreases. To reduce the variance of the LCA results used for this purpose, the DaVAT system should use common databases, apply the same inventory, characterization, normalization and weighting methods, as well as refer to the same impact categories and the same cut-off rules. LCA as a whole can stay as it is, but for use with DaVAT specific impact categories (e.g., sub-limits for aggro-toxic assessment based on previous studies has been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

321 Framework for the optimal design of sustainable chemical processes

A. Gonzalez Garay, R. Calvo-Serrano, G. Guillein 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. The general framework is illustrated with a case study of the production of methanol from CO₂ and hydrogen.

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


Reuse and recycling of products are key elements towards a sustainable and circular economy. 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 a decision 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 PFAEs and alternatives from the durable water repellence layer (DWR) of textiles during use
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In the durable water repellence (DWR) layer of textiles of outdoor clothing, PFAEs have been used because their perfluoroalkyl chains have the ability to repel liquids of a wide range of polarities (DWR, hydrophobic and hydrophobic). 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. Groh, 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. Geuweke, Food Packaging Forum Foundation; A. Lennquist, Chemsec; H. Leslie, VU University Amsterdam / Environment&Health; L. Hageman, Food Packaging Forum Foundation / General Management
Plastic packaging is increasingly used globally, causing raising concerns for the environment and human health from littering, release of microplastic and leakage of hazardous chemicals. Specifically, chemicals may migrate into foods or the environment 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 used 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 a Classification, Labeling and Packaging (CLP) hazard scheme that besides SVHCs also considers and weighs other risk and benefit factors of chemicals originating from plastic packaging. 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
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Innovative nano-enabled products can overcome some of the traditional restoration techniques, especially in the case of complex and unstable materials used in contemporary artworks. However, nanomaterials have been demonstrated to be potentially hazardous to both humans and the environment. Thus, their application for the conservation of cultural heritage requires a proper assessment and management of potential risks. A Safe by Design (SbD) approach can support the early identification and management of uncertainties and risks during an innovation process and allows for the modification of a product design to avoid undesired properties. Within the EU H2020 “NANORESTART” project, a stepwise SbD framework for the sustainability assessment of nano-based products for restoration has been proposed, taking into account the current EU legislative context as well as the specific features of the innovation process in the restoration field. The proposed framework embraces the SbD concept proposed by NANoREG initiative, which uses the Cooper Stage Gate innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state-of-the-art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self-classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post-application stages, while the manufacturing stage cannot be included until the industrial up-scale has been finalised. The SbD framework is currently being applied to NANORESTART advanced nano-based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three bioassays for acute aquatic toxicity, mutagenicity, and cytotoxicity, as well as tests for cystocytotoxicity, DNA-damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long-term behaviour of products in post-application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Recent developments in environmental risk assessment for pollinators
326 Managing on the Margins: The confluence of Modern Agriculture and Aiculture
Z. Browning, Brownings 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 honey producti for 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 backyard garden to the almond orchards of California. 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 manage, and the use issues honey bee health, or habitat loss, chemical uses, 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 is both for food production or protection of human and animal health from disease vectors must be coordinated to ensure profitable production outputs for all stakeholders. Beekeepers can assist in the development of
scientifically supported risk assessment through participation in research development. Beekeepers know bees; researchers know research protocols. To understand how honey bees function under migratory beekeeping and crop field conditions beekeepers need to be part of designing the risk assessment research. Beekeepers, no matter the level of beekeeping or number of hives, are eager to be included in research that will help alleviate the risks to honey bees, and native pollinators. Involving beekeepers in risk assessment and research design is key to ensuring the research premise and results truly reflect the real-world of beekeepers and honey bees. In some ideal world beekeepers would be respected for the ecosystem service their honey bees provide to farmers. Beekeeper and farmer would understand their symbiosis in connection with the health of the crop, and the success of the crop’s yield. Both would work to ensure a healthy crop and healthy honey bees by pollinating all crops. One begets the other: each supporting each other; beekeeper and farmer, honey bee and crop (personal examples). As such all stakeholders who rely on honey bees and native pollinators to maintain a healthy ecosystem would balance competing interests to ensure pollinators have clean, plentiful, and diverse forage, pollinators are healthy to provide appropriate pollination services to the ecosystem, and land management is facilitated to reduce soil erosion, protect water, and reduce the threat of disease vectors. (Share Bee and Butterfly Fund programs as results)

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

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

328 PESTICIDE EXPOSURE ASSESSMENT PARADIGM FOR BUMBLE BEES

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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 exposure assays available, a next step could be to develop exposure assays that can be used to determine the chronic exposure to bee species. • For bumble and solitary bees very few substances pass the acute screening step and none pass for chronic risk assessments. • Even known low-bee-toxic substances fail the risk assessment and would need higher tier refinement. In order to pass the assessment, the required doses that would have to be tested would be so high that they would not be technically (solubility) or practically (consumption by the bee) achievable. Results of the Tier 1 assessment following an industry proposed approach will be presented, together with a comparison of existing honey bee and bumble bee data, proposals for protection goals and higher tier testing methodology. In its present over-conservative form, the EFSA guidance will make it difficult to register any new or existing insecticides, as well as many herbicides and fungicides. Industry believes that further work and significant revision are required to build a pragmatic, applicable and consistent guidance document within the regulatory framework and has invested much time and money in developing a practical alternative based on the same science.

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

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

332 Consumption of products - a proxy for changes in chemical flows in urban areas and to the environment?
E. Undeman, D. Bolinius, 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 two 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. Jollét, University of Michigan
Building materials have important contribution to the chemical exposome 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 ingestion were calculated using the PiF metric. Results showed that for VOCs, 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 10³ 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.

334 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. Jiang, Environment and Climate Change Canada; M.L. Diamant, University of Toronto / Department of Earth Sciences; Y. Adjei-Kyereme, University of Toronto / Chemical Engineering and Applied Chemistry
Organophosphate Esters (OPEs) are used in a wide range of consumer products and building materials resulting in their ubiquitous presence in the indoor and outdoor environment. Concentrations of OPEs in indoor air can be relatively high, in the range of 10⁻⁵ ng/m³ 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. “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 Toronto, Canada. “Top down” emissions were calculated using the Multimedia Urban Model based on measured Toronto outdoor air concentrations, main receptors for these molecules. Pharmaceuticals can be related to the TP 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 lower emissions from commercial buildings. OPEs from indoor air are likely to be influenced by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoor, fates 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 related to the TP 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 lower emissions from commercial buildings. OPEs from indoor air are likely to be influenced by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoor, fates is governed by air advection and water movement, because of the high solubility of OPEs.

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and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; A. Di Guardo, University of Insubria / Department of Science and High Technology

Different monitoring campaigns showed higher PCB concentrations in the air of cities compared to rural areas, indicating the presence of ongoing emission sources in urban locations. This is the result of both the past usage of these chemicals in building materials and electrical equipment from which they can volatilize and/or become airborne in e-waste contaminated soils. It was estimated that cities could emit up to about 1 tons/year of PCBs (Gasic et al., 2009; Diamond et al., 2010), which can be transported to rural sites, posing adverse effects to human and ecosystems. The city of Brescia, is characterized by the presence of a factory (Caffaro s.p.a.) that produced PCBs between 1930-1984 and its surrounding areas were found to be heavily contaminated with high PCB concentrations in soil at mg/kg levels. For this reason, about 200 ha of this city were declared National Priority Site for remediation (SIN Brescia Caffaro) by the Italian authorities, representing an important secondary source of PCBs to the atmosphere. The aim of the present study was to investigate the potential of the Brescia city in driving the PCB contamination at regional scale up to 100 km from the point source and the current effects on air concentrations, combining measured data and a multimedia mass balance model. Different sampling campaigns were organized to collect samples of soil and leaves along four 100 km transects that ran in NW, NE, SW and SE directions considering the production plant as starting point. In each sample, the following PCB congeners were determined: PCB 28, PCB 52, PCB 101, PCB 153, PCB 138, PCB 180 and PCB 209. The results were analysed to tune-dependence of the relative contribution of far- and near-field routes emission with distance from the point source. Furthermore, a spatially resolved version of a dynamic air-vegetation-soil model (SoilPlusVeg model) was used to (1) predict a temporal emission profile from the city, (2) verify if an emission source strength predicted previously for this city justifies soil concentrations in the surrounding area and, (3) evaluate the importance of other sources and processes involved in the contamination processes. This study shows how a combined modelling approach could be used to unravel the past and recent impact of PCB emissions from a source on the surrounding areas at a regional scale.

337 Using a Dynamic, Aggregate Exposure Model to Identify Far- and Near-Field Contributions to Human PCB Exposure through Time
L. Li; University of Toronto at Scarborough / Department of Environmental Sciences; J.A. Arnt, ARC Arnt Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences; J.A. Arnt, ARC Arnt Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Humans are exposed to polychlorinated biphenyls (PCBs) through “far-field” exposures 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 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 have been 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. Wengen, Empa Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, EMPA

Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwaters. Assessing the emissions of plastic is possible using a life-cycle oriented approach, and permits to compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in Europe using 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, polypolyethylene (PP), polystyrene (PS), expanded polystyrene, polycarbonate (PCP) 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 the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss productions and consumptions. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-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. Koelmann, Wageningen University / Aquatic Ecology and Water Quality Management; C.M. Holmes, Waterborne Environmental Health Program and High Technology; G. Raspa, Sapienza University of Rome / Department of Environmental Sciences; J.A. Arnt, ARC Arnt Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences

Pollution with nano- and microplastics (MPs; particles < 5 mm) is a topic of emerging concern and as such receives growing interest. Although measurement and monitoring data are indispensable, there also is a need for estimated concentrations to enable prospective assessments and to guide analysis of retrospective ecological analyses. Besseling et al (2017) provided the NanoDuFLOW model, a detailed MP aggregation-sedimentation model integrated in a hydrological and particle transport model. A much larger scale model potentially suitable to simulate MPs originating from WWTPs is the iSTREEM® model, which has been developed to estimate chemical concentration distributions for all rivers and streams of the USA receiving WWTP discharges. Here we merge these two riverine modeling worlds: NanoDuFLOW with iSTREEM for MPs, to simulate the trading of MPs from each WWTP point source in the US and to assess export to the Great Lakes for a range of particle sizes. This combines the mechanistic realism of NanoDuFLOW, accounting for formation and settling of heteroaggregates, with the US well-established iSTREEM implementation. We modeled floating as well as non-buoyant MP, for diverse sizes, from 100 nm to 10 mm, a range that incorporates the theoretical parabolic size-settling relationship reported by Besseling et al (2017). Depth dependent in-stream first order removal rate constants simulated with NanoDuFLOW were combined with standard iSTREEM output (which was used to simulate the emission, transport and water column concentrations of MP) in an Excel-based post-processing phase, without modifying the iSTREEM model directly. Simulations were spatially explicit with MP concentrations being modeled for the Sandusky River watershed in Ohio (~2300 km²). Emitter capital is sized and population served for each of the 20 WWTPs within the watershed. Modelling results show the effects of population density, MP size and density on riverine concentrations and export to Lake Erie. Buoyant as well as the smallest non-buoyant MP fractions can be transported over long distances, reaching receiving waters such as the Great Lakes. In contrast, larger non-buoyant MPs settle more locally in the vicinity of the WWTPs. Simulating depth-dependent removal as demonstrated here could be incorporated into the core iSTREEM code in order to efficiently process all US waterways impacted by WWTPs, as well as examining ultimate marine discharge proportions by particle size. 

340 The routes to uptake and bioaccumulation of nanoparticles in freshwater sediments
R. Cross, C. Liddle, University of Exeter; T.S. Galloway, University of Exeter / Biosciences

Plastic contamination of freshwater sediments is well documented, and whilst quantitative measurement of nanoparticle routes to the environment is in sediments are becoming of increasing importance, models assessing their potential uptake and transfer through food chains can contribute towards the data required to inform decisions as to the suitability of classifying nanoparticles as POPs. This study provides initial insights to address this question in
an ecologically relevant system, using the freshwater aquatic worm Lumbriculus variegatus, representing an entry point for nanoparticles from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorochemically dyed nano-polystyrene (50 nm) upon their uptake is systemically 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 plasticized nanoplastics can be ingested both in 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 solid constituents of the sediment. Ongoing work addresses the potential for formation of an "ecocorona" to alter the bioaccessibility of nanoparticles for the worms. These results will also be presented during the platform presentation.

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Life-history and biochemical responses of Chironomus riparius exposed to different sized microplastics
C. Silva, CESAM & University of Aveiro, J. Pestaña, 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 particle micro-debris in sediments (lakeshores and riversbanks) makes them long-time available for benthic species. The objective of this study was to investigate developmental, and physiological effects induced by the presence of polyethylene microparticles (PE) in Chironomus riparius, due to its key-role in the freshwater ecosystem. For that partial life cycle tests using different sized polyethylene particles (PE 40-48 µm; PE 125 µm and PE 350 µm) allowed evaluation of effects on C. riparius larval growth and emergence patterns while acute exposures were used to assess effects in parameters related to neurotransmission (ACHE); antioxidant defences and biotransformation (CAT, GST total glutathione levels); oxidative damage (LPO); cellular energy allocation (CEA) and immune response (phenoaxidase). Exposure to PE 40-48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagoes and on emergence rate. PE 40-48 µm were then selected to assess effects on physiological homeostasis. Acute exposures to PE 40-48 µm generated alterations in C. riparius larvae antioxidant and biotransformation enzymes activities (CAT, GST and total glutathione) and activation of immune response (induction of phenoxidase). Larvae exposed to microparticles 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.

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The effects of rigid and flexible Polyvinyl chloride (PVC) microplastic particles on the transcriptome of Daphnia magna
B. Toots, 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 are based on the polymer type alone, or if incorporated additives are responsible for the observed effects, as the insight desorb from the polymer matrix. With our transcriptome analysis, which was conducted via the use of a microarray, we showed that Daphnia reacts substantially different to the chronic (31 days) exposure to rigid PVC or flexible PVC (with diisononyl phthalate (DINP) as a plasticizer) with changes in gene expression. Rigid PVC caused a fivefold up-regulation in a total of 19 genes (15 up-regulated and 4 down-regulated) related to structuro-functional processes (e.g., increased mortality and reduced growth) in the associated ecosystem processes (reduced leaf decomposition). The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid reaches from plant material and may influence downstream food webs directly and indirectly.

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Poster spotlight: TU149, TU150, TU151

When ecotoxicology meets trophic ecology

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Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food chain
E.L. Fernandes, University of Koblenz Landau; M. Bundsche, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences
Pollution is a major driver of ecosystem change resulting in alterations in food webs and associated trophic dynamics. 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 (Isoptera 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 decomposing to cages containing the predator. The cages were deployed in an unplotted 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 reduced survival and reduced leaf decomposition. The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid reaches from plant material and may influence downstream food webs directly and indirectly.

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Accounting for trophic relationships in fish bioconcentration models applied as emergent-pollutants risk-assessment tools
J. Baevoie, Wageningen Environmental Research; J. Denree, Wageningen Environmental Research / Fau, B. Backhaus / Environmental Consulting; 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 (Arnot & Gobas 2004; Armitage et al. 2013) underlying each fish component. It calculates for given environmental conditions (pH and temperature) the uptake and elimination rates defining the one-compartment model of the internal concentration dynamics. The considered foodweb contains fish components with different trophic relationships, representing fish species used for human consumption with different body size and lipid content, chosen to represent extreme cases with respect to expected bioconcentration. Internal concentrations in phytol- 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. Wragg, 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 Kow values ranging from 4.5 to 8.5, in lake trout (Salvelinus namaycush), with a food web bioaccumulation model that uses bioenergetic equations to ensure that the physiological parameters applied to a species are internally consistent (i.e. energetically balanced). Empirical growth rates and diets for lake trout in six Canadian lakes (Salvelinus namaycush) with six aquatic prey organisms of riparian spiders. We found less gradient was negatively related to the number of individuals of spiders and the positivity associated with the proportion of aquatic prey of sampled spider communities and measured their intake of aquatic prey in 1998. To investigate the spiders' diet, we fed on invertebrates, which are low in the food chain. Moreover, very large trout in Great Slave Lake with higher energy requirements feeding on an energy rich diet have lower BAFs compared to the same sized trout in Lake Memphremagog feeding on less lipid rich rainbow smelt.

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

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

Riparian and diets for lake trout in six Canadian lakes (Salvelinus namaycush) with six aquatic prey organisms of riparian spiders. We found less gradient was negatively related to the number of individuals of spiders and the positivity associated with the proportion of aquatic prey of sampled spider communities and measured their intake of aquatic prey in 1998. To investigate the spiders' diet, we fed on invertebrates, which are low in the food chain. Moreover, very large trout in Great Slave Lake with higher energy requirements feeding on an energy rich diet have lower BAFs compared to the same sized trout in Lake Memphremagog feeding on less lipid rich rainbow smelt.

348 Migration effects on pollutants in eggs of Arctic-breeding gese

D.J. Hitchcock, University of Oslo; M.J. Loonen, University of Groningen / Arctic Center; N.A. Warner, NILU - Norwegian Institute for Air Research / Environmental Chemistry; D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; I.M. Tombre, NINA - Norwegian Institute for Nature Research; P. Shimmins, BirdLife Norway; L.R. Griffin, WWF Caerlaverock Wetland Centre; Varpe, University Centre in Svalbard; T. Andersen, University of Oslo / Department of Biosciences; K. Borga, Department of Biosciences, University of Oslo / Department of Environmental Chemistry; K. Frisch, M. Link, V.C. Schreiner, E. Szocs, University of Koblenz Landau; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

Females 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 gese's _flyway_. Results of ringed gese 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 (PFAs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be related to PCBs, but emerged to POPs like perfluorinated compounds due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across egg collections. In the same way, heritability of POPs for PCBs. Protein associated pollutants (PFAs) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

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

K. Drouillard, 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 DDE, are biodegraded to POPs like perfluorinated compounds 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 biodynamic distribution potential of POPs. However, we report here 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, 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 PCCs were higher, indicating that PCCs 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 PCCs were considerably higher than TMF values found in aquatic systems.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling
Toxicokinetic-toxidynamic 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 typically collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (LC₅₀ or EC₅₀) is usually estimated at the end of the exposure. In this form of evaluation, the fact that endpoints are monitored over time is not fully exploited. Standard DR models do also assume that the exposure concentration remains constant during the experiment, which makes it difficult to extrapolate the results to more realistic exposure profiles for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxidynamics (TKTD) models is suggested, because TKTD models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TKTD models have many advantages in terms of mechanistic understanding of the chemical mode of action, of deriving time-independent parameters, of interpreting time-varying exposure and of making predictions for untested and time-variable exposure. Another advantage of TKTD models for ERA is that they make it possible to calculate any LC/EC₅₀, 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, but this is not due to lack of software tools (for example R and MATLAB 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 ‘morsec’ 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 within R 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-particles 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 insects, little is known about effects on crustaceans and other estuarine species. Lethal and sublethal impacts of neonicotinoids and copper fungicide, i.e., Cuprafor Micro® (50% copper oxychloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of replicates for low (10-15 mg), medium (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-toxidynamics approach (considering all stages of growth and differences between development stages) coupled with a DEB-based toxidynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided an 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 organismal-level effects of toxicant exposure. However, the connection between the two modeling frameworks remains a challenge. The molecular mechanisms underlying Key Event (KE) relationships defined in AOPs are often poorly known, even for well-studied compounds; thus, the mechanistic linkages between KEs and effects on DEB processes are often difficult to discern. Further, AOPs whose adverse outcome is lethality are not very informative 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 (Klanjscek et al. 2016). The connection between damage and DEB and the influence of KE-DEB processes on mortality are crucial for ecological risk assessment. 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 DEB processes, 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

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., Cuprafor Micro® (50% copper oxychloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of replicates for low (10-15 mg), medium (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-toxidynamics approach (considering all stages of growth and differences between development stages) coupled with a DEB-based toxidynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided an understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.
such as estrogen synthesis and secretion by ovarian follicles. In vitro results are extrapolated to metrics of reproductive performance (fecundity, fertility, egg size) in trout using a mathematical model of the trout hypothalamic-pituitary-ovary-liver (HPOL) axis. We evaluated IVIVE by comparing predicted effects against laboratory results obtained from a yearlong exposure of female trout to four different chemicals: tamoxifen (biotransformed into the anti-estrogen 4-OH-tamoxifen), prochloraz (interferes with 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 atretic / non-fertile eggs) exposures. The tamoxifen induced decrease in egg size translated to significantly smaller larvae at 20 dph. The HPOL model, guided by in vitro testing, accurately predicted the reproductive effects of prochloraz and tamoxifen and the lack of effect by fluoxetine. Our results support the use of biologically based mathematical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

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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 infection. Each of these stressors might have effects on the response of fish to the other. Some of these effects have already 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 non-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 Pompomorphynchus tetricollis. 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 efflux for Sciopterus from storage, gills, kidney, liver, and intestine to blood as well as the external exchange. Model calibration was carried out by using experimental data generated when the infected chub were exposed to Ag in 48-day exposure and 51-day depuration periods. The initial results from model calibration show potential of the PBPK model for simulating the accumulation of metals in fish-parasite systems. For example, the model could simulate the changes in the concentration of Ag in storage, gills, and intestine. The stability in the concentration of Ag in kidney was also simulated by the model. However, the model is being further calibrated to improve its capacity for modelling the accumulation in liver and in the 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)

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High-throughput exposure and risk modelling of chemicals in European river basins
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SOLUTIONS is a EU 7th Framework Programme R&D project that aims at strengthening the management of emerging contaminants. It developed a collection of integrated models (the "Model Train"), to increase our understanding of issues related to emerging chemicals in Europe’s river basins, to support the prioritisation of chemicals and the abatement of the problems they cause and to evaluate future scenarios. The model train consists of four key building blocks: (i) the prediction of substance properties based on their molecular structure, (ii) the simulation of emissions, (iii) the simulation of fate & transport, and (iv) the characterisation of the risk of mixtures of chemicals for human health and aquatic ecosystems. The Model Train does not rely on extensive substance-specific input data. This implies that the model can truly "emerge" from the available (limited) 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 but for one or more individual river basins. It makes use of the pre-existing Europe-wide hydrology model E-Hype. The Model Train complements lab and field based approaches, by providing information for substances and sites which are not included in monitoring and by providing full time coverage. Validation results for the Danube, Rhine, four Spanish and a series of Swedish River Basins reveal that the accuracy of the simulated concentrations of a range of chemicals is higher for substances with a single type of use (e.g. pharmaceuticals, pesticides) and lower for substances with multiple uses. The predicted changes in pharmaceutical based mathemetical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

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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 needed to be developed to align chemical and ecological monitoring results, based on 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.

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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. Sabin, who famously provided a solution to a cholera outbreak near 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 measures such as EU Water Framework Directive. We present novel results of scientific research at the nexus of chemical and water policies, connected to the European goals to reach a non-toxic environment and the good chemical and ecological status for aquatic systems. The presentation consists of the analyses of vast sets of surveillance monitoring data using a combination of techniques originating from the fields of bioassessment and ecotoxicology. It thereby bridges these – so far often disparate – scientific disciplines, to support sustainable chemical and water policies. One of the most recent examples is provided by a diagnostic analysis in which the Good Ecological Status appeared associated to the Good Chemical Status, the latter shown to be a limiting factor for reaching a good ecological status. The presentation will provide a rationale for eco-epidemiological analyses as well as various types of results, from diagnostics to preventive actions and outreach. The EU project MARS (mixing aquatic ecosystems and water resources under multiple stress) recently concluded four years of in-depth research on this topic. MARS looked into mixture-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing mixture-stressor effects and guided management of multiply stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European mixture-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

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

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Chemicals of emerging concern (CECs) in the water cycle have been the focus of research over the last decades. The current use of mixture stressors, removal efficiencies of various (advanced) drinking water and wastewater treatment technologies has been studied. Advanced water treatment technologies are based on sorption, (advanced) oxidation and size separation principles. The experimental settings in studies on the efficiency of these technologies are not homogeneous; technologies can be tested at bench-, pilot- or full scale, with different compound types, with different water matrices such as real or standardized surface water, ground water, drinking water or wastewater, the test chemical can be spiked or real environmental samples can be used, there can be variations in the application of the treatment e.g. dose, contact time or pore size, and variation in how all this is expressed, in ml/cm2 or W/m² in case of UV oxidation, with frequent isomerizations or removal percentage in the case of GAC etc. These variations and missing clarity therein hamper the interpretation and evaluation of the data concerning the removal efficiency of CEC of specific treatment technologies. In a previous study it was found that stakeholders within the whole urban water cycle had sufficient information on CECs and their possible mitigation options, but that the relevance of the information often was unknown. A set of criteria describing what is important to know when evaluating removal efficiency studies can be helpful in this respect, with criteria for reliability and relevance where needed made explicit for the specific technologies to be evaluated. Examples of such criteria from the field of toxicology are available and well-used, e.g. to identify studies for the derivation of environmental quality standards in a scientifically sound way. Here we aim to highlight the current knowledge of the removal efficiencies with regards to CECs of (advanced) drinking water treatment and wastewater treatment technologies both for surface water and wastewater. This to provide decision makers with the knowledge needed to make an informed decision with regards to which technologies will be relevant for their specific needs. To be relevant to end-users in water management the treatment technologies needs to be in use and considered available. Not all advanced technologies can be considered promising but are generally not an option for end-users in water management as they need to have been tested on large scale and to be available commercially at relatively low cost. Commonly used advanced water treatment technologies are for sorption the use of activated carbon (granular activated carbon (GAC)) and powdered activated carbon (PAC), for (advanced) oxidation the use of ozone (O₃) and UV + H₂O₂ and finally the use of nano- and ultrafiltration membranes for size separation. We developed an evaluation criteria set for the specified treatment technologies. We used thes criteria to evaluate removal efficiencies as collected in a database on removal efficiencies consisting of approximately 2000 entries, 93 compounds and 9 treatment technologies for wastewater (ozone + H₂O₂, conventional WWTP, UV, UV + H₂O₂, PAC, GAC, NF, UF) and drinking water treatment (ozone, ozone + H₂O₂, UV, UV + H₂O₂, PAC, GAC, NF, UF).

361 Future perspectives of chemical pollution and regulatory development

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Future developments in society will result in the emission of new substances to the environment which will require an adaptation of existing legislation for protection of human health and ecosystems. Scenarios for the future development of society can provide valuable indications on changes in future pollutants in river basins. Some developments are directly connected to consumption of specific substances, e.g. demographic change where a longer life expectancy will lead to changes in amounts and types of pharmaceuticals used and thus also to the related concentrations in the environment. Future technological progress may help to identify and introduce alternative substances. Chemicals and their mixtures may also provide indications on how future regulations may have to be adapted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solutions-focused approach: when the same alternative for industrial emission 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)

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Conservation Biology; K.J. Musters, Leiden University / Institute of Environmental Sciences; P.M. Van Bodegom, CML Leiden University / Institute of Environmental Science CML. G. de Snoo, Leiden University / Institute of Environmental Sciences; M.G. Vijver, CML Leiden University / Conservation Biology

Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong linkage between agricultural fields and adjacent water bodies as they are a common sink for agricultural chemicals such as neonicotinoid insecticides and fertilizers. As these agrochemicals are bound to co-occur in the ditches, we aimed to study the effects of thiacloprid on invertebrate population and community response. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted under outdoor conditions. 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 Macroinvertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams
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Siltation is a common stressor affecting ditch ecosystems and their associated biodiversity. While the widespread availability of various pesticides in agricultural landscapes might reduce the risk of siltation, the proper managed siltation can lead to ecosystem state shifts and significant losses in ecosystem services. We held a workshop (September 2017 in Wageningen, The Netherlands) to develop a conceptual framework to assess the effects of multiple stressors on the structure and functioning of aquatic ecosystems. This framework was subsequently applied to three ecosystem types (ditches, floodplains and harbours). The proposed framework consists of two parts: an environmental filter and a transmitting function to allow effects to propagate to higher levels of biological organisation. Applying the framework consists of the following steps: 1) Select an ecosystem of concern; 2) Identify stressors and potential interactions; 3) Identify receptors/sensitive groups for each stressor; 4) Identify stressor-response relationships and group stressors according to their mode of action; 5) Construct an ecological model that includes relevant functional groups and endpoints; 6) Predict the resultant impact of multiple stressors; 7) Confront the predictions with experimental and monitoring data and 8) Adjust the ecological model if needed. The workshop resulted in a “best approach” framework to assess the effects of multiple stressors on freshwater ecosystems. Their entry pathways are mainly related to pesticide use in agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Romania (Where), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on chemical inputs (intensive). We assessed that, in contrast to pesticide toxicity, excess 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 found that pesticides from agricultural use are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide use in agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Romania (Where), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on chemical inputs (intensive). We assessed that, in contrast to pesticide toxicity, excess 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 detection of approximate time-weighted pesticide concentrations in streams during heavy rainfall events. Secondly, we used polyethylene sheets that were placed in the detection of lipophilic pyrethroids and organophosphates. The toxicity of the 88 detected pesticides was assessed using the sum toxic unit (sumTU). Stream macroinvertebrate communities were sampled twice, using a quantitative multi-habitat-sampling. This allowed the analysis of relationships between the community composition and diversity with a gradient of pesticide toxicity in interaction with additional agricultural stressors. The toxicity gradient originated from pesticides and nutrients (NH₄⁺) showed no relationship to the intensity of agriculture expressed as the average size of the adjacent fields. This indicates that pesticides and nutrients co-occur independently of agricultural intensity. How and to which extent, in terms of effect size, the communities are affected by the pesticide gradient and the additional presence of other stressors originating from agricultural land use will be presented during the conference.

366 Daily temperature variation determines the toxicity of a pesticide mixture
Y. Delnat, T.T. Tran, L. Janssens, KU Leuven / Biology; R. Stoks, University of Leuven / Department of Biology

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 tested the effects on body mass, larval survival and 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 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.

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**Warning 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 and changes in climate on 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-storior scenario where we quantified the single and combined effects of (i) increases in mean temperature and (ii) in DTF, and (iii) exposure to the pesticide chlorpyrifos (CPF) in larvae of high- and low-latitude populations of *Ischnura elegans* damselflies. CPF imposed mortality and more so in high-latitude compared to low-latitude larvae. Moreover, CPF was more toxic at 24°C compared to 20°C, confirming the higher toxicity of organophosphates at higher temperatures. A key finding was that DTF also increased the toxicity of CPF, providing novel evidence that DTFs can amplify the toxicity of pesticides. Furthermore, the increased toxicity of CPF by DTF was more pronounced at 24°C. This novel pattern is likely general as at a higher mean temperature, DTF will expose the animals to even higher temperatures during the daily cycle, thereby increasing exposure to stressful temperatures. Also, the negative effect of CPF on larval growth strongly depended on DTF. CPF did decrease larval growth considerably, but only in the 10°C DTF treatment. Probably the higher metabolic demand for cell maintenance in the 10°C DTF treatment resulted in lower growth rates. Our results convincingly show that the organophosphate pesticide chlorpyrifos is not only more toxic to damselfly larvae at the higher mean temperature (24°C) but also at higher daily temperature fluctuations (DTFs). The behavior of other pesticides awaits further testing 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 adamantane-1-amine (Log D = -2.34), trifluoromethanesulfonate (Log P = -1.35) and -caprolactam (Log P = 0.15) were not removed by PAC even for very high doses. Only naphthalenesulfonate (Log P = -0.41) was fully removed for 5 mg L\(^{-1}\) PAC. The other PMOCs i.e. aromatic sulfonates, aromatic amides, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in water resources showed a very low reactivity with ozone with rate constants below 100 M\(^{-1}\) s\(^{-1}\) and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-di-pentylguanidine and the 1,3,di-o-tolylguanidine, an olefinic sulfonate and an amine compound, the N-benzylidemethylamine, were rapidly transformed by ozone. Transformation of both guanidines occurred in few seconds at neutral pH during disinfection by chlorination. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. US EPA toxicity prediction tool showed that the identified and hydroxylated analogues of MOSCs are less toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl\(_2\)-guanidine ratio of 1 and 10. Thus, reactions with chlorine during disinfection can be a source of new, persistent and more toxic chemicals in drinking water. Some PMOCs like -caprolactam, halogenated methanesulfonates, adamantane-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor be transformed in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

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**RPLC-HILIC and SFC coupled with Mass Spectrometry: Polarity Extended Organic Molecule Screening (PROMS)**

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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 highly polar molecules. To achieve 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 was 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 +2. Nearly all compounds could be retained in both systems with relative standard deviations of retention times (RT) (n = 6) typically between 2 and 5%. Both techniques have considerable benefits when combined with accurate mass spectrometric detection. Molecules RT and accurate mass were recorded in a database for each set up. This information was used for compound screening allowing compounds like “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant effluents), and is 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. Groen, S. Grosse, T. Letzel: RPLC-HILIC and SFC coupled with mass spectrometry: Polarity-extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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

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Extended organic molecule screening in environmental samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

**Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study**

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The occurrence of polar micropollutants (MPs) in drinking water sources is regarded as one of the most challenging issue of our times. Polar MPs can preferentially remain in the water phase during environmental and water treatment processes, potentially reaching finished drinking water and thus raising concern over adverse effects to human health. In The Netherlands reverse osmosis (RO) has been proposed as a stand-alone treatment capable of producing impeccable drinking water. However, riverbank filtration (DBF) could be an alternative treatment. We studied removals, and transformations of 141 compounds in two RO systems. Methods: Raw anaerobic riverbank filtrate was used as feedwater. The performance of each system was assessed by on-line TOC and DOC monitoring, and were fractionated into lab-scale RO and full-scale RO to assess the removal of polar MPs. Results: the lab-scale RO showed a removal of 3.7% while full-scale RO showed a removal of 35.2%. Most of the compounds were not removed by PAC even for very high doses. Only naphtalenesulfonate (Log P = -0.41) was fully removed for 5 mg L\(^{-1}\) PAC. The other PMOCs i.e. aromatic sulfonates, aromatic amides, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in drinking water were very low reactive with ozone with rate constants below 100 M\(^{-1}\) s\(^{-1}\) and thus will not be transformed during ozonation of drinking water. Some PMOCs like -caprolactam, halogenated methanesulfonates, adamantane-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor be transformed in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultrahigh-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzo[a]pyrene, benzo[e]pyrene and phenanthrene, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MP by RO was mainly governed by size exclusion. For neutral and moderately polar MP the inversion of RO passage was well established, and it was seen for bisphenol A, which displayed 4% passage. The higher passage of moderately polar and hydrophobic MPs could be attributed to solute-membrane hydrophobic interactions followed by diffusion. All anionic MPs displayed less than 1% passage, opposed to cations for which up to 10% passage was observed. The negative charge in the membranes surface explains the result. Overall this study showed that high chemical removal rates can be achieved by RO. Tighter membranes and multi-stage RO will be investigated to improve the removal of small neutral MPs for drinking water applications.

371 Identification of transformation-derived very polar organic contaminants and their relevance in the water cycle
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Highly polar organic substances are well water soluble, non-volatile, and exhibit only minimal adsorption to nonpolar surfaces. Therefore, they may be able to penetrate natural and artificial barriers and are thus mobile in the water cycle. If these mobile organic contaminants (MOCs) are persistent (P), they may also be bioaccumulative, resistant to degradation pathways such as biotransformation, oxidation with MnO_2, or photolysis experiments. After structural elucidation of the 9 detected transformation products with high resolution mass spectrometry (HRMS) we developed a qualitative HILIC structural elucidation method and screened 25 mobile organic contaminants (MOCs) in the water cycle and only few (e.g. cyclodextrins, glycosphate) have been extensively studied and monitored. MOCs and PMOCs are identified on the basis of their ion clusters, and the origin is available, which severely exacerbates the sophisticated monitoring and effective regulation of their precursors. Based on the work of Arp et al. and Schulze et al. we selected 15 industrial chemicals with a high expected potential to form PMOCs upon further degradation and studied their structural elucidation. In practice, however, these functional units are partially descriptive, production systems. These damages are conventionally characterized per functional unit. In life cycle assessment (LCA) the main focus is on damage assessments of chemicals, such as for biocides, plant protection products (PPP), veterinary and human medicinal products (VMPP). These are often evaluated by the PBT assessment during substance evaluation. As in other hazard based assessments (e.g. GHS/CLP regulation, POP), the PBT/PvP assessment focuses on the properties of a substance only and does not necessarily take into account the use of the substance nor its exposure. Consequently, the identification of a PBT or PvP substance should be independent from the regulatory framework under which it is assessed. However, in our comparison of conclusions on PBT properties for a number of substances falling under more than one legislation it became apparent that the outcome of the PBT assessment does not necessarily correspond between different regulations. This holds true in the case of a comprehensive and consistent assessment of chemicals and to ensure a high level of protection of human health and the environment against hazardous chemicals within the EU. In order to elucidate the reasons still hampering a harmonised PBT-assessment, we did a compilation of a number of technical (amount and quality of data, acceptability of specific data, derivation of endpoints, applied guidance documents), and conceptual criteria (numerical criteria, testing strategy, assessment of transformation products) as well as of other factors (consequences of PBT-assessment, data management and publication of assessment results).

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 screened activities associated with the product life cycle should after all be considered, but also those associated with the benefit induced by the product. In the second part, we specify how a better product benefit characterisation could improve life cycle assessment and its policy support. Three advantages are specified. First, as these functional units are often not specifically defined and a product can have multiple functions, comparison is often impeded in practice. Second, the respective product life cycle could then be performed in a different way, not necessarily the same. A better specification of the functional unit in terms of an aggregated single score for product benefit, such as the net impact on human well-being, would permit to compare all types of products.

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

374 Product benefits and positive outcomes: valuation and beyond

375 'One for all and all for one' - Can we REACH a harmonised PBT-assessment across EU-regulatory frameworks?
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Persistent, bioaccumulative and toxic (PBT) substances and REACH are frequently called in one breath. However, also other European regulatory frameworks for chemicals, such as for biocides, plant protection products (PPP), veterinary and human medicinal products (VMPP) stipulate the performance of a PBT-assessment during substance evaluation. As in other hazard based assessments (e.g. GHS/CLP regulation, POP), the PBT/PvP assessment focuses on the properties of a substance only and does not necessarily take into account the use of the substance nor its exposure. Consequently, the identification of a PBT or PvP substance should be independent from the regulatory framework under which it is assessed. However, in our comparison of conclusions on PBT properties for a number of substances falling under more than one legislation it became apparent that the outcome of the PBT assessment does not necessarily correspond between different regulations. This holds true in the case of a comprehensive and consistent assessment of chemicals and to ensure a high level of protection of human health and the environment against hazardous chemicals within the EU. In order to elucidate the reasons still hampering a harmonised PBT-assessment, we did a compilation of a number of technical (amount and quality of data, acceptability of specific data, derivation of endpoints, applied guidance documents), and conceptual criteria (numerical criteria, testing strategy, assessment of transformation products) as well as of other factors (consequences of PBT-assessment, data management and publication of assessment results).

Outgoing from this, we developed several proposals facilitating a harmonised PBT assessment, starting from the implementation of an overall PBT-guidance up to an inclusion of transformation products in the PBT-assessment by all regulatory frameworks. Although it cannot be denied that a harmonisation process is ongoing, we conclude that there are still some fundamental choices to be made both at the organisational level and at policy level first to achieve the goal of a standardised PBT identification among EU legislations.
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 unmet (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 substantial 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 μDALY/y. We also develop a profiling system for 6000+ food items consumed in the US that aligns publically available data from multiple databases with risk factor definitions from the GBD. Finally, for 6000+ food items we estimate the Healthy Nutrition Index (HENI), the total avoidable health burden from all dietary risk factors per serving and 100 kcal. Nutritional CFs for food group and food-item level between -8 avoided μDALY/y for sodium, up to 57 avoided μDALY/y for omega-3 from seafood. HENI score typically ranges from -80 avoided μDALY/serving for Frankfurter sandwiches to 50 avoided μDALY/serving of nuts and seeds. Absolute HENI scores and ranking of food items vary substantially when using 1 serving or 100 kcal as a functional unit. Unhealthy food groups such as 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 meats, 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 for this new midpoint impact category in LCA 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 advances of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 70% 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
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Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what people eat. Our study looks into the monetary value of other animal products from the diet. Accounting for the environmental and health benefits of realistic dietary patterns, can help support improved recommendations.

378 The cost of CO2 in Life Cycle Assessment
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Climate change has gained increasing attention over the past decade in response to the revelation that we need to maintain a viable climate for humans and the environment. The increasing emission of greenhouse gases (GHG) such as CO₂ may accelerate climate change and cause subsequent damages. Correspondingly, countries and companies actively develop strategies to minimize their GHG emissions and thus climate impacts, but which strategies that will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategy, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the research. This paper 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

380 Assessment of Human Health Benefits and Risks of Contaminated Sediment Remediation
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Environmental Health Sciences; G. Burton, University of Michigan / School for Environment and Sustainability; J. Semrau, University of Michigan - Civil and Environmental Engineering and Program in the Environment; O. Jolliet, University of Michigan

Billions of dollars have been spent on environmental dredging projects to remediate contaminated sediments. However, the extent to which this remedy can reduce human health risks is unclear. Environmental dredging projects can alleviate health impacts from contaminated sediments, but they can also introduce additional risks. The 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 DALYs, respectively. For the remediation scenario, the selected AC cap could (i) reduce health impacts via resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents, (ii) love the minimal organic doses needed for the introduction into soil as the first step of intensive remediation. Potential benefits of MNA are further highlighted when resuspension of sediment is related to an important factor. Furthermore, potential health impacts created by the selected AC cap were within the same order of magnitude as potential benefits. Our study provides a tool to validate efficacies for the assessments of the benefits of MNA and the selected remedy scenario. Impact associated with chemical inhalation exposures are less substantial, albeit not negligible. The quantitative framework of this study, when supplemented with adequate monitoring data, can provide valuable insight into the overall effectiveness of a given remediation in light of alternatives.

381 Six inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement

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The applicability of thin-layer 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 repeatedly evaluated using conditions with the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, 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 resuspended 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.

382 Ecosafe nanotechnologies for environmental remediation: the NANOBOND project

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In situ remediation of sludge and dredged harbour sediments is currently highly cost-effective despite an ever increasing number of sites requiring swift treatments to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and associated ancillary exposures. 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 DALYs, respectively. For the remediation scenario, the selected AC cap could (i) reduce health impacts via resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents, (ii) love the minimal organic doses needed for the introduction into soil as the first step of intensive remediation. Potential benefits of MNA are further highlighted when resuspension of sediment is related to an important factor. Furthermore, potential health impacts created by the selected AC cap were within the same order of magnitude as potential benefits. Our study provides a tool to validate efficacies for the assessments of the benefits of MNA and the selected remedy scenario. Impact associated with chemical inhalation exposures are less substantial, albeit not negligible. The quantitative framework of this study, when supplemented with adequate monitoring data, can provide valuable insight into the overall effectiveness of a given remediation in light of alternatives.

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

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A natural soil at many places is prone to enormous threats due to increase of anthropologic activities. Increasingly, human industrial activity, our irresponsibility, and impunity have a negative influence on the condition of soils. Thus, the problem of soil contamination, especially with several nanoparticles, and multiple heavy metals refers mainly to the industrial areas. Majority of those contaminations are bioavailable, and they are deposited in plant tissue as well as in edaphon. Moreover, they can easily be absorbed at all levels of the food chain where they pose a huge threat not only to the ecosystem but also to human health. Long-term exposition to a high concentration of pollutants (especially heavy metals and toxic nanoparticles) leads to soil depletion, and hence loss of organic fraction in the soil. Lack of organic compounds in connection with high contamination with single heavy metals, a mixture of heavy metals or toxic nanoparticles makes area impossible to any usability. Hence, a necessity to know their mechanism, behaviour, and their ability to release into surface water and groundwater by recla...
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 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 (Drilla 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 Trapp, 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 sorption of organic compounds in the soil environment. First, sorption behaviors of nineteen pharmaceuticals across four groups ( neutrals, strong bases, weak bases, acids) were explored in five test soils. Using the measured sorption coefficients for each group, we evaluated the applicability and accuracy of existing predictive models that have been proposed to predict the sorption behavior of organic chemicals in soil. Finally, Pearson correlation analysis and Principal components analysis (PCA) have been carried out at the group level to systematically assess the potential factors (both soil and drug properties) influencing the sorption behavior of pharmaceuticals in soil and to get better understandings of the sorption mechanisms of different pharmaceuticals in the soil.

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 examples of a landfill in the town of Dilijan 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, 170, 180, 189. Quantitative determination was carried out using chromatography with electron capture detectors (ECD) equipped with gas capillary column with stable phase DB-5MS UI and the following parameters: 60 m x 0.250 mm i. d. 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 such are integral in all investigated soil samples. Dioxin-like PCBS were detected, however, in which the maximum contamination concentration was 17.5 ng/g.

387 Characterization of a pesticide residue in cattle feedlot effluents

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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 prevalent micropollutants in aquatic environments because of their intrinsic toxicity, even at trace-levels. They were firstly used for agricultural yield improvement but they are now used as biocides for the protection of construction materials, wood, textiles, paints, etc., or as veterinary treatment susceptible, and can be discharged in rivers via wastewater treatment plants (WWTP) or Separated Stormwater Overflow (SSO). This multiplicity of uses is linked to high concentrations in rivers, affecting aquatic ecosystems that play role of final receptor for micropollutants in general. It is thus necessary to consider pesticide inputs to wastewater treatment plants. Treatment of pesticides can be quite expensive and inputs may not be clearly identified or collected. Effluent reduction at source can be considered as an interesting alternative (dose reduction, practice changes, etc.). However this approach requires first of all the identification of uses responsible for inputs, as information is often available nowadays. This study monitored for 4 years a peri-urban continuum formed by a river, SSO and a WWTP also as wastewater to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important concentration of pesticides while WWTP effluents presented significant concentrations of biocides and veterinary molecules which are among the most toxic pesticides. Flux calculation allows identifying agriculture as the major source of pesticide residues in many aqueous matrices, due to their enormous use. Pharmaceutical products such as steroids and non-steroids hormones, antibiotics and non-steroidal anti-inflammatory drugs from agriculture have been indicated to have the potential to show significant endocrine and other health effects. In this study, a High Performance Liquid Chromatography coupled to ultraviolet detector (HPLC-UV-Vis) method was optimized and validated for the detection and separation of the selected pharmaceuticals in effluents for livestock farms with major activity in the study areas. Multi-residue solid phase extraction (SPE) procedure was developed and validated for the recoveries of acetaminophen (AC), diclofenac(DP), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHIR), ciprofloxacin(CIP), bupivacaine(BP), 17β-estradiol(E2), melatonin(MT), and ivermectin(Iv) from agricultural wastewater using the hydrophilic-lipophilic balance(HLB)-SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions spiked concentrations of between 2 and 10 µg/l were: E2, 76.62 – 85.47 %; AC, 78.29 -94.34 %; TC, 88.35 – 92.15 %; CHR, 76.62 – 88.35 %; SA, 79.38 – 81.49 %; E3, 85.42 – 92.15 %; BPA, 80.27 – 89.42 %; CP, 76.58 – 90.21 %; DP, 75.46 – 87.55 % and IV, 80.27 – 84.89 %. Various levels of veterinary drugs - AC, < 0.48 – 1.07 µg/l; SA, < 1.37 – 15.49 µg/l; TC, < 3.45 – 4.57 µg/l; CP, 0.45 – 2.46 µg/l; and IV, < 1.74 – 1.63 µg/l were detected in the grab water samples. The results of the health risk assessment clearly showed mutagenic activity being observed in samples from sheep and poultry farms. It also showed low estrogenic activity in the pig farm. The results indicated that making use of the maximum concentration of 17β Estradiol found in the samples, there was a slight risk of developing cancer through accidental ingestion via recreational activities with higher risk if the water was used for domestic purposes without treatment to remove them or if the water was used for irrigation purposes.
389  Study of bioconcentration of benzophenone-3 in gill-head Bream and characterization effects
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Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and mammals 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, biocumulation 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-ionicizable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolism activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography – high-resolution mass spectrometry allowed the identification of a broad suite of BP-3 by-products in seawater and fish tissue/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified demethylation, hydroxylation and glucuronidation as the main degradation pathways of BP-3. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the projects CTM2014-66268-C3-1-R and CTM2014-66268-C3-2-R, Xunta de Galicia (ED431C/2013/36) and FEDER/ERDF. H. Ziarusta 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
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Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environmental media. However, the role of plants in removing organic pollutants is still not well understood. Phytoremediation of realistic environmental concentration (10 μg L⁻¹ of the chiral pesticides tebuconazole and imazalil) by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a growth 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 transformation products (TPs) in both hydroponic solution 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, respectively, followed by a decrease of both compounds concentration. Two TPs of tebuconazole could only be quantified in solution, while two imazalil TPs were quantified in both solution and plant tissue. The uptake of both pesticides was positively correlated with evapotranspiration. The removal of imazalil and tebuconazole from the hydroponic solution was not enantioselective, however, both translocation and degradation inside Phragmites were enantioselective. For tebuconazole, the enantioselective degradation was found in both Phragmites roots and shoots.

391  Effects of the non-steroidal anti-inflammatory 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 on how ibuprofen is metabolized by plants, mostly due to analytical methodology gaps for determining these compounds at low concentration in complex matrices. In this study, the effects of ibuprofen treatment on the growth and its comprehensive metabolic profile in whole plant cultures and seed germinates of Vigna unguiculata were investigated using ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry (UHPLC-QTOF-MS). To this end, the developed method achieved simultaneous quantitative analysis of ibuprofen, 1 and 2-hydroxyibuprofen and carboxyibuprofen while preserving the instrument ability to get precursor and product ion mass spectra of non-target compounds. The trigger was the precursor ions to reach 100 cps intensity. Seeds of V. unguiculata were obtained from Gizaan area of Saudi Arabia, were germinated in Petri plates and grown for 14 days on a solution containing 15 mg L⁻¹ of ibuprofen. Seeds and plants were incubated in a growth chamber in the dark at 26 ºC for 5 days. Forty-six metabolites of ibuprofen in V. unguiculata were successfully identified. The 1-hydroxy and 2-hydroxy ibuprofen were confirmed and quantified using their analytical standards. The structures of the other metabolites were proposed using high resolution mass spectrometry (HRMS) and high resolution tandem mass spectrometry (HRMS/MS) data. In particular, the combination of mass accuracy and the fragmentation patterns of metabolites and parent compounds allowed proposing plausible structures for each metabolite. Six hexosides were already reported in study on Phragmites australis and Lemma gibba. Thirty-eight of the identified metabolites were already reported in a study on certain 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
J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; B. Verbruggen, University of Exeter; L. Gunnarsson, University of Exeter / Biosciences

This presentation will describe the total consumption-based environmental risks posed by 130 human medicinal products and the impact of mode of action, lipophilicity and dilution on these risks. In accordance with Article 8(3) of Directive 2001/83/EC, as amended, a new marketing authorisation application shall be accompanied by the evaluation of the potential environmental risks posed by the human medicinal product. These environmental risk assessments (ERAs) estimate the potential environmental impact on a product-by-product basis rather than a substance-by-substance basis. In the cases where an active pharmaceutical ingredient (API), or substance, is used to treat multiple clinical diseases, there is the potential to under-estimate environmental impacts. The pharmaceutical industry and Medicines Agency (EMA) guidance for the environmental risk assessment of human medicinal products has been in place now for over 10 years. The introduction of this guidance marked a step change in the ERA requirements for human medicinal products, with a shift from short-term acute to long-term chronic environmental effects assessments, and tailored ERAs for active pharmaceutical ingredients (APIs) with suspected or known reproductive effects. To determine the total substance or API risk, we have: (i) identified and collected definitive published no observed effect concentrations (NOECs) for available APIs (excluding anti-infectives and anti-parasitic products); (ii) collated human consumption data for each of these APIs in European Countries where these products are licenced for use; (iii) conducted a worst case exposure assessment (predicted environmental concentration (PEC) and estimated environmental concentration (EEC)) and (iv) analysed the variability in the risk quotients (RQs) for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and
Estimation and prioritization of hospital API emissions:
A.M. Ragas, Radboud University / Department of Environmental Science; C. van Lenten, M. Galpen, K. Tippat, Radboud University; R. Oldenkamp, Radboud University / Department of Environmental Science.

Hospitals constitute an important source of APIs, particularly for substances like antineoplastics and contrast agents. Measuring these emissions and their impacts is possible, but it is time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-side emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speediQ® as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LC/MS. 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 imipenem 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:
R. Oldenkamp, S. Hoeks, V. Barbarossa, M. Cengic, Radboud University Nijmegen / Department of Environmental Science; L. Carter, University of York / Environment Department; E.E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department; A.M. Ragas, Radboud University / Department of Environmental Science.

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 potential concentrations. 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 API concentration in environmental waters based on country-specific per capita consumption data. The starting point for modeling the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewerage system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g., physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.
The University of York / Natural and Built Environments; R. Ashauer, University of York / Environment Department. The majority of active pharmaceutical ingredients (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for the ionisation rate. Assessed was the impact of pH variations in relation to pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound. In L. variegatus. Toxicokinetic (TK) characterisation and the underlying experiments involved the measurement of uptake of amitriptyline into L. variegatus at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data for two intermediate pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in L. variegatus varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2.9 pmol/g and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.295 pmol/g and a pH range of 7.41-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and 4 in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study reveals important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

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

398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines
G. Gonsior, 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 the most suitable for aquatic non-standard species. Most tests were performed based on the Lemna guideline OECD 221, the two Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum spicatum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatc Macrophyte Risk Assessment Procedure). An overview of the tested test protocols is presented by Johanna Thiessen (2010). Further, the proposed ring test protocol for the emergent macrophyte Myriophyllum spicatum was presented by Dr. Allison Heine. Additional a long-term experiment with two pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

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

Agriculture is the dominating land-use of the EU member states by covering nearly half of the surface area. Using herbicides to reduce weed competition in agricultural crop species and interspecies competition and predict community level effects based on dose response data. These models can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

400 Use in risk assessment of recovery in plants from exposure to chemicals
T.A. Springer, EAG Laboratories / Specialist Projects & Histology; H.O. Krueger, EAG Laboratories / Aquatic, Plant and Insect Toxicology; J.W. Green, DuPont / Data Science and Informatics

The plant interest group of SETAC has a committee working on the topic of recovery and this presentation concerns statistical issues arising from this work. Traditionally evaluating the risk of chemicals to plant species involves assessing both lethal and nonlethal effects, but little or no consideration is given to whether the effects at the population or community level are transient or persistent. Considering the ability of plants to recover after the exposure to a chemical is important when evaluating effects on populations conducting a risk assessment. For example, a young plant in a vegetative vigor study may show damage today, but recover within a day or two after the stress treatment. However, 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 lemmi studies, an aliquot of cells can be transferred to untreated media at the end of a test and after several days, the growth rates of the affected groups may approach that of the controls indicating recovery. Recovery in terms of growth rate of these simple aquatic plants is likely to be indicative of a population’s ability to sustain itself. In more complex mesocosm studies the concept of recovery is even further
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, lemma, and myriophyllum studies will be presented as well as results from mesocosm studies. Statistical procedures and experimental designs will be presented for these examples and interpretation of results will be discussed.

402 Aquatic primary producers and plant protection products: endpoints and level of protection achieved in the first tier of the risk assessment scheme

S. Druquesne, UBA, Federal Environment agency; L. Hønnemann, S. Matezki, M. Solé, K. Swarowsky, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV  plant protection products

In the risk assessment for aquatic primary producers exposed to plant protection products (PPP), the endpoint (EP) corresponding to 50% inhibition of growth (EC50s) is used in the first tier. The EC50s can be expressed as inhibition of the average specific growth rate (ErC50) or as reduction in biomass, calculated from yield (EY50) or as the integral under the growth curve (EB50). The lowest available EP among ErC50, EY50 or EY50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use EC50s 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 the thus of conservatism of a factor of 6.9 and 3.5 for algae and Lemma sp. respectively. It also shows that the level of protection achieved for primary producers becomes insufficient in 59% of the cases, since the Tier 3 Regulatory Acceptable Concentrations (RACs) from micro-/mesocosm studies (considered as surrogate reference Tier) are lower than the Tier 1 RACs from standard toxicity tests. The results demonstrate that the intended level of protection is currently reached in only 41% of the cases versus 69% of the cases previously. In addition, this work explores which combination of EC50, (EC50, EC50, ErC50, etc.) and measurement 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 biomonitoring

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and tree 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 needescolected 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 dioxins and furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoralkyl substances (PFAS), 3 isomers of hexabromocyclododecanes (HBCD), 7 polybrominated diphenyl ethers (PBDE), 24 polybrominated dibenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PBBS and PFASs, POPs of all substance groups could be quantified, although to different extents. Concentrations of individual PAHs and HFRs were in the same order of magnitude as those observed in coniferous shoots or deciduous tree leaves from nearby located areas. Highest levels of PCDD/F, dieldrin, 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 Solingen (forestry) and Scheerln (agricultural) and were lowest at the site in the Halle-Leipzig conurbation. Thus, surrounding land-use does not seem to be the (only) driving force determining the POPs burden in moss samples. PBDE moss concentrations observed in this study were similar to those observed at background sites in Spain and lower than those of background/remote sites in Norway. Concentrations of Dechlorane Plus were more than a factor of 100 higher than moss concentrations reported for Svalbard (Arctic Norway).

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

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

Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss have been collected at ca. 7500 sites in different forests throughout Germany. While half of the analyses were performed on unwashed samples, the other half that were thoroughly rinsed with deionized water prior to chemical determination of heavy metals (since 1990), nitrogen (since 2005), and persistent organic pollutants (since 2010) in moss samples, quality control and statistical evaluation was conducted according an harmonized methodology [1]. Mapping the percentile statistics of heavy metals and nitrogen concentration in moss sampled in forests across Germany is in the focus of this paper. Thereby, element- and survey-specific as well as heavy metals and surveys integrating statistical evaluations and GIS-mapping were performed. Cr, Hg, Sb and Zn show, contrary to Fe and Pb, no constant decrease of element concentrations, but an intermediate increase between 2000 and 2005, which did not continue until 2015. Al, As, Cd, Cu and V stagnated between 2000 and 2005. Hg from 2005 to 2015. Therefore, Cr, Sb and Zn will be focused in this paper together with Cd, Hg, Pb and N which are of priority according to the Convention on Long-range Transboundary Air Pollution. Survey-specific statistical analyses corroborate that the spatial pattern of elements concentrations in moss is changing across time long-term information on the percentile statistics of bioaccumulation of atmospheric deposition in moss is essential for further scientific evaluation as well as for measurements and reporting of nature protection and environmental management. References: [1] W. Schröder, S. Nickel. Such effects are known also for food chains. However, plants differ in the uptake of essential and non-essential inorganic elements and organic pollutants and the accumulation varies over time and space mainly due to the different geochemistry and climates in different regions. Here we report on the results of a biomonitoring study using holm oak (Quercus ilex L.) and two pine species (Pinus nigra J. F. Arnold and P. pinaster Ait.), i.e. evergreen deciduous and coniferous species, to monitor ecosystem recovery after forest felling and needle sampling was conducted at different locations in the Mount Amiata and Colline Metallifere region in spring 2017 and the samples consisted of three age classes. While half of the analyses were performed on unwashed samples, the other half rested on samples that were thoroughly rinsed with deionized water prior to the analyses. ICP-MS, ICP-OES and CNS elemental analyses were applied for the determination of Cu, Cd, P, K, Mg, As, Pb, Cd, Zn, Fe and S. Apart from the significant differences in element concentrations and patterns between the tested species, regions and sites, differences between the washed and unwashed samples was less pronounced indicating that deposition of dust does not play a great role in the area. On the other hand, our preliminary analyses showed significant differences in element concentrations between different age classes, which relate to the availability, translocation, accumulation or growth dilution of plant essential and non-essential elements. Multi-element analyses and nutrient ratios can serve to differentiate between the characteristic geochemical and species-specific patterns and the positive derivation from these patterns points to the exceedance of element levels due to pollution and eutrophication. Biomonitoring in post-mining areas serves to identify pollution hotspots and can be used as a key component in controlling the success of land reclamation for agriculture.
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 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 207Pb/206Pb within the bat guano deposit in association with the introduction of leaded gasoline.

**408 Perfluoroalkyl substances and metallic elements in South African dragonflies**

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

Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallic elements and PFASs has been reported. In this study, PFASs 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 Zn/PFASs concentrations than sites located closer to industrial areas (median Zn/PFASs of 0.32 ng/g/wet mass for North and 0.8 ng/g/wet mass for South). Adult dragonflies have been shown to contain perfluorooctane sulfonic acid (PFOS) associated at similar concentrations at all sites, but with quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (Zn/PFASs >20 ng/g/wet mass), which is known to be polluted by PFOS. The results also indicated that all species of dragonflies, regardless of body size and habitat type preference are suitable indicators of environmental metallic elements. Sites located near wastewater treatment plants had elevated concentrations associated with mining and industries. Dragonflies from sampling sites near potential pollution sources that seemed to be affected by PFOS concentrations than other sites. Based on these results we conclude that dragonflies, regardless of body size and habitat type preference are suitable indicators of environmental metallic elements, PFASs, and PFOS concentrations.

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

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

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

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

A. Bertucci, F. Piron, University of Bordeaux / UMR EPCO CNRS 5805; J. Thébault, Université de Bret / LEMAR UMR 6539 CNRS/UBO/IRD/Ifermer; C. Kloppe, INRA Institut National de la Recherche Agronomique / Plate-forme bio- informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Bellec, Université de Bret / LEMAR UMR 6539 CNRS/UBO/IRD/Ifermer; F. Gonzalez, University of Bordeaux / UMR EPCO CNRS 5805; M. Baudrin, University of Bordeaux / UMR EPCO CNRS 5805. 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 cranial 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 sclerochrology) 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 retrotansposons-related genes. To investigate this effect, we separated 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.

411 L-CRHRMS based-metabolomics to highlight bionutrition products and effects of diclofenac in Mytilus galloprovincialis

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Diclofenac (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2015/495/EC). However, relatively little is known regarding its bionutrition effects and its impacts on Mediterranean mussels. Environmental metabolomics affords several advantages to study both topics. The metabolome refers essentially to i) the “endometabolome”, constituted by endogenous metabolites, and to ii) the “xenometabolome”, in reference to xenobiotics and their biotransformation products [1]. Metabolomics profiles acquired through mass spectrometric techniques may reveal the exposure by direct detection of xenobiotics and their metabolites (xenometabolome investigation) and effects by the detection of endogenous metabolites which concentrations may differ from physiological levels following the exposure to xenobiotics. The diclofenac investigation was carried out on mussels which were exposed to DCF (endometabolome investigation). To demonstrate the approach feasibility, an endometabolome investigation was performed. The data indicated that the contamination of M. galloprovincialis induced a decrease in saturated fatty acids (SFA) and an increase in unsaturated fatty acids (UFA). The changes were more marked in the diet of autochthonous M. galloprovincialis. In conclusion, the L-CRHRMS based-metabolomics approach could be a promising tool to identify early effects of xenobiotics.
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 tryptoaphan metabolism was mostly up-modulated. To our knowledge, such DCF effects on mussels have never been described despite being of concern for these organisms. Astatelamines and serotonin are involved in osmoregulation, and in gain control 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)

4.2 Metabolomes used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in polar bears

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Worldwide, serious concern has arisen about the increased incidence of learning and developmental disorders in children. From a scientific point of view, there is no doubt that exposure to neurotoxic chemicals during early brain development can adversely affect learning and development. Various recent epidemiological studies have indicated that exposure to low doses of environmental biologically active contaminants (e.g. pesticides) during human development can have deleterious effects on cognitive development in childhood. The European commission-funded project DEnAMIC "Developmental Neurotoxicity Assessment of Mixtures in 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.

4.3 Relationships Between Persistent Pesticides 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 phospholipidylcholines (PCs) to identify how changes in the metabolome relates to extrinsic factors, including e.g. exposure to persistent organic pollutants (POPs) and metals. Polar bears (Ursus maritimus) from Hudson Bay (Canada) are differentially exposed to complex mixtures of POPs and metals including total mercury (THg = inorganic + methyl-mercury), and legacy and new POPs. In the present study, quantifiable profiles of 295 organic POPs and THg in fat and liver samples were compared to non-exposed individuals (SHB; n = 14) and Western Hudson Bay (WHB; n = 15) male polar bears were combined for multivariate and univariate statistical analyses. Correlated compounds and significantly different or impacted physiological pathways were identified that may be related to differences in POP exposure or other environmental factors. Partial least squares discriminant analysis (PLS-DA) and variable importance in projection (VIP) were applied to the combined metabolite-contaminant profiles of these polar bears, and Spearman correlation analyses were used to establish relationships between metabolites and contaminants, as well as with other biological factors. Forty-one metabolites [membrane lipids, acylcarnitines (ACs), and symmetric dimethyl arginine (SDMA)], and 21 POP discriminated the subpopulations. Perfluorinated alkyl substances (PFASs), polybrominated diphenyl ethers (PBDEs), p,p'-dichlorodiphenylchloroethylene (DEE) 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.

4.4 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 species of its taxon and has been selected as a genomic model organism for soil toxicology studies on non-target soil arthropods. This work aimed to determine the toxicity mechanisms of a widely applied fungicide formulation (Bravo5000®), with active compound chlorothalonil (CHT), in F. candida, by linking effects at different levels of biological organization like reproduction, gene expression and protein levels, following a time series exposure. Therefore, organisms were exposed in laboratory 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 in mechanistic mechanisms 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 exposure when identifying mechanisms and their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

4.5 Using functional genomics to find mechanisms of herbicide toxicity in the Slime mould Myxomycetes

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At present, environmental risk assessment of chemicals is limited to measuring physiological endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best method for gene function discovery is functional genomics based on high throughput screening of single-genome mutants. Out of the large number of potential interventions (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: atrazin and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II, and 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 atrazin and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutants of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defence against oxidative stress.
stress and lipid metabolism. Finally, there were also several genes that were among the enriched separately for diuron and atrazine, which points to possible different secondary modes of action for both herbicides. While we are currently still analyzing the obtained profiles and individual genes, our results demonstrate that functional genomics is a useful method for discovery of molecular mechanisms of chemical toxicity.

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

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

M. Fossi, M. Baini, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

Concern about the occurrence, quantity and effects of marine litter in the world’s ocean and seas has grown rapidly in recent years, attracting interest from a wide range of stakeholders, environmental NGOs, the scientific community, the media and the general public. Mediterranean Sea, which is a crucial biodiversity hotspot and a critically polluted area, has been also described as one of the areas most affected by marine litter, including microplastics, in the world. Recent studies in the different regions of the basin suggested that some areas are affected by important concentration of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on organisms and ecosystems. The information obtained by biondicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of biondicators can allow to measure not only the occurrence of marine litter in the species and its environment but also the threat posed to organisms by the evaluation of contaminants accumulation and any related 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, biodicator 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 biodicator 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.

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**Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD**

F. Giliani, IFREMER

Preventable assessments of the state of the marine environment, monitoring and the formulation of environmental targets are perceived as part of the continuous management process within the MSFD. Of the 11 descriptors listed in Annex I of the MSFD for determining GES, Descriptor 10 has been defined as “Properties and quantities of marine litter do not cause harm to the coastal and marine environment”. In 2016, the Revised Commission Decision identified four indicators for Descriptor 10, of which two are focusing on harm considering (i) The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned (indicator 10DC3), and (ii) The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects (indicator 10DC4). For these two indicators, Member States shall establish that list of species to be assessed and thresholds values for these levels through regional or sub regional cooperation. In the context of the Mediterranean Sea, we discuss the ongoing work that is focusing on the implementation of monitoring and reduction measures, defining constraints, protocols, better defining harm and research needs to support monitoring efforts and reduction measures. The analysis of existing data will reveal (i) the suitability of some approaches for better monitoring the adverse effects of litter, and (ii) the potential of visual observations of the sea floor for the measurement of interactions between litter and invertebrates as an approach for evaluating entanglement. Strategies for the implementation of monitoring are discussed, as well as risk assessment and the possible associated measures within MSFD.

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**Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface**

T. Vlachogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

The growing urgency and complexity of interconnected societal challenges, such as marine litter, demand that they be addressed through the strengthening of the science-policy-society interface so as to provide the necessary conditions for translating research-based knowledge into effective action. NGOs are essential partners in promoting environmental protection and sustainable development. Their active participation at local, national and transboundary level in all phases of projects and processes, from their design, implementation in the field, operationalization, monitoring and evaluation, contributes not only to increased transparency, wide visibility and outreach of the project or process, but also to enhanced overall quality and increased ownership of the outcomes, as well as amplified possibilities for replication of its activities. In full acknowledgement of the prominent role of NGOs in the realm of environmental governance, MIO-ECSDE, a Federation of some 130 Mediterranean NGOs working on Environment and Sustainable Development, in fulfilling its vision and mission, has developed and implemented a number of actions on the science-policy-society interface that address the growing threat of marine litter in the Mediterranean, ranging from the monitoring and influencing of relevant policy, all the way to hands on and pilot activities (e.g. within the framework of the IPA-Adriatic DeFishGear, the FP7 MARLISCO, the Interreg Med ACT4LITTER, the EU SWIM-H2020 SM, etc.). How marine litter and its inherent environmental, economic, social, political and cultural dimensions have been tackled by MIO-ECSDE illustrates the broad extent of involvement and interventions required for the protection of the marine and coastal. The term “biodegradable” could be misunderstood and gives the false impression that the waste has already been decomposed, the state of many ecosystems would be different today. The NGO community has an essential role to play in terms of strengthening the science-policy-society interface towards an effective response from society on the issue of marine litter and other societal challenges.

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

F. Deligiannis, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and the lack of investments in prevention, and recovery programs. Bioplastics hold promise for aquaculture professional applications (e.g. Novamont SpA, Probioplastics) and other applications at high risk of dispersion. Concluding, the idea of solving the problem of plastic 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 biodicator 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.
Management (RPML) in December 2013, providing for a set of programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment. It includes innovative and traditional measures of a policy, regulatory and technical nature, addressing different aspects of marine litter prevention and management from land and sea based sources. The Regional Plan measures impose clear obligations regarding the waste management hierarchy, closure of illegal dumping/dumpsites, shift to sustainable consumption and production patterns, removal of existing marine litter using environmental sound practices e.g. fishing for litter, clean up campaigns, port reception facilities at possibly no special fees, and monitoring, assessment and reporting on implementation of measures as well as enforcement of national legislation. Significant effort has been made on marine litter at regional and national levels, since the adoption of the RPML. The Mediterranean countries have included marine litter in their updated National Action Plans (NAPs) and the ambitious and novel Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria has been adopted since 2016 by the Mediterranean countries including two common and one candidate indicators on marine litter. Furthermore, with the support of the EU-funded Marine Litter MED project, UN Environment/IMAP is implementing key reduction and prevention measures on marine litter in the Southern Mediterranean. At the invitation of the UN Environment/MAP, the Regional Cooperation Platform on Marine Litter in the Mediterranean was established in September 2016, consisting of more than 20 international and regional partners with a clear mandate on marine litter management. The aim of the platform is to assist to the cooperation within the RPML, further steps have been taken, towards a more effective marine litter management at regional level. One of the latest developments of the UN Environment/IMAP is the 2017 Mediterranean Quality Status Report (QSR) that dedicates two chapters on marine litter related to beach, floating, and seafloor marine litter.

421 Science and awareness: a Mediterranean Connection Against Marine Litter. First Results of the Commitment Presented at UN Ocean Conference

G. Zampetti, Legambiente

“Science and awareness: a Mediterranean connection against marine litter” is the title of the voluntary commitment that Legambiente and the University of Siena presented at the last UN Ocean Conference in New York, in June 2017. There was a connection between scientific research and raising awareness built to tackle marine litter in the Mediterranean Sea by sharing experiences and developing new integrated action. In 2013, Legambiente started the monitoring of floating macro litter within Goletta Verde, one of the most popular campaigns of analysis and information about sea pollution. In the last few years, there has been an increase in the marine-litter-related activities, including surveys using citizen science and awareness raising projects. Following the Scientific Environmentalism purpose Legambiente applied official methods and protocols to contribute to the estimation of the marine litter amount in seas and along the coastline, cooperating also with national research institutes, universities and other research organizations. Now, thanks to the cooperation with the University of Siena, a further step has been reached, carrying out studies and research on the presence of contaminants adsorbed by floating plastics and their potential effects on biodiversity. The first results of this research will be presented in this meeting.

422 Discussion

423 Final Remarks

G. Leone, UNEP/Mediterranean Action Plan

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

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

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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 specific loss 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 amphibians, algae, macroinvertebrate and fish communities related to environmental pressures. The data obtained from the field work conducted in three of the Globoqua 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.

425 Changes in pCO2 after the reproductive toxicity of common active pharmaceutical ingredients

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Increasing pCO2 in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in to the atmosphere, which is absorbed by surface waters. Traditionally this stressor has been studied in isolation, however environmental variation such as changes in pCO2 or pH can alter the ionisation and consequently the effects of contaminant compounds. A notable group of compounds susceptible to these changes include the active pharmaceutical ingredients (APIs), which often have pH-specific biological effects and are increasingly detected in sewage effluent and receiving waters. The aim of this study is to investigate the hypothesis that changes in pCO2 affect the effects of active pharmaceutical ingredients on sperm swimming parameters and fertilisation success. The species chosen to explore these effects were the lugworm Arenicola marina and the purple sea urchin Paracentrotus lividus due to them being keystone coastal species in areas where API contamination is occurring, and them being established model species for artificial sparing 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 the interaction of toxicity of common chemical pollutants through changes in sperm swimming parameters and consequently fertilisation success. Our results also indicate that this combination of stressors is compound-specific between contaminants with multidirectional effects dependent on conditions of the exposure. Our findings provide novel evidence that future environmental conditions may substantially alter the role which contaminants such as APIs play in the environment. API contamination is likely to increase following anthropogenic pressures such as population growth and healthcare advances. As a result, we believe it necessary to consider future conditions such as increased pCO2 conditions when accurately assessing the environmental risks of such compounds.

426 From individual traits to ecosystem functioning: natural phytoplankton community responses under combined environmental stress and chemical pollution

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Phytoplankton are crucial for lentic ecosystems productivity and foodwebs, but facing multiple antrhopic challenges that may lead to complex alterations of their ecology and function. Climate change is expected to decrease the stability of lentic ecosystems and enhance fluctuations in environmental conditions. More frequently occurring storm events will potentially disrupt the normal stratification patterns in boreal lakes, thereby dispersing algae from the depth layers they are optimally
acclimated to. Many species of algae are highly adaptable 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 could result in significant changes with respect to previously reported extreme events. An extreme meteorological event was mimicked by sampling and mixing phytoplankton communities over the entire water depth of the lake. The chemical stressors comprised a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC50 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 33 days experiment. Our results show that, above environmental contamination levels, the environmentally relevant concentrations have a drastic persistent impact on the different levels of organisation of the phytoplankton community. At community level, contaminant decreased the photosynthetic yield. At higher concentration levels these effects persisted throughout the duration of the experiment, resulting in lower productivity and communities with contrasting. This suggests that diffuse chemical pollution 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

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In this study the combined effects of hydrological and chemical stressors on benthic macroinvertebrates are evaluated in order to explore the response of the biological community in relation multiple pressure factors. The Adige River, located in the Southeastern Alps, was selected as a case study because representative of a variety of different catchments in the Alpine region. As expected, flow showed a seasonal pattern, with higher values in the spring-summer period; however, in some sites the natural hydrological regime was altered by the presence of hydropower plants, which management affected most low values of streamflow. Statistical analysis showed a clear seasonal and spatial pattern in both chemical and hydrological parameters; in detail higher concentrations of nitrate, Personal Care and Pharmaceutical products were found in winter season associated with lower streamflow. Changes in richness, diversity and composition of macroinvertebrate community are related with inputs of urban pollution along the river, and with hydrology, chiefly downstream hydropower plants. Pollution (nitrates and other compounds such as PhACs and FCP) favor higher invertebrate densities but lower diversity, changes in thermal natural regime affects Plectoptera, and Gomphus sp damselflies, which are negatively influenced with flow variability. This study lies in giving a comprehensive and general explanation of the response of biological communities to multiple stressors investigated in an Alpine environment; in particular the analyses performed allow to distinguish the main pressures that impact macroinvertebrates in the Adige river.

428 Coping with antidepressants in a changing ocean: tissue bioaccumulation and behavioural implications in juvenile Argyrosomus regius exposed to venlafaxine


Anthropogenic activities have contributed to great environmental challenges: remarkable chemical contamination and dramatic climate change. Both factors strongly affect marine ecosystems and are expected to worsen in the future, threatening marine species’ welfare and survival. Yet, information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-regulated pharmaceutical and personal care products (PPCPs) have recently become a great environmental concern, since these compounds are often discharged into the aquatic environments, but their elimination through conventional wastewater treatments is rather limited. Within pharmaceuticals of human use, venlafaxine (VFX) is one of the most ubiquitous in the aquatic environment, often reaching higher concentrations than other well-known psycho-active drugs, such as fluoxetine (i.e. Prozac). In this context, this study was carried out to determine the first time effect of seawater warming and acidification on VFX bioaccumulation in fish tissues, as well as the behavioural implications resulting from the exposure to these stressors (alone or combined), using juvenile meagre (Argyrosomus regius) as model organism. Overall, data evidenced that seawater temperature and pCO2 levels can strongly affect the bioaccumulation patterns of antidepressants in marine organisms. Furthermore, the distinct behavioural patterns observed when VFX contamination, acidification and warming acted alone or in combination evidenced that multiple environmental stressors should be considered when assessing fish behaviour under a future changing ocean. The results here gathered further strengthen the need to carry out greater research efforts to understand how multiple environmental stressors interact with each other.

429 A modelling approach to assess present and future land use pressures on a salmonid river: a case study in the River Tamar catchment (UK)

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A linked-model approach was applied to the River Tamar catchment (Southwest, UK) to assess current and likely future impacts of land use practices on salmonid populations; Atlantic salmon (Salmo salar) and brown trout (Salmo trutta). Land use data were incorporated into a validated water quality model (QUEST2) at the sub-catchment level and a baseline generated for the period 2000 to 2012. Future scenarios of water quality were also generated based on land use practices recommended under ongoing catchment initiatives. Overall, the baseline water quality parameters found to be non-compliant with “Good Status” under the Water Framework Directive, or outside the freshwater requirements for salmonid, conformed with reported land use pressures in the Tamar, namely, catchment-wide frequent elevated levels of inorganic phosphorus and, less frequently, suspended sediments. Tested future land use scenarios bringing improvements in inorganic phosphorus levels included upgrading technology at sewage treatment plants and the implementation of riparian buffer strips, combined with a corresponding reduction in livestock density. These improvements however, were marginal therefore the tested land use scenarios should be adjusted and/or new scenarios explored. Baseline seasonal average values for water quality parameters in different areas of the catchment explained 68% of salmon and trout fry density variation, and showed how different parameters might be affecting the density of these two species. Our results suggest that catchment pressures are contributing to the regulation of salmonid fry densities in some tributaries and upper catchment reaches. Moreover, they can be used to inform local and seasonal targeted measures, aimed at improving those water parameters most influential on fry densities. These types of measures are likely to bring the highest benefits to salmonid productivity in the catchment.

430 Evaluation of PBT and vPvB substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH

S. Knoepflert, Wageningen University / Social Sciences; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Nendza, Analytical Laboratory 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 non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals use, including from PBT and vPvB substances, are use-specific. Furthermore, due to stock pollution properties of PBTs/vPvBs, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBT/vPvB substances, the evaluation of PBT/vPvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e.
target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from 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 transport 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 use of multiples of a PBT/vPvB substance and to benchmarks being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorooctane 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

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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 is to guide the risk assessment of 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 PBTs/vPvBs on the environment and on human health via the environment (toxicological benchmarks), and to other specific concerns. The resulting fingerprints of concern (pattern of the individual scores) and the overall scores for impact potential can be used for comparative assessments. For example, if similar fingerprints are observed for two substances with a similar use, the total score gives an indication which substance might be less (or more) critical. For 17 case study chemicals, data on partitioning properties (log Kow, log Koa), stocks in water/sediment and soil, long range transport potential (LRTP), overall persistence (Pov), toxicological benchmark values for water and soil, CMR properties (H-phrases), endocrine disruption (ED) potential, production/emission volume, and use pattern have been collected from REACH dossiers or estimated with suitable tools. The examples illustrate the possibilities to assess the fingerprints of concern and to define improvement measures. Further research on the topic is needed. The project will 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 fractions in soil – Extraction matters


The formation of non-extractable residues (NER) of chemicals in soils and sediments is a critical issue for the environmental risk assessment of these compounds, as they may potentially be remobilised as parent or transformation product. However, a standardised or commonly accepted methodology for the characterisation and evaluation of NER does not yet exist. In scientific literature different terms like “Non-extractable Residues”, “NER” or “PFER” are used for what is usually the sum and the separated fraction which are considered to be possibly remobilised into the environment. Therefore, it is necessary to determine at least this fraction for an adequate risk assessment. Other types encompass residues which are covalently bound to the soil and those residues where the test substance or its breakdown products were incorporated into the biomolecules. These residues are considered to be irreversibly bound to the soil or transformed into biomass and therefore no risk for the environment can be anticipated from these fractions. The comprehensive scientific assessment of this classification and the analytical accessibility of these NER types will be discussed and supported by experimental data. Therefore, incubation experiments were carried out following the OECD 307 test guideline, which allows a mass balance of the different NER types in soils. Though the non-extractable residues could not be characterised standard soils were used and with acetonitrile, trichloro- and fenoxycarboxylic acid labelled test compounds were selected representing a pharmaceutical, a biocide and a pesticide. The substances are already well described with regard to their degradation kinetics and the formation of different NER types. Different mild to harsh extraction procedures like shake flask extraction and pressurised liquid solvent extraction are comprehensively discussed. Furthermore, different soil matrix destabilising and destroying procedures are evaluated in order to characterize the four NER types proposed by Eschenbach et al. [2]. Finally, a refined extraction scheme shall be proposed with respect to the general applicability for an adequate risk assessment of NER. [1] Kastner et al. 2014. Classification and Modelling of Nonextractable Residue (NER) Formation of Non-extractable Residues (NER). [2] Eschenbach et al. 1994-49, 2107-2117. [2] Eschenbach et al. – Sequential extraction procedures to characterize non-extractable residues (NER). 2013. Poster at SETAC 2013, Glasgow.

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 (Possberg et al. 2016) a distinct analysis of NER has been performed. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been performed. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been performed. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been performed. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been performed.

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/ECTOC 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 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.

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

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There is already a long discussion around the bioavailability and ecotoxicological relevance of Non Extractable Residues (NER) in soil. Is NER formation a decision making process and should it be considered to be a hidden hazard? NER can only be established using labelled chemicals (e.g. 14C) 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 material, 2) Mineralisation and incorporation of carbon into microbial biomass and carbohydrates? 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 a layer of exchangeable ions (Tennex 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 14C chemicals. In first experiments formation of Non-Extractable 14C 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 also without labelled 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 chemical. 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
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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 quick, opposite ways of how decisions are made. The second distinction to be made is between what type of decisions are made, by whom and what the objectives are. It’s a big difference if you want to make a decision about different options for new products, determine the long term company strategy or select the most sustainable supplier. Even more so, the objectives will differ per organisation or even situation and thus the criteria will also be different. In other words: the context of the decision determines what support is needed and what’s the relevance of the outcomes. Results can have a different meaning in different context. Therefore, it’s important to assess first which methods are fit for purpose to support decisions in a specific context. To enable this, we want to introduce an intermediate step to determine whether LCA, LCT or any other assessment is best suited to answer the questions that are relevant in a specific decision making situation. For this goal we developed a tool to assess the water phase (Tennex 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 14C chemicals. In first experiments formation of Non-Extractable 14C 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 also without labelled 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 chemical. 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.

437 Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical

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6-Aminopenicillanic acid (6-APA) is the beta-lactam nucleus of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nuclei represents one of the largest production scale processes within the biopharmaceutical or biotechnological industries. The processes 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. The use of the Ciba-Geigy process of 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 tonnesCO2eqyr, 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 assumed energy mix to a Brazil mix (constituting a higher proportion of renewable resources), the contribution to climate change was reduced by 15%. Manufacture in China and India where coal combustion is the main source for electricity; the emissions were significantly higher (20%). Other location dependent variables were inputted into the model in conjunction with the switch of energy mix. Depending on the location’s water scarcity, the burden of 6-APA on this dimension varies greatly. A case study was used to observe the moment when switching production from US to China. This is due to the higher use of hydroelectric power in the national energy mix and lower abundance of water in China. Production itself is water intensive due to high volume required for fermentation media and cleaning. Thus, overuse of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location of production is a critical factor in the planning of biopharmaceutical manufacturing.

438 A SUSTAINABILITY PERFORMANCE-BASED METHODOLOGY AND TOOL FOR ECODESIGN: the case of transport infrastructures
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The importance of sustainability in transportation infrastructure has raised in recent years due to the link between anthropogenic activity and global change, 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 use 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 complete this challenging task, a decision support tool (DST) was developed in the scope of the training-through-research programme Sustainable Pave...
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 methods to both “tailor” the approaches to be applied for an LCA, to consider the impact of different factors on the sustainable complex system. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is an important environmental management technique integrating approaches using the space industry to assess the environmental impacts of products over their entire life cycle. The European Space Agency (ESA) began work on this topic in 2009, employing an internal concurrent design study called ECOSAT to consider the life cycle impact of the design, manufacturing, launch and operations of a satellite. Since then ESA has continued to develop LCA methodology for this purpose, creating the first set of LCA guidelines for space systems in 2016 and now is working to integrate LCA into the concurrent design process. Whilst space-based LCA is still in its early stages, its further development relies on it being increasingly employed within the broader space sector to give parity across the industries. For this reason, moving towards space-based Life Cycle Sustainability Assessment (LCSA) is a logical next step which allows for the third pillar of sustainability (environment, society, economy) to be addressed within one assessment. Tailoring this integration for space systems will allow the industry to become more accountable and responsible for their operations by taking into account the full spectrum of life cycle sustainability issues associated with the operation of space systems. This paper will present the LCSA methodology used in an open-source platform under development at the University of Strathclyde, outlining the approach and how this relates with environmental life cycle assessment 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.

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

Characterization and management of excavated soil and rock

G. Mininni, CNR-RSA; A. Scioti, F. Martelli, Italferr SPA

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 ESP, up to several millions of tons. Their management as a waste certainly requires a huge amount of financial and human resources. Both hard- and soft-coupling (hard-soft-coupling) dynamic are defined according to (a) data flow direction and (b) coupling type. Higher the degree of coupling, the higher the computational time; therefore the use of hard-coupling should be limited to studies integrating feedback in adaptive decision-making process. This paper addresses some methodological guidelines on the way of creating a dynamic LCA, planning LCA on the inventory phase. Future research in this field should now address temporal dynamics in the life cycle impact assessment.

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REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICALITY AND FUTURE PERSPECTIVES

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For those who carry out public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to reduce the importance of these times, there are numerous cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques, and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.
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 management processes can be re-used by-products, if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C>12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its possible ecotoxicological effects on soil and water organisms. The ecological approach here reported, consisting of site-specific studies together with ecotoxicological tests performed on the real excavated soils, aims to fill the gap between the lack of threshold limits in soil and water for these multicomponent commercial products and the environmental protection. The studies are planned following a preliminary evaluation of the foaming agent treatment ratios to be used for the specific lithological characteristics of the excavated soils. Here we report the main steps of the environmental studies useful for producing a “Protocol for the assessment of environmental compatibility of the spoil material during the tunnelling in the construction site”. The aim of the protocol is to address engineering contractors and stakeholders (e.g. Railway and Motorway operators) on how to verify the environmental compatibility of excavated soil before putting it in the destination site, it is very important to highlight that the protocol (e.g. the ecotoxicological test selection) has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

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

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A novel product, based on a natural mineral has been developed for use as a foaming agent and soil conditioning agent with earth pressure balance (EPB) tunnelling machines (TBMs). It is available as readily water dispersible granules or pre-prepared aqueous suspension form (see Figure 1), transport and dispose of the treated material. In the worst case, the uncontrolled chemical injection could lead to the production of several tons of hazardous waste, whose management might be significantly onerous in terms of cost and time. The University of Rome Sapienza and Astaldi started a joint research program with the aim of acquiring knowledge, data and expertise in the use of chemicals currently used in the soil conditioning processes. This research program has led inevitably to deal with the environmental impact of different products. Preliminary experimental studies started to be performed, a large number of different product were considered, preliminary screenings on the chemical structure and properties of each compounds has been necessary and the physical and chemical features of pure products and their modifications were investigated. The major component of this new product as a natural mineral widely distributed in the earth’s crust. It is virtually insoluble in water and has no known ecotoxicity. Specifically, there is an absence of toxic effects on two aquatic organisms (Danio rerio and Daphnia magna) and a demonstrated low risk to arthropods, earthworms and soil bacteria. In a recent study commissioned with an environmental consultancy, it was considered that excavated soil is very important with the product and deposited in a licenced waste facility would not pose a risk to the surrounding environment. Compared with existing products it contains very low levels of synthetic chemicals, relying instead on the natural mineral component to stabilise foams by a completely different mechanism; one that is potentially less susceptible to the degrading influence of soils that can compete for the surfactants that are present in, and that stabilise conventional foaming agents in a product. The research and development laboratory have demonstrated the good stability of the foams produced using the product (half-life measurements of water drainage), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and soil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

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

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

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Fascinating properties of Carbon nanotubes (CNTs) allow the development of novel materials with increased functionalities (e.g. reduced weight, increased strength). Nevertheless, CNTs do pose potential environmental and human health risks and reliable methods to quantify CNTs at low concentration in complex matrices are still lacking. In this study we have evaluated two unique shapes of the CNTs to quantify these materials in complex matrices. Multiwalled CNTs (IRMM 382) suspended in either ultrahigh quality (UHQ) water or in soil
extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400, FEI) operated at an acceleration voltage of 20 kV in 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 in the images. The concentration of CNTs was calculated based on the total length of all CNTs (provided by the ridge detection algorithm) detected on the images in combination with their thickness (20 nm), their density (1.4 g cm\(^{-3}\)) and the well-defined volume of suspension that was centrifuged on the TEM grids. CNTs were well separated on the TEM grids and an increasing number of CNTs was observed with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 \(\mu\)g L\(^{-1}\) to 100 \(\mu\)g L\(^{-1}\)) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of \(\sim 2\). Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 mg kg\(^{-1}\)) indicating that the detection of the CNTs was not compromised by the presence of soil particles. Future experiments will focus on a selective removal of the soil particles by an additional treatment with diluted hydrofluoric acid. Initial experiments are promising and suggest that the detection limit of the methods can be lowered to 1 mg CNT per 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


A multiresidue analytical method using LC-MS/MS was developed for perfluorinated compounds (PFCs), insecticides, and brominated flame retardants (BFRs) in water samples with the simultaneous SPE method. The ranges of recoveries were 19.7 ~ 135.0 % (PFCs), 95.0 ~ 117.2 % (Insecticides), and 72.5 ~ 86.4 % (BFRs), with coefficients of variation of less than 15%. Method detection limit (MDLs) of PFCs, insecticides, and BFRs were 0.3 ~ 7.1 ng/L, 3.0 ~ 3.7 ng/L, and 5.1 ~ 11.7 ng/L, respectively while limit of quantification (LOQs) were 0.9 ~ 21.4 ng/L (Insecticides) and 15.4 ~ 53.0 ng/g (BFRs). For understanding the background levels of PFCs, insecticides, and BFRs in the river water, those compounds were monitored in Geum river main stream, So-ok stream, Juwon stream, and Daechung Lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were FFOA, PFXA, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

### 450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

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**Impacts of Contaminants of Emerging Concern on Terrestrial Organisms**

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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 sources, it has evolved into a 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 persistence and bioaccumulation in the environment. In addition, their mass spectrometry, \(^{13}\)C tracing, enzyme extraction and Illuminia sequencing techniques, we evaluated a wide range of biological effects in terrestrial organism caused by exposure to CECs. Organisms in these studies included, the cabbage looper (Trichoplusia ni), an earthworm (Eisenia fetida), a model plant (Arabidopsis thaliana) and cucumbers (Cucumis sativus), radishes (Raphanus raphanistrum sativus) and tomatoes (Solanum lycopersicum). These studies have revealed a multiplicity of effects including increased mortality and development time, reduction in weight, changes to the microbiome and up-regulation of enzymes associated with oxidative stress. Further, the study has highlighted the potential for higher plants to take up, translocate and detoxify CECs.

### 451 Occurrence of pharmaceuticals and their metabolites in Euthynus alletteratus bile


The use of manufactured objects in surface waters has been attributed to the effluents of WWTP among others. The widespread occurrence of pharmaceuticals in the aquatic environment has raised concerns about their potential adverse effects on exposed wildlife. Little is currently known on exposure levels of drugs in fish, but some studies reported the detection of pharmaceuticals and endocrine disrupting compounds in this type of biota. Due to possible accumulation processes, pharmaceuticals and metabolites could be thousand times more concentrated in fish than in polluted living waters. By other hand, fish are known to possess a hepatic detoxification system which are likely capable of metabolizing pharmaceuticals taken up from polluted waters. Some studies proposed the analysis of bile from fish to evaluate pharmaceuticals exposure including the identification of metabolites by UPLC-HRMS. In this context, we propose the evaluation of the metabolism of frequently detected drugs in fish, performing a screening bile of by HR-MS for the presence of stable intermediates. Fish were collected from different regions in the Mediterranean coast of Spain. Afterwards, their bile was isolated from the fish and analyzed for the detection of parent drugs and some metabolites listed in an in-house suspected list. A sampling campaign was planned to collect tuna fish, Euthynus alletteratus, from the Mediterranean coast of Spain. Tarragona, province of Tarragona, Spain in the summer of 2017. The bile samples were analyzed directly by UPLC-HRMS after a protein precipitation. The HRMS data allowed screening for suspected pharmaceuticals and their metabolites and provided plausible chemical formulae. The comparison of MS/MS spectra of the parent compounds and their metabolites allowed to propose chemical structures for possible metabolites in fish bile. With this analytical methodology some metabolites, corresponding to different reactions that includes products of hydroxylation, glucuronide conjugates were identified. The suspect analysis of bile samples allowed the detection of several pharmaceuticals. Psycho-active drugs were one of the most commonly detected drugs. Their identities were proposed by matching their accurate MS and MS/MS data against different libraries. Finally, authentic standards were employed to confirm the proposed drug identities and to determine analytic concentrations in the fish samples.

### 452 Accumulation and fate of 12 human drugs through the soil-root-leaf system

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Crop irrigation with reclaimed water has become an extended practice in many countries worldwide where the water scarcity and excessive exploitation of agriculture are forcing local authorities to look for alternative resources. Despite this, irrigation increases local water consumption and contributes to nutrient recycling, using reclaimed water for irrigation, however, represents a primary source of emerging organic contaminants resilient to wastewater treatment processes, such as some pharmaceuticals and personal care products [1]. These pollutants can be retained in the soil, directly uptaken by crops or translocated from soil to plant tissues above the ground [2,3]. The present work aimed to evaluate the transfer and the bioaccumulation of organic contaminants of emerging concern (mainly pharmaceuticals) in lettuce tissues and soil. The distribution of twelve relevant wastewater-derived pollutants was evaluated in lettuce tissues (leaves and root system) and soil. This list included nine prescription drugs (dichlofenac, temophrop, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, midazolam, and methadone), an illegal drug (cocaïne) and two transformation products (acridone and valsartan acid). Lettuce plants were grown in pots in a controlled environment and irrigated with artificial spiked water containing the 12 compounds during the entire growing period (60 days). Control was irrigated with tap water. Afterwards, a set of new lettuce plants were grown in the same soil pots and irrigated with rainwater or with tap water, if necessary. At the end of each growing period (leaves and root system), whereas cis-diltiazem, methadone, and midazolam were preferentially accumulated in the plant root system and the soil. Concentrations of the target analytes in the plant-root-soil system after the second growing season were significantly lower than those measured after the first growing season.
season, but still detectable for most of the compounds.

453 Root-uptake and dissipation of atenolol, sulfamethoxazole and carbamazepine applied as a single compound solution or in mixture of all compounds in three soils and five plants

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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 Epifert. Five plants (radish, arugula, lettuce, spinach and green peas) planted in those soil were initially irrigated by fresh water and next with water contaminated by a single compound or their mixture. After 3 or 4 weeks, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant parts and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds' transformation depended on a plant family. Considerably higher concentrations of atenolol, sulfamethoxazole and metabolites of atenolol were measured in roots in comparison to those in leaves and soils. In the case of carbamazepine, the highest concentrations were measured in leaves followed by roots and soils. Both indicate a high potential of plants to accumulate studied pharmaceuticals in their bodies and a high ability to transform studied compounds. Particularly in the case of carbamazepine, the considerably higher concentrations of metabolites were measured in leaves in comparison to concentrations in roots and very low or negligible concentrations in soils. Transformation of compounds in plant bodies is attributed to enzymes CYP450. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (mixture) regardless of the type of soil and plants were used for all tested plants. The impact of application (single compound versus compounds' mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced dissipation of other two compounds in soils, which increased relative concentrations of compounds in plants (i.e., concentrations of compound in plant divided by compound loads in soils that is a total amount of applied solution divided by a dry mass of soil).

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

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish

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A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in a wide range of concentrations. However, individual variation, with blood plasma: water partition coefficients ranging from 1-3 for ibuprofen and 1-9 for diclofenac. To identify factors affecting PG levels in individual fish we measured plasma lipid content and plasma protein binding influencing partitioning and bioavailability, haematocrit and plasma osmolality as a measure of stress in fish, potentially affecting plasma NSAID and PG concentrations. From our analyses, no single factor could explain the observed variations in NSAID uptake and pharmacological response. Our data highlight some of the complexities in interpreting biological exposure and effects data for NSAIDs.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward

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Human pharmaceuticals are extensively tested 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 quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Besides, the current process of peer review of the data sets is shown and insights and gaps in the data sets and their anonimity 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 less than desired. So far for some pharmaceutical ingredients detected in surface water environmental effect data are lacking, because they entered the market before implementation of the EMA guideline. Furthermore, the tailor made assessment approach for substances with very specific mode of action will be addressed, especially regarding the remaining uncertainties for protection of biodiversity and the environment. This does apply e.g. for endocrine active substances, like contraceptives or anti-cancer drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 nL/G) 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 approaches for the replacement long-term by short-term test factors as applied usually for chemicals without any specific mode of action will be analyzed.

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

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Pharmaceutical and personal care products (PPCPs) are used worldwide for medical treatment and personal hygiene. PPCP residues are usually discharged into the environment during wastewater treatment. The environmental fate of these chemicals is poorly understood, leading to concerns about potential health effects and ecological impact posed by their use and release. In many developing countries, information regarding the consumption patterns of PPCPs is often limited, even though consumer product usage data are crucial for more realistic exposure estimates, like needed for risk assessment. To overcome this following study was performed to estimate PPCP use in Nigerian households to prioritise the potential for PPCPs to enter source water. Using questionnaires as the survey instrument, we elicited information from 350 participants, concerning the most frequently used PPCPs, duration and amount of use in households. Drug usage was limited to over-the-counter(OTC) medicines and was estimated by application of the US National Health Organization - daily dosage. The consumption of personal care products (PCPs) was calculated by multiplying the quantity of products used by the frequency of its use. To prioritise PPCPs, a risk index was developed to rank chemicals according to their potential to enter source water. Consumption of PCPs was 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, clocloxacillin, sulfamethoxazole, trimethoprim and pseudoeheadrine) and 4 PCP ingredients (sodium lauryl ether sulphate, alcohol ethoxylate, ammonium thigloyclate and dichlorvos). This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

457 Aquatic toxicity related to pharmacological or secondary targets of human pharmaceuticals

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Human pharmaceuticals target specific biological structures to exhibit their intended therapeutic effect. The presence of the anticipated biological target of a pharmaceutical in a non-target species may lead to specific effects in that organism, while in the absence of the target non-specific baseline toxicity such as narcosis would prevail. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green alga Raphidiocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint undertaking funded by the FP7 grant agreement n° 115735, resources of which are composed of financial contribution from the European Union's Seventh Framework Programme (FP7/2007-2013) and EFPIA companies’ in kind contribution.

458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and behavioral profiles in zebrafish embryos and larvae

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Neurotoxic pharmaceuticals are of growing concern as aquatic contaminants due to environmental and human health risks. Even low concentrations can interfere with molecular pathways and population-relevant behaviors. At the same time there is no EU regulatory framework for environmental neurotoxicity assessment. This project aimed to contribute for establishing a neurotoxicity testing approach by integrating molecular (transcriptomic) and behavioral (phototaxis and thigmotaxis reactions (5 dpf)) endpoints in zebrafish embryos or larvae (n=20). RNA was extracted from pooled embryos spontaneous movement (1 dpf), touch and end of exposures by antidepressant or oxazepam (benzodiazepine derivative anxiolytic) at the µg/L level behavioral alterations 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 or 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. fkbp5, cfos, per3). Reference genes were ef-1a, rpl13, rpl8. 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 10 nM Oxazepam, while venlafaxine affected prevalently larvae 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 modification of response to abiotic stimuli, 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 1980. 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 iPHE project (IM grant no.115735-IP). Those in silico methods provide a first tier of screening, but we are likely still faced with hundreds of compounds to assess at multiple concentrations. We have been developing in vitro tissue micro-organisms (organoids) that replicate the in vivo tissue. These can be used to build a virtual fish that will allow the screening of pharmaceuticals (or other compounds of concern or even metals) without testing live fish (BBSRC/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.

Emergence and multidimensional interactions of engineered nanoparticles in toxicity

460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations

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Little is known about the effects at cellular, tissue and individual levels of emergent compounds such as fullerenes. In particular, the mechanisms of action are poorly investigated. In this research, the effects of C60 on mTOR (mechanistic Target of Rapamycin) activity in mussel digestive gland were studied. mTOR is an evolutionarily-conserved serine/threonine protein kinase that senses and integrates a variety of cellular physiological and environmental signals to regulate cell growth, mTOR is found in two functionally distinct complexes, mTORC1 and mTORC2. In 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 temporal control of cell growth by activating anabolic processes (such as autophagy); mTORC2 is primarily involved in actin. Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations...
461 Proteomic responses to nanoparticle and ionic silver in freshwater microbes with different background

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Enhanced use of silver (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 assessing 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 Articulospora tretacaudata, 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

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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. This has raised serious concern regarding the risk of silica nanomaterials and was in 2010 selected as one of the priority substances by the OECD Working Party on Manufactured Nanomaterials. In order to thoroughly examine the toxicity of silica nanomaterials to deuteriums, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), biocide free, silica nanomaterials, were tested on bacteria, algae and fish cell lines. Based on the result, the current study also examined the selection of an appropriate exposure metric comparing mass (mg/L), number of particles (No/L) and surface area (m²/L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC20 value of 5.1mg/L after exposure to the smallest particle at a concentration range of 12.5-100mg/L. Toxicity to fish cells was determined to be surface dependant, except for particles coated with ethoxy silane, which did not show the effect. 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

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Titanium dioxide engineered nanoparticles (TiO2-ENP) are extensively employed in manufacturing of cosmetics, pharmaceuticals and health care products. As a result, TiO2-ENP can reach the ultimate sink such as soil in the environment during their life cycle. In this context, investigations to understand environmental implications of nanoparticles including TiO2-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO2-ENP (r-TiO2-ENP) in soil sediments, 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

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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 combination 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 nZnO 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 were dependent on the form of ZnO and also properties 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. Rico, 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 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
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 limit. Norwegian 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 micropolllutants (MPs). In this study, the presence and distribution patterns of these multifunctional organic micropolllutants within 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 succralose, with concentration range of

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

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 much of the megacities will continue to emerge over the next few decades, accumulation of chemical products is occurring faster than public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage production is not treated, but returned to the environment and thus reused for various purposes. These non-traditional reused waters are being recycled for agriculture, including aquaculture in areas experiencing rapid urbanization, yet implications for water security, food safety and international trade are not routinely examined to manage more sustainable aquaculture practices. In the current presentation we draw from our ongoing efforts in Asia and North America to understand bioaccumulation of organic contaminants of emerging concern in common fish and shellfish used for aquaculture. For example, we have observed aquacultured bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and effluent 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 nonionizable organic contaminants. In North America we are examining intersections among water reuse practices and aquaculture for various products. Such efforts apparent warranted at the global scale.

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

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included teflubenzuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of teflubenzuron and deltamethrin a saturation column was employed within a flow-through system to deliver a stable concentration of test chemical over a 14-day uptake phase. Water and mussel samples were collected at time intervals during the 14-day uptake phase, and again following transfer of the mussels into clean flowing seawater during the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation and depuration of teflubenzuron were also tested. Further, other mussel species in brackish waters show different bioaccumulation dynamics. So far, preliminary 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, emamectin showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.

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

Environmental pollution from aquaculture is often seen as a major concern, but today, increasingly is the potential exposure of aquaculture to contaminants. In order to fully understand the contamination risk of farm-raised species, nuclear approach can be used to trace these contaminants and to assess the susceptibility of economically important species (fish and seafood) to be contaminated. Marine fish farming is regarded as the future of aquaculture and thus, the safety of these farm-raised fish is paramount particularly as 50 % of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current 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 radioracer techniques over conventional techniques are their 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 radioracer permits the non-destructive analyses of contaminant levels in living organisms. This paper identifies present and future threats on fish farming from a contamination point of view, and presents a synthesis of experimental results completed on farm-raised fish using EiE to contaminants in realistic 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


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 demonstrated an apparent increase 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 (contaminated with antibiotics). Water samples were taken by net vs. unmedicated with local fish such that allows identifying for non- medicated or medicated with three antibiotics (oxytetracycline, 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 oxytetracycline, and 19000 – 54000 ng/g (average 10% of applied amount) for flumequine. Florfenicol was not detected. Different accumulation rates were found in covered/uncovered traps due to wild fish influences in the availability of feed and bioturbation. Physico-chemical characteristics of the sediment also changed; with a higher S and lower N content and a larger percentage of fine material in feed affected treatments. Invertebrate...
presence was also correlated with the food availability, although no evident effects
of the antibiotics were found over the analyzed samples. Bioaccumulation of the
target antibiotics in the invertebrate community and evaluation of the antibiotic
impacts over the microorganism and resistome of the sediment bacteria is still
ongoing. This is one of the first studies describing fish feed and antibiotic impacts
produced by aquaculture under Mediterranean conditions.

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

472 Systems toxicology approach for the assessment of zebrafish cardiac and neurotoxicity
A major goal in the field of toxicology is to predict long term animal health risks and/or environmental hazards associated with a particular substance(s).
Traditionally utilised classical toxicology methods involve animal exposure over a relatively short period and recording adverse outcomes. These data are then extrapolated to humans and to other species. The accuracy of such extrapolation would benefit from mechanistic understanding of toxicity. However, molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present our systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to cardiotoxicity and neurotoxicity in zebrafish larvae based on the knowledge curated from scientific literature. Key signalling nodes in the model are linked to information about downstream gene expression. Differential expression of downstream genes can be used to infer activity of the upstream protein – a process termed network scoring. Scoring of the network highlights the most affected nodes, which leads to mechanistic hypothesis generation and gives a quantifiable measure of network perturbation. In parallel to network scoring, we utilize classical toxicology methods to detect adverse outcomes. We present the acute toxicity results for selected chemicals (e.g. acrylamide, arsenic, citalopram, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236).
We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the network model in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.

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

474 How to implement functional responses of microalgae in risk assessment processing?
E. Delignette-Muller, VeAgro Sup / Laboratory of Biometry and Evolutionnary Biology; M. Schmitt-Jansen, UFZ - Helmholtz Ctre 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 (e.g., Scenedesmus). 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 items (metabolites/transcripts) according to the concentration response curves of each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. Then, the molecular items were linked (when possible) to the pathways they are involved in. From that information, we built a SSD-like tool based on functional responses captured at the community level in order to protect functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

475 Sex, drugs and Daphnia magna. A multi-omics approach suggests conserved mechanisms of interaction between metallohormones and endocrine disruptors
E. Caamaño-Gutierrez, University of Liverpool / Computational Biology Faculty; F. Raines, University of Liverpool / Institute of Integrative Biology; L. Kehrmah, The University of Birmingham / School of Biosciences; K. Grintzalis, The University of Birmingham; M.R. Viant, University of Birmingham / School of Biosciences; F. Falciani, University of Liverpool / Institute of Integrative Biology
The assessment of environmental exposure to toxic chemicals released by human activity as well as their impact on biological systems is key to protect the biosphere. Current environmental monitoring protocols are hit and miss and do not necessarily reflect the assessment of biodiversity. Although this has been a very effective strategy, it has some shortcomings. These include the fact that a relatively limited number of compounds can be measured and linked to biologically relevant organism-level responses. The issue is particularly challenging in chronic exposures and in complex mixtures scenarios. This project aims at identifying the molecular networks linked to single and mixture exposures and to use these to infer the effects of chemical mixtures. We approached this important challenge by applying a systems biology approach to integrate expression profiling, metabolomics and phenotypic data (respiration and feeding rates), representing the response of Daphnia magna to a panel of environmentally relevant chemicals and their mixtures. Firstly, it was exposed to a battery of single compounds with known mode of action (MoA) i.e. estrogen disruptors and acetylcholine esterase (AChE) inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either estrogen disruptors (AChE inhibitors) or inorganic compounds (Cd), whereas metal disruptors, has already been shown to play a role with the estrogen receptor in humans but its role in D. magna is still under surveillance. To further study this finding we exposed D. magna to complex mixtures of Cd and ethinylestradiol. While the individual exposures triggered the alteration of expression of a relatively large number of genes, the exposure to the mixture showed little or no effect. These results indicated that both compounds share a complex interaction at a molecular level suggesting that the degree of conservation of the regulatory pathways underlying response to endocrine disruptors may be higher than previously thought.
Overall, our work shows that it is possible to predict a compound MoA from its
molecular state and also predict additive or synergistic effects of mixture exposure.

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. Foekema, 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. Waterbionormica is an example of such additional treatment, consisting of a sedimentation pond, reed bed and a wetland forest. In this work, we have used three-spined stickleback living in mesocosms containing water from various stages of additional remediation from three different sites in the Netherlands. Aim. The aim of this work was to understand the effects of additional steps of water remediation. Results. We have used a data-driven systems biology approach to understand the relationship between the environment (chemical concentrations), molecular high-throughput measurements (stickleback liver gene expression), physiological parameters and more traditional measures of toxicity. We 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 (alidicarb, chlorpyriphos, fluoranthene, pirimiphos methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in one or the other male of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCBs and mineral oils) are associated with modules containing several high-risk chemicals. Functional annotation reveals further insights. For example a module of the male stickleback network correlated with liver weight and several chemicals including triclosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450“. However, a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation“, „type 1 diabetes mellitus“ and „cytokine-cytokine receptor interaction“). Conclusion. We have showed the potential of data-driven systems biology approach integrating various types of data to give insight into the effects of a complex remediation system.

Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology.

D. De Vito, post doc, Istrea / UR RIVERLY Laboratoire Ecotoxicology; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Istrea Lyon / UR MALY Laboratoire Ecotoxicology; J. Trapp, Istrea Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, Istrea / UR MALY Laboratoire Ecotoxicology; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics Determining the impact of environmental contaminants 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 no 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 Gobius niger. Upon initial shotgun proteomics data was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides potentially inducing endocrine disruption in this crustacean. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology.

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

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

S. Vanthournout, 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 and 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.

Discussion: the need to promote good science and evidence in public debates

How to communicate the risks posed by endocrine disrupting chemicals? (I)

J. Legler, Utrecht University / Institute for Environmental Studies

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks used 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.

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 of organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

Discussion Endocrine Disrupting Chemicals

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

S. Vanthournout, 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 and 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.

Discussion: the need to promote good science and evidence in public debates

How to communicate the risks posed by endocrine disrupting chemicals? (I)

J. Legler, Utrecht University / Institute for Environmental Studies

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks used 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.

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 of organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.
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). 

In 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: A. Leopold, Calidis Environment BV / Calidis Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Ajao, ECHA-European Chemicals Agency

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

487 The impact of chemical pollution on the resilience of soils under multiple stress. A. Schaffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; W. Amelung, University of Bonn; H. Hollett, RWTH Aachen University / Institute for Environmental Research; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; E. Kandler, University of Hohenheim; J. Kruse, University of Bonn; A. Milten, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnol; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; H. Pagel, University of Hohenheim; S. Peth, University of Kassel; C. Poll, University of Hohenheim; G. Rambold, University of Bayreuth; M. Schloter, Helmholtz Zentrum Munchen / Research Unit Environmental Genomics; S. Schulz, Helmholtz Zentrum Munchen; T. Streek, 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 compiling the literature exemplarily for the effects of Cu contamination and compaction on soil functions and structure. However, examples of further co-occurring stress scenarios will be described as well. In this discussion paper, we propose to intensify research on effects of combined stresses involving a multidisciplinary team of experts and provide suggestions for corresponding experiments. Our concept offers thus a framework for system level analysis of soils paving the way to enhance ecological theory.

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturase and elongase transcription in fathead minnow (Pimephales promelas) M. Fadlouli, INRS - Eau, Terre et Environnement / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Couture, INRS / Centre Eau Terre Environnement

In this project, two freshwater fish commonly found in areas affected by metal contamination were acclimated to different temperatures (9 and 28°C for yellow perch (Perca flavescens)) and 15, 25 and 30°C for fathead minnow (Pimephales promelas)) and exposed either to Cd or Ni during 8 weeks. At the end of exposures, we measured cell membrane phospholipid fatty acid composition, the activities of superoxide dismutase, catalase, glutathione-S-transferase, glutathione peroxidase (enzyme indicators of antioxidant capacities), the concentrations of glutathione (antioxidant) and malondialdehyde (indicator of lipid peroxidation (LPO)) as well as the transcription levels of desaturases (fad2, degs2, scd2) and elongases (elev2, elev5, elev6). Both yellow perch and fathead minnow counteracted the effects of changes in acclimation temperature on cell membrane properties by remodelling their phospholipid fatty acid composition. Specifically, in the muscle of both species, polyunsaturated fatty acids increased in cold-acclimated fish compared to warm-acclimated fish, in agreement with the theory of homeoviscous adaptation. However, brain cell membrane composition was more conservative, especially in fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than saturated fatty acids and metal contamination leads to oxidative stress. We therefore tested the hypothesis that temperature-induced changes in cell membrane polyunsaturation are accompanied by variations in LPO in metal-exposed fish. Unexpectedly, in both species, metal exposure itself affected membrane fatty acid composition. In yellow perch, the normal response of cell membrane composition to thermal acclimation was reversed by exposure to both metals. Yet, in spite of the high polyunsaturation level in warm-acclimated fish under Ni exposure, MDA concentration was the lowest, suggesting a massive response of the antioxidant system to fight against LPO. In fathead minnow, metal exposure also affected the membrane fatty acid composition of both tissues, but was more pronounced than for yellow perch. We observed a mismatch between desaturation and elongation gene transcription and membrane composition. Overall, our results suggest that levels of control of cell membrane fatty acid composition other than gene transcription may be affected by temperature and metal exposure, such as post-transcriptional regulation of gene transcription and de novo phospholipid biosynthesis.

489 The effect of water chemistry on cadmium induced olfactory impairment in juvenile rainbow trout (Oncorhynchus mykiss) S. Voiz, RWTH Aachen University / Department of Ecosystem Analysis; S. Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological Sciences; H. Hollett, RWTH Aachen University / Institute for Environmental 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 130 to 40 mg/L as CaCO3 increased the inhibitory effect of Cd on the EOG response from 55% to more than 95%, respectively. Hence, hardness ameliorated Cd-induced olfactory impairment. By contrast, Cd-induced olfactory inhibition increased with rising pH, which may be due to a difference in metal speciation. DOC had a protective effect against Cd-induced olfactory impairment, likely by forming complexes with Cd ions and reducing their
bioavailability. In conclusion, water chemistry is an important modulator of metal toxicity, not only for acute lethality but also for sub-lethal effects, such as olfactory impairment. In order to enable the prediction of site-specific olfactory toxicity, the development of a BLM 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

A. Figueira, University of Aveiro / Biology; R. Freitas, University of Aveiro / Department of Biology - CESAM; C. Patinha, Universidade de Aveiro, E.F. Silva, University of Aveiro / Geosciences; E. Figueira, University of Aveiro / Biology CESAM

Coastal systems often serve as sinks for toxic elements, and changes in salinity, predicted to occur due to global climate change are expected to influence elements geochemistry in aquatic systems. The effects of these changes can also alter biota sensitivity and performance. Therefore, it is of key importance to evaluate the impact of changes in the salinity regime on the performance of bioturbating species. Among the most important bioturbators are the mud shrimp, which support a large proportion of the 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 fine sand sediment for salinity 40 led to a decrease in olfactory and swimming kinetic in marine neapolitana individuals exposed at salinities 21 and 40, for both sediments, exhibited lower laboratory 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 parasite infestation influence the activity of the bioturbator Upogebia pusilla?

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In marine environment, bioturbating species are considered as important ecosystem engineer species. Bioturbators are mainly benthic organisms living in the sediment. Their fossorial life style deeply alters the physical and biochemical properties of sediments. In marine soft-bottom environments, mud shrimp are considered as among the most important bioturbators. Because of their intense burrowing activities, they exert a major influence on solute and porewater exchanges, habitat structuring 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 bioturbation activities and therefore modify the influence of this ecosystem engineer species. Regarding mud shrimp, only a few factors have been studied. Among them, the role of trace metals on mud shrimp performance and bioturbation activities has never been investigated yet. Besides, mud shrimp are frequently parasitized by bopyrid isopods, known to have a deleterious effect on their host. Indeed, they deeply impair mud shrimp physiological state and potentially alter the bioturbation intensity. The aim of this study was to examine the role of a common trace metal (cadmium) and of bopyrid parasites on the physiology and the bioturbation activity of the mud shrimp Upogebia pusilla. We performed a 14-days ex-situ experiment evaluating the influence of Cd and/or parasite on the mud shrimp U. pusilla. Cadmium bioaccumulation and potential genetic responses to stress exposure were determined after 3, 7 and 14 days to trace metal exposition. The influence of both stressors on U. pusilla bioturbation activity was determined by evaluating sediment reworking rates of the mud shrimp after 3, 7 and 14 days to trace metal exposure.

492 Integrating ecotoxicology and ecology to advance understanding and prediction in multiple stressor research

R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; J. Piggott, Trinity College Dublin / Zoology

Global environmental change is driven by multiple anthropogenic stressors. Conservation and restoration requires understanding the individual and joint action of these stressors to evaluate and protect management measures. To date, most studies on multiple stressor effects have sought to identify potential stressor interactions, defined as deviations from null models, and related meta-analyses have focused on quantifying the relative proportion of stressor interactions across studies. These studies have provided valuable insights about the complexity of multiple stressor effects, but remain largely devoid of a theoretical framework for prediction of effects and null model selection. We suggest that multiple stressor research would benefit by 1) integrating additional null models from ecotoxicology and 2) selecting null models based on their mechanistic assumptions of the stressor mode of action and organism sensitivities as well as stressor-effect relationships. We present a range of null models and outline their underlying assumptions and applications on multiple stressor research. Moving beyond mere description of the stressor interaction requires multiple stressor research to shift its focus from identifying statistically significant interactions to the use and development of mechanistic (null) models. We discuss how ecotoxicological and ecological concepts will aid in achieving this.

Improving the Quality of Ecotoxicological Testing and Assessment

493 Updating the OECD Guidance Document 23 on aquatic toxicity testing of difficult substances and mixtures to include state-of-the-science approaches

W.S. Hunter, U.S. Food and Drug Administration / Center for Veterinary Medicine; G. Stoddart, C. Fältbinder, PETA International Science Consortium Ltd.; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHCP EURL ECVAM; E. Salinas, BASF SE / Eperimental Toxicology and Ecology

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 Assesment Factors

F.M. Bakker, Eurofins-Mitos; S. Aldershof, Bioresearch and Evaluation; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; C. Elyson, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow Agrosciences / Regulatory Sciences; G. Weymann, ADAMA; P. Neumann, Bayer Ag Assessment factors for aquatic non-target arthropod (NTA) studies were calibrated against NTA full fauna field studies for a large array of species, 20 active ingredients (23 products) and wide geographic coverage in the EU. It was investigated whether the current assessment endpoints at lower testing tiers are sufficiently protective and whether the array of test systems is sufficiently comprehensive. Lower tier studies, both Tier 1 and Tier 2, with several test species and different assessment approaches were designed to calibrate test factor values for each species. Both Tier 1 and Tier 2 studies were included. For each product a Hazard Quotient (HQ) was calculated based on the most sensitive lower tier test result, both lethal and sublethal (only tier 2), and the test rate applied in the field study against which the HQ was calibrated. Thus, multi-rate studies could yield more than one HQ. Values obtained were related to the longest duration of adverse effect observed in the field. With this information we derived limit values for assessment factors based on different field risk tolerance criteria, for example in-field recovery periods varying from 1 to 12 months. Phytophagous taxa were analyzed separately, but as no differences in
outcome with other taxa were observed, these were considered jointly. As expected Tier 1 studies had the most sensitive endpoint and consequently the highest HQ. Using the recovery endpoint, it was found that for the off-field HQ’s of 1, 6 and 250 delimit recovery ranges of 0 weeks (no effects), 4 weeks and 8 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 2-6, 6-12 and 12 months were delimit by HQ-values of 40, 375, 620 and 2590. Tier 2 studies could have lethal or sublethal endpoints. Using the most sensitive of the two and including a Vegetation Distribution Factor (VDF) of 5 the following HQ-values were derived for the off-field: HQ=1.7 for no effect level. These HQ’s also correspond to 1 and 2 month recovery periods. For the in-field, using VDF=1, HQ’s are 1.3 for no-effect and 6.6, 15, 60 and 560 for 1, 2, 6 and 12 months respectively.

495 The unforeseen consequences for animal welfare of the OECD TG 240 (MEOGRT) biological validity criteria
E. Salinas, BASF SE / Experimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology
The Medaka Extended Exposure Reproduction Test (MEOGRT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEOGRT 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 relevance of 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 MEOGRT 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, the data is currently very few laboratories can implement this highly complex TG. The MEOGRT 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 MEOGRT 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 MEOGRT fecundity validity criteria is in principle achievable, however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRT. 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.L. Estes, Exponent; J.W. Green, DuPont / Data Science and Informatics; J. Nusz, Exponent, Inc.; D.E. Edwards, BASF Corporation / Ecotoxicology; K. Henry, NovaSource / Tussenderlo 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, Nifarm; T.S. King, FMC/CropSafety/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 residues is a challenge for using and interpreting the data for risk assessment. Standardized NTTP testing protocols were initially designed to calculate the application rate causing a 25% effect (ER25, used in the U.S.) or a 50% effect (ER50, used in Europe) for various growth measures based on an observed dose-response relationship. The requirement to generate a no-observed-effect rate (NOER), or, in the absence of a NOER, the rate causing a 5% effect (ER05) has raised questions about the reproducibility of the variability in, and statistical detectability of, these tests. Statistically significant differences observed between test and control groups may be a product of inherent variability and may not represent biological relevance. Attempting to derive an ER05 and the associated risk assessment conclusions drawn from these values can overestimate risk. To address these concerns, we evaluated historical data from approximately 100 emerging seedling and vegetative vigor guideline studies on pesticides to assess the variability of control results across studies for each plant species, examine potential causes for the variation in control results, and define the percent effect that can be estimated or the minimum percent effect that can be reliably detected statistically. The results indicate that with current test design and implementation, the ER05 cannot be reliably estimated.

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. Spieker, EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Foudoulakis, Dow Agrosciences / RSRA ERS; 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, where we present the results of historical control avian reproduction and mallard duck reproduction studies performed at the Evans Analytical Group LLC avian toxicology laboratory over the period 1985 - 2016. The analysis demonstrates the stability of reproductive parameters over time and good agreement to normal control ranges as required by the regulatory test guidelines. The major source of variation is shown to be within study variation. Recommendations for the use of historical control data for the interpretation of avian reproduction studies are made. We believe the analysis and evaluation presented here can facilitate the development of practical guidance that can be implemented in regulatory programmes requiring this test.

498 Experimental Design and Model Selection for Ecotox Risk Assessment
J.W. Green, DuPont / Data Science and Informatics
Recent experience with regulatory requests for re-analysis of older studies using newer statistical methodology has resurrected an old statistical issue of designing a study to fit its objectives and the dangers of imposing a statistical structure on data not fit for purpose. There is a continual need to update statistical methodology as new ideas arise data is aware to implement these methods become available. Problems can arise when new methods are imposed on old experimental designs. Imagine buying a plot of land with a small cottage. If we tear down the cottage, but leave the cellar and foundation, and then build a mansion in its place but based on the existing foundation, the resulting structure can be unstable and severely restricted in functionality. This presentation will explore the relationship between experimental design and the type of statistical model that can be fit to the resulting data and endpoints that can be estimated or determined from the model. In some instances, newer methods can be applied without problem to existing data. In other cases, existing data cannot support newer methods. It is important to understand the data requirements of the methods or models we intend to use. The size effect that can be estimated or detected is critically important and is strongly related to experimental design and biological variability. There is a model underlying every statistical test used to derive a NOEC or estimate an ECx. The basic statistical model for a simple toxicity experiment is given by Y=q1i+q0i, where qi is the expected mean response in the i-th concentration, and the e are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another are 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. Husved, R.A. Alvarezanga, 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, therefore, recycling of post-consumer wood waste requires special attention to the determination and control of dust and dust from particleboard. For instance, for example, may contain high concentrations of heavy metals such as arsenic and copper. Heavy metal toxicity is a threat to the environment and is associated with adverse health effects. In the particleboard industry, heavy metals may be discharged into the air when dust from wood waste is incinerated to supply heat for dryers. Moreover, downstream industrial customers of particleboard (e.g. furniture manufacturers) who import particleboard as a raw material can be exposed to dust from particleboards for internal heat supply, are of concern as well. Local human health effects due to reduced local air quality may question the overall benefit of recycling contaminated wood waste
into particleboard. A need exists to investigate the local human health risks associated with recycling contaminated wood waste, while simultaneously considering other impacts on human health and the environment throughout the entire life cycle traditionally modelled with Life Cycle Assessment (LCA). The objective of this study was the combined use of local Risk Assessment (RA) and LCA to achieve a broader assessment of the sustainability of recycling contaminated wood waste into particleboard. The current scenario, in which the use of contaminated wood waste in particleboard is limited by Flemish government’s standards, is compared to a future scenario with a higher use of more contaminated wood waste. As a consequence, in the future scenario, a lower proportion of the contaminated wood waste will be incinerated with electricity (and heat) recovery. Modeling of the local air pollution is performed with the 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
K. Loksh, University of York / Department of Chemistry; X. Bengoa, Quantis; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioeconomy Systems; A. Ermont, J. F. Sees, V. Rossi, Quantis

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 limited 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 analysis has the potential to upscale these results via a holistic impact assessment 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 crucial aspects that need to be included 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 agricultural lignocellulosic biomass, or non-agricultural biomass like algae. Macro-algae is one such potential source that given they throw 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 lignocellulosic. 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 ids most hotspots 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 biomass. This requires external application of nutrients and intensive of chemical pretreatment. Today decision making of chemicals 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 payed when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and a clear understanding is required of the underlying drivers. 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 gases 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 find the most sustainable application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended for early stage assessments. 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 than economic activities. 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

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the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing the required amount of LCA data. This makes the method universally applicable.

**504 Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecoinnovations**

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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 Consumer 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/recycling 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 BoPs, the consumption of 2010 has been halved for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, by acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to unveil possible trade-offs.

**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 improved since the fall of the Iron Curtain in 1989. Sediments, however, still carry the memory of an industrial past and are often “on the move”, transported by the current and especially during flood events to downstream sites. The question, where they originate, what chemicals they carry and how much of it may still be around, has been in the focus of several previous studies (e.g. Heise et al. 2008, Hillebrand et al. 2015). Little attention, however, had been paid for long term to sediments in those ca. 1000 backwaters and flood plain lakes along the Elbe with regard to their contamination, their ecotoxicity and their mobility in times of high water discharges and flood plain submergence. Two studies, carried out in 2013 and 2014, were dedicated to this kind of structures with the task of evaluating a potential risk from these sites. Over a stretch of 230 km along the Middle Elbe, sediments from 25 backwaters were sampled, analyzed for heavy metals and for Elbe-typical historic contaminants (HCH, HCB, PCB, PAHs, DDX). Additional lines of evidence in an assessment of risk comprised the thickness of the sediment layer and sediment mobility during flood events. Dating of sediment cores by 

**506 Multiple lines of evidence for risk assessment of old sea deposits for ilmenite mine tailings in SW Norway**

M. Schaanning, H. Trannum, K. Ndenye, S. Ónevad, NIVA Norwegian Institute for Water Research

An old ilmenite mine deposit produces up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposits were sampled and reference sites were sampled for studies of macrobenthic communities, bionochemical fluxes, metal mobilization and metal uptake in gastropods and DGT probes. O₂ and pH in the sediments were measured using micro-electrodes. The tailings were easily traced in the sediments by high concentrations of fine fractions, Fe, Ni, Cu and Co. Tailings were still abundant in the top 0-1 cm of the sediments at both deposit sites, but clearly less abundant at the sediment surface than in deep deposit layers and also less in the outer basin deposit than in the fjord deposit. Compared to Norwegian and European quality standards [1], Cu exceeded MAC-EQS (“Maximum Admissible Concentration”) for coastal sediments indicating a “risk of acute toxic effect” on marine organisms. The DGT-profiles showed that Fe and Mn was recycled within the sediments, whereas Ni and Cu leaked to the overlying water from mobilization centers consistently located in the oxidised upper 1 cm of the sediments.

**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, Centre for Water Science and Water Quality, Environment Canada; W.A. Maher, University of Canterbury / Institute for Applied Ecology; A. Taylor, University of Canterbury / 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 often are inadequate due to differences between laboratory and field conditions and since the concentrations of metals that are biologically available can be highly variable depending on many factors such as pH, redox potential and temperature. The DGT device uses an ion-exchange resin (Chelex) which selectively accumulates divalent metal present in the sediment porewater and weakly-bound to the sediment particulate phase. The DGT metal flux measured at the sediment water interface (SWI) was compared to biological responses of organisms exposed to sediments contaminated with mixtures of metals, in the laboratory (amphipods and bivalves) and in the field (bivalves). To assist in the analysis of effects from the mixtures of the metals (Cd, Cu, Ni, Pb, Zn), DGT metal fluxes were normalised using water quality guideline values to account for predicted differences in the toxicity of the different metals. Strong dose-response relationships were found between normalised DGT metal fluxes measured at the SWI and biological effects on survival and reproduction of the amphipod exposed to laboratory conditions. Usefull 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.

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

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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 a core component 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 methods for contaminated sediments with 3 freshwater species, Hyalella azteca (amphipod), Chironomus dilutus (midge) and Lumbriculus variegatus (oligochoete) 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 workgroups, 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 need to have a minimum level of chloride and species of a mixture of sand, suspensite or plant, such as the oligochaete Tubifex tubifex containing approximately 2 cm sediment and 1 L aerated spring water. Tests were therefore established with the oligochaete Tubifex tubifex, supplemented with a second standard test species. Tubifex tubifex 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 diffuse 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

510 Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fluodxonil

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

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

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511 Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA

S. Bagnis, M. Fitzsimons, Plymouth University; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; A. Tappin, Plymouth University; S. Comber, Plymouth University / Environmental Science

The increasing consumption and production of active pharmaceutical ingredients (APIs) is growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DWW) which creates a heavily polluted area, named the “impact zone”. Little is known about the environmental fate of APIs in this area. Nevertheless, a few available measured environmental concentrations (MECs) of LLMICs show higher concentrations than for high-income countries with developed wastewater treatment infrastructure. Globally, the MECs of APIs in the “impact zone” are typically above 0.01 μg L⁻¹, which, if predicted, would trigger the environmental fate refinement of the environmental risk assessment (ERA). In the ERA PEC calculation, a default dilution factor (DF) of 10 is used, but in at least 53 countries worldwide, the local predicted median DF is lower than 10. There is no information available in the literature about the effects of low dilutions on the natural attenuation of APIs nor impacts of DWU. Furthermore, information on the effects of low dilution on mixtures of APIs is missing, hence necessitating the requirement for evaluation of biological endpoints for the impact zone ERA. This information is pivotal for the development of an impact zone ERA approach, and we are proposing an original attempt to expand this area of study within this paper. The lumen of the gut is supposed to show a pronounced temporal pattern and 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 diffuse 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.

512 Active Pharmaceutical Ingredients Entering the Aquatic Environment From...
Wastewater Treatment Works: Measurement, Prediction, Risk - A Cause for Concern?

S. Comber, Plymouth University / Environmental Science; M. Gardner, Atkins Ltd.; P. Sorne, AstraZeneca / AstraZeneca Patient Safety; B. Ellor, UKWIR

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 ethinylestradiol, diclofenac, propranolol, the macrolide antibiotics, fluoxetine, tamoxfen and carbamazepine. All except the last two of these substances were present in effluents at concentrations higher than their respective estimated PNEC (based on measurement of effluents from 45 WwTW on 20 occasions). The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WwTW in the UK (approximately 13% of all WWTW) may 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. 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 WWWT, as well as before and after the upgrading of the WWWT. 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 lipidperoxides allowed us to draw conclusions about proteotoxic and oxidative stress. Analyses of heat shock protein (hsp70) levels and lipidperoxides allowed us to draw biological conclusions about proteotoxic and oxidative stress (based on data generated from two large US-wide WWTW monitoring programmes). 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. 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 WWWT, as well as before and after the upgrading of the WWWT. 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 lipidperoxides allowed us to draw conclusions about proteotoxic and oxidative stress. Analyses of heat shock protein (hsp70) levels and lipidperoxides allowed us to draw biological conclusions about proteotoxic and oxidative stress.
used to water supply and has been reported as contaminated by cyantoxins 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 phytoremediation programs. Keywords: Green Liver System, Reservoir, aquatic macrophytes, phytoremediation.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health

517 Identifying hotspots of Antimicrobial Resistance Selection in the Natural Environment
J.B. Sallach, University of York / Environment; A. Boxall, University of York / Environment Department
Releases of antimicrobials into the environment increase selective pressures on environmental microbes contributing to the proliferation of antimicrobial resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding environmental AMR is the high cost and organization required to provide widespread environmental monitoring. In lieu of this monitoring data, predicted environmental concentration (PEC) modelling based on pharmaceutical usage data has been demonstrated to be a useful tool in approximating antimicrobial exposures to the environment. Recently, attempts have been made to predict no-effect concentrations (PNEC) for selective pressures in the development of AMR. Coupling PEC and PNEC values provides a powerful tool to estimate the risks associated with a particular compound or class of compounds relating to AMR proliferation. Here we use this approach to identify hotspots where antibiotic exposure may be contributing to AMR selection for a range of different scenarios. Antibiotic usage data, data on metabolism, wastewater treatment and dilution data were used to determine PEC values, which were compared with reported PNECs to determine AMR hotspots for 56 compounds used in Wales as well as 9 chemical classes of antimicrobials in European Countries. Finally, using daily flow data, the approach was applied to a single wastewater treatment utility serving a population of approximately 18,600 persons with effluent discharge into the River Foss, UK to highlight the variation patterns in daily risk associated with AMR selection. Having illustrated the utility and 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.M. Mclean, 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 resistance debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for this rapid emergence continues to be debated. It is known that soil pollution is inherently linked to co-selection for ARGs yet limited information exists on large scale multi-contaminated sites. This study used 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
A. Lufti, University of Geneva / Institut Forel; V. Slavuykova, University of Geneva / Département F.-A. Forel des sciences de l’environnement et de leau; J. Poté, University of Geneva / Department F.A. Forel of environmental and aquatic sciences
The occurrence and dissemination of antibiotic resistant bacteria and their resistance genes from clinical settings to environmental compartment have become a major concern because of serious threat human health worldwide. Given the serious clinical threat of Extended-spectrum β-lactamases (ESBL) and carbapenem-resistant Enterobacteriaceae (CRE), studies are 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. Using the occurrence of ESBL and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Democratic Republic 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 the presence of multidrug resistance and virulence genes. The results highlight a high level of clonality in strains (67 clones) and an important level of multidrug resistance regardless the sampling point. 53% of E. coli resistant to the 3rd generation of β-lactams were also resistant between 6 to 8 antibiotics. 14% of ESBL producers also carried virulence genes factors linked to E. coli pathotype determination. The genera E. coli, S. telluriophilus and S. argillaceus which are not naturally 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 aquaculture results in antibiotics and antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can be used to measure selective endpoints. This work compares previously published methods for determining and predicting selective concentrations of antibiotics to two novel methods developed in this study. The first method tracks resistance gene prevalence over time in a complex community using qPCR, and the other is based on reduction in growth of a complex community. Results show that predicted no effect concentrations (PNECs) derived using standard ecotoxicological assays are not always protective against resistance selection. Currently, no standardised method for selective endpoint determination is always protective of the other; though there is good agreement between PNEC’s (PNECs for resistance) published previously and PNEC’s determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNEC’s for environmental risk assessment of antimicrobials.

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
Antimicrobial resistance is a major concern because of serious threat human health worldwide. 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. Using the occurrence of ESBL and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Democratic Republic 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 the presence of multidrug resistance and virulence genes. The results highlight a high level of clonality in strains (67 clones) and an important level of multidrug resistance regardless the sampling point. 53% of E. coli resistant to the 3rd generation of β-lactams were also resistant between 6 to 8 antibiotics. 14% of ESBL producers also carried virulence genes factors linked to E. coli pathotype determination. The genera E. coli, S. telluriophilus and S. argillaceus which are not naturally 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.

522 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 Global Environment / Medical School; W. Gaze, University of Exeter / Medical School
Antimicrobial resistance is one of the most significant threats to modern society. Use, misuse and overuse of antibiotics clinically and in the community; in agriculture and in aquaculture results in antibiotics and antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can be used to measure selective endpoints. This work compares previously published methods for determining and predicting selective concentrations of antibiotics to two novel methods developed in this study. The first method tracks resistance gene prevalence over time in a complex community using qPCR, and the other is based on reduction in growth of a complex community. Results show that predicted no effect concentrations (PNECs) derived using standard ecotoxicological assays are not always protective against resistance selection. Currently, no standardised method for selective endpoint determination is always protective of the other; though there is good agreement between PNEC’s (PNECs for resistance) published previously and PNEC’s determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNEC’s for environmental risk assessment of antimicrobials.
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 or absence of a variety of macrolide resistance genes (ermF,ermB,mraA, msrD and mefA) from P. putida KT2440 and V. cholerae O139 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 ermA at 50μg/L but we do see significant selection at 75μg/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 mobilome.
C.H. Lau, Y. Tien, Agriculture and Agri-Food Canada; E. Topp, Agriculture and Agri-Food Canada (AAFC)
Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylosin, chlorotetracycline and sulfamethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, clarithromycin and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 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, nalidixides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e01989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. int1, 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 cassette amplification are repressed in soil following repeated antibiotic exposure. The enhanced expression of these genes associated with integron cassettes is amplified in soil following repeated antibiotic exposures. Overall, these results suggest that genes associated with integron cassette amplification are repressed in soil following repeated antibiotic exposure.

523 Inter-annual monitoring of microplastics in marine intertidal sediments of the Firth of Forth
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Microplastics (MP) are nonliving pieces 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 MP database. We present the results of a three-year pilot project in the Firth of Forth, point to innovations in sampling and contamination prevention, as well as the limitations. Sediment samples were obtained in triplicate from intertidal sites in May2014, May & Sept2015, May & Sept2016, 2017 using glass bijoux tubes as miniature cores and sealed with metal screw caps, processed using a density separation procedure and the polymer types determined using FT-IR spectroscopy. The results showed that there are high numbers of plastic particles (34-4,800 kg^-1) and fibres (1,700-4,300 kg^-1) along both shores of the Firth of Forth. The number of Fibres was generally higher in the particles. There was no apparent pattern of spatial disintegration. Although a spike in MP particles was observed in May2015 and May2016, there was 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.
M. Déniel, Institute of molecules and materials of Le Mans / Physique des Interfaces et des MésoStructures; N. Errien, Institute of molecules and materials of Le Mans; A. Caruso, laboratory Mer Molécule Santé; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMM UMR CNRS
Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylosin, chlorotetracycline and sulfamethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, clarithromycin and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 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, nalidixides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e01989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. int1, 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 cassette amplification are repressed in soil following repeated antibiotic exposure. The enhanced expression of these genes associated with integron cassettes is amplified in soil following repeated antibiotic exposure. Overall, these results suggest that genes associated with integron cassette amplification are repressed in soil following repeated antibiotic exposure.

526 Interactions of carbon nanoparticles and benzo(α)pyrene on marine mussels, Mytilus galloprovincialis A. Barranger, University of Plymouth / School of Biological Sciences; Y. Aminot, University of Plymouth; M. Banni, Laboratory of Biochemical and Environmental Toxicology; S. Sforzini, Universita Del Piemonte Orientale Amadeo Avagnado / Department of Sciences and Technological Innovation (DiST); V.M. Álir, Kings College London / Chemistry; 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. The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns over their potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) can interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels were exposed for 3 days to benzo(α)pyrene (BaP) and two different types of carbon nanoparticles, [C60 fullerences and multi-walled carbon nanotubes (MWNNTs)], both alone and in combination with BaP. Tissue specific distributions and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GCMS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology targeting 15 stress response pathways. Contrasting results were obtained: GSEA pointed to the use of different carbon nanoparticles used. Co-exposure of mussels to MWNNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to C60 and BaP does not seem to affect the uptake and genotoxic effects of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g. DNA metabolism, cytoskeleton, oxidative stress and heat shock response) as well as pathways of interest. In order to have a better understanding of the effects of these 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, Université Catholique de L'Ouest / Université Catholique de l'Ouest; A. Baun, Technical University of Denmark / DTU Environment; J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences; H. Selsk, Roskilde University / Dept Science and Environment Nanoparticles (NPs) will inevitably end up in the aquatic environment, where they will settle out and accumulate in the sediment. Therefore benthic fauna is at particular risk. The uptake of carbon-based nanoparticles in sediments has been reported for different benthic invertebrates, which serve as foraging organisms of fish. Here we examine if transfer of copper (II) oxide (CuO) NPs and dissolved copper (administered as CuCl2) can occur from sediment to worms (Tubifex tubifex) and further from worms to fish (Gasterosteus aculeatus). CuO NPs (< 50 nm; Sigma) were characterized with regard to primary particle size, shape, hydrosolubilic diameter and dissolution at different experimental conditions using TEM, DLS, PALS and ultrafiltration followed by ICP-MS analysis, respectively. Worms were exposed to sediment amended with CuO NPs or CuCl2. Cu concentrations in sediment, overlaying water and worm tissue were determined using ICP-MS. In addition, the metal binding protein metallothionein (MT) was quantified with DPP (differential pulse polarography). Fish were exposed for up to 7 days to worm-shaped CuO NP and CuCl2-spiked food packages produced from uncontaminated tubifex homogenates (2 μg Cu/g fish/day). Cu concentrations were measured in intestine, liver and carcass using ICP-MS. In addition, intestinal and hepatic mRNA expression levels of genes relevant for Cu uptake, storage and toxicity including metallothionein A (mta) were measured using RT-qPCR. The total Cu body burden of tubifex increased by 3 and 3.5 μg Cu/dw tissue after 7 days of exposure in CuO NP- and CuCl2-spiked sediment, respectively, suggesting that NP uptake into the organism occurred. Cu accumulation was also observed in fish receiving CuO NP and CuCl2-spiked food packages, in particular in intestine, and was concomitant with upregulation of mta transcription. The increase in intestinal Cu concentration and mta expression in CuO NP-exposed fish is higher than in the control, but did not reach levels measured in CuCl2-exposed fish. At the same time the amount of Cu egested with the faeces was significantly higher than in the CuCl2-treatment. These results suggest that transfer of CuO NP along the food chain may be limited compared to dissolved Cu. We suggest future studies on how NP bioavailability and accumulation in fish is influenced by other important factors, such as exposure dose, time and NP properties upon biotransformation by the foraging organism.

528 Corbulica fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study J. Wolter-Divo, Lie - Université de Lorraine - CNRS / LIEC, CNRS; S. Pain-Devin, Université de Lorraine / UL / LIEC - CNRS - UMR 7360; B. Sohn, University of Lorraine / LIEC, CNRS; S. Devin, Lie, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; M. Auffan, CEREGE / International Consortium for the Environmental Implications of Nanotechnology; C. Mouneyrac, Université Catholique de l'Ouest / UBL, Mer Molécules Santé; L. Giambartini, Université de Lorraine / CNRS, Engineer nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic freshwater bivalve Corbulica fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosms containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 μg Cu/O 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 both in terms of growth, inducing an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

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

529 Applications of Luminous Bacteria Enzymes in Toxicology and Ecology V. Kratasyuk, Siberian Federal University / Biophysics; E. Imbekova, Siberian Federal University / Biophysics. A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to obtain, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)H:FMN-oxidoreductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymolum was used to facilitate and accelerate the development of the bioluminescent enzymatic nanoparticles. Applications of Luminous Bacteria Enzymes in Toxicology assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

530 Toxic and adaptive effects via luminescent assay systems of different complexity - from cells trough enzyme reactions to proteins

114 SETAC Europe 28th Annual Meeting Abstract Book
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 bioguidance is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in bioguidance is explained by a number of reactions to external stimuli and to the type of cells 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 fulmantgent fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chalarosporiense, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi from 1000 times dilution containing medium had a leading variation of sucrose (0.3 and 3%) and humic substances (0.02 and 1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 300, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spores suspensions of the NPs original) and 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 chromophores like NADH and or melanin. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon.

Therefore we consider this research as promising on the way of using fungal fluorophores to assess responses of filamentous fungi to external stimuli.

533 Effect of surface functionality on Fe3O4 nanoparticles toxicity

L. Kulbakov, Moscow Aviation Institute; P. Uchano, Institute of Ecology and Evolution RAS / Laboratory for soil ecological functions; S. Patsaeva, Lomonosov Moscow State University / Depament of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; K. Kudryasheva, Institute of Chemistry and Chemical Technology; and agar Cracep medium contained a varying level of sucrose (0.3 and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 300, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spores suspensions of the NPs original) and 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 chromophores like NADH and or melanin. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon.

Therefore we consider this research as promising on the way of using fungal fluorophores to assess responses of filamentous fungi to external stimuli.
Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
C. Porto, IDAEA-CSIC / Department of Environmental Chemistry; M. Blanco, IDAEA - CSIC; A. Maceda- Veiga, University of Barcelona / Department of Animal Biology
New developments of analytical techniques have allowed the effective identification and characterization of lipids and the development of lipidomics, which has recently emerged as a key technology for human disease research and discovery of biomarkers. However, on an environmental 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 response of two fish species (Barbus meridionalis, Squalius 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-plasmalogens (PC-P), cholesterol esters (CE), triacylglycerols (TG), diacylglycerols (DG) and sphingomyelins (SM) were detected in the muscle tissue. Partial least squares discriminant analysis (PLS-DA) allowed a clear separation of the lipidome of fish from polluted and reference sites. Specifically, a relative increase of Ce’s (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:4, 36:5, 38:6) was detected in the muscle of B. meridionalis sampled in polluted sites. In contrast, the lipidome of S. 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). 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.

Lipid profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes
N.D. Denslow, M. Nouri, University of Florida / Physiological Sciences; K.J. Kroll, University of Florida / Physiological Science; C.J. Martynik, University of Florida / Physiological Sciences; V. Dang, Iowa State University
The organochlorine pesticide (OCP) contamination of Lake Apopka largely derived from high application use in the muck farms on the North Shore. These practices were discontinued in the 1970’s but fish in Lake Apopka continue to have relatively high body burdens of organochlorine contaminants. Previous transcriptomics experiments have indicated that the OCPs alter endocrine related endpoints in ovary and liver of exposed fish. In addition, changes in lipid transport and metabolic pathways are affected. Current work explores changes in the lipidome of largemouth bass caught in Lake Apopka compared to fish from a relatively clean lake in the Ocala National Forest. We used both a shotgun approach and a targeted approach to quantify perturbations in phospholipids in liver of largemouth bass from Lake Apopka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol was decreased and cholesterol esters were elevated in the livers of fish from Lake Apopka compared to Wild Cat Lake. This finding corroborates reduced hormone biosynthesis in organochlorine contaminated fish. Other changes in the lipidome are consistent with predicted changes that are related to immune dysfunction. Enrichment in Lake Apopka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylethanolamines. But decreases were observed in sphingomyelins, phosphatidyl-ethanolamines and other phospholipids. These changes are consistent with lipids that are changed due to inflammation and other immune responses. We postulate changes in the lipidome are important biomarkers of OCP contamination.

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

Nanotechnology: When shading effects through agglomeration of carbon nanotubes (CNT’s) are confused with toxicity by media and the public - a case example revisited
S. Schwab, Adolphe Merkle Institute / Materials Science
Engineered nanomaterials are relatively new contaminants with that can enter the environment via an increasing variety and number of waste streams. The long-term toxicity of nanomaterials is not well understood, and these materials are therefore of emerging public concern. In 2011, we published a press release about our scientific publication on the effects of carbon nanotubes on green algae [1]. We found that the nanomaterials under investigation did not directly affect the algal viability, but indirectly reduced the algal growth via shading and agglomeration. To our surprise,
this press release led to a cascade of secondary articles and events. On the one hand, some online newspapers used our article to produce alarming articles about the dangers of nanoparticles for the environment (example translated from German: “Nanoparticles Identified as Potential Environmental Killers” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that we got to this press release, and re-iterate the short- and long-term lessons learned from this case study. Most importantly, the ‘real’ work for a scientist writing a press release starts after its publication. News on topics of public concern such as the toxicity of engineered nanomaterials are very closely watched and instrumentalized both by the pro- and the anti-nano community for their respective intentions. Reactions on press releases concerning these topics have to be monitored closely, wrong quotations must be corrected and biased interpretations must be adjusted, in order to provide correct scientific information for the common public. The reward for this work is an overall more balanced communication thereafter. [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.lifegen.de/newsish/shownews.php?4&getnews=sm2011-11-09-3109&ps=02. Accessed 22 Nov 2017

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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 misunderstood CNTs to be toxic. As a result, Dr. Schwab and her colleagues were accused of fear-mongering. Things escalated to the point that Der Spiegel had to shut down the article’s comments section. Where did things go wrong? How can scientists make sure the media presents their work accurately, but also in a way the general public can understand? We will discuss the diverging roles and realities of science and media, particularly the considerations that scientists and editors need to take into account when they decide to write/publish something.

543 Discussion Nanotechnology

544 Microplastics: The risks of plastics – perceived or real?

M. Kotteman, IMARES / Fish

Plastic has not only become a major research topic, it is also broadly covered in popular news. As result the general public knows about the plastic soup and how dangerous it is, supposedly, for wildlife and ultimately for human health. However, the history of plastic research is peculiar. Some of it was straightforward; wildlife choking in plastic does not need much additional proof or QC QA. But, as with many new research topics, the first articles about the dangers of plastic were soon followed by others. The focus was on the presence of small plastics particles even in seafood, honey to even drink 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.

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 talks, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

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

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

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

547 Discussion Microplastics

548 General discussion with panel of all speakers about topics emerging from the session

549 Wrap-up and closing

A. Leopold, Calidris Environment BV / Calidris Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Ajao, ECHA-European Chemicals Agency

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (I)

550 Development of a diagnostic toolbox for ecological effects of pollutant mixtures and application to evaluate results from the third Joint Danube survey

A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; T. Seiler, RWTH Aachen University / Ecosystem Analysis; E. van den Brink, Alterra Wageningen UR / Alterra Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
How can we identify "drivers of mixture risks"?

T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; R. Altenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health

Mixtures relevant for human health or the environment can easily contain dozens or even hundreds of chemicals. However, those components do not contribute equally to the overall toxicity of the mixture. For instance, some substances may under certain conditions alone be without observable effects. These ob­-1-1­onomic thresholds of effect can still be of concern and contribute to combined effects. Environmental compartments usually contain mixtures of chemicals with low, possibly non-toxic concentrations of the individual components, any approach to assessing the combined biological 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 de­-1-1-1-react, phytoplankton blooms, or others, may also cause a failure to achieve 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 improved, health-based and formalized assessments could (WoE), and how the concept could be operationalized. In the presentation, we will provide the background of existing approaches to define “mixture risk drivers” and explore the consequences of their application to a real-world dataset (Swedish pesticide monitoring data). In particular, we will demonstrate that the use of Concentration Addition, which is common in all approaches, might not always be justifiable for the ranking of mixture components. Additional we will discuss: (i) the sensitivity of the various methods to data gaps, (ii) the challenge of tiering the various approaches for risk driver identification, and (iii) the question whether a risk-based ranking is the optimum approach, or whether hazard- or exposure-based methods can be suitable alternatives. In summary, we conclude that, although the identification of drivers of mixture risk would constitute a major step forward to systematize and simplify the seemingly overwhelming complexity of chemical exposures occurring in the Danube, 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 capability.

Towards the development of a framework for applying non-target chemical analysis data within exposure and risk assessment

T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; R. Parmar, ARC Arnot Research Consulting; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

There is an increasing trend towards multi-targeted and non-target analysis (NTA) screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the opportunities in 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. Therefore, in this project, for the purpose of better understanding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.

A common framework for the assessment of human and ecological risks from pollutant mixtures in European surface waters - case study with > 300 chemicals co-occurring in the Danube

A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermler, Brunel University London / Institute of Environment, Health, and Societies; D. De Zwart, DfZ 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

Wildlife is exposed to an infinite number of different combinations of chemicals. There is evidence that single substances that are present below their individual thresholds 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 assessment approach. The national and the international aquatic hazard classification, 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 (RQmix) 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 RQmix>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 for the appropriate use of NTA data within exposure assessment recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.
assumptions about modes of action are introduced. We tested the utility of the scheme by using data on the levels of more than 300 chemicals that occur together in the river Danube, from the Joint Danube Survey 3 (JDS3). For each of the 54 sites along the river Danube we ranked the chemicals in terms of their contribution to a mixture effect, separately for algae, daphnia and fish. We found that the overall mixture toxicity was driven by only approximately 10 chemicals. Substances not yet defined as priority substances under the EU Water Framework Directive made a substantial contribution to combined exposures. We also assessed possible combined risks to humans by evaluating whether water drawn from the Danube would be fit for human consumption. Overall, exposures of concern for humans could not be detected at higher tiers of the assessment. We conclude that the protection goals defined in the Water Framework Directive for freshwater aquatic communities are not achieved for combined exposures at many sites along the Danube.

555 Pesticides do rarely come along, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX

B. Scholze-Starker, RWTH Aachen University; T. Hodson, University / Institute for Environmental Research / Institute for Environmental Research; S. Bar, German Federal Environment Agency UBA / Section Plant Protection Products; B. Daniels, RWTH Aachen University / Institute for Environmental Research; T. Frischke, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Rödl-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schaffner, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Sybertz, RWTH Aachen University / Institute for Environmental Research; C. Ullich, German Federal Environment Agency UBA / Section Plant Protection Products; S. Knüllmann, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology.

In the European Union, legislation so far strictly regulates plant protection by means of chemical pesticides on the level of single products. Common agricultural practice and manifold pest pressures lead to the exposure of non-target organisms to complex mixtures in a spray series. In the on-going COMBITOX project, we collated a dataset for the actual application patterns of pesticides in 12 representative crops in terms of 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 pressures. Combining all information on empirical use patterns and their regional and temporal variation, we calculated indicators of use intensity and environmental risk. Toxicity exposure ratios (TER) were calculated using standard toxicity data (aquatic & soil organisms) from two publicly available databases AQuaDB (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 accounted according to the standard approach as conducted by the UBA within the PPP-authorization procedure in Germany. In sum, 29 risk indices were computed (TER-values). Mixture risk indices were calculated based on the concept of concentration addition from single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixtures and spray sequences are predominantly in all crops that were considered in our studies. From the data, we revealed that crops group together in classes of use patterns. The cereals received a wide range of different pesticides classes in medium intensities during the whole spraying sequence; vine and apple orchards were dominated by fungicides and high-intensities. Risk exceedances became relevant if multiple individual TER-values (TERsingle) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixtures for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimens as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

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

556 Time-dependent effects of two fungicides and their mixture on enchytraeid and earthworm communities under field conditions

J. Amoss, S. Bart, INRAAgroParisTech; C. PELOSO, INRA (Institut National de la Recherche Agronomique), INRA, INRAAgroParisTech.

According to the current regulation for the registration of plant protection products on the market, the environmental risk assessment of pesticide use is generally performed under laboratory conditions. Very little information is available in natura, where multiple stresses occur. In this study, we assessed the effects of two commercial formulations of fungicides, i.e., Cuprafor Micro® (composed of 500 g/l oxycarboxin and 80 g/l diminosystrobin), and Sinella curviseta (composed of 50 g/l diminosystrobin and 133 g/l dimoxystrobin), 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 lamina method. Our results showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 ha-1 of Swing Gold® and 4.24ha-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 annecic earthworms was only observed at t6. No lethality was observed later at t12. We showed no overall significant difference in total feeding activity, enchytraeid density and diversity between treatments with or without pesticide at different sampling periods. In the Swing Gold® treatment, earthworm community did not recover twelve months after pesticide application. We suggest thus going beyond the ISO norm 11268-3 (2014) - for the study of the effects of pollutants on soil communities under field conditions - i.e., considering Oligochaeta community and other functional endpoints (e.g. organic matter decomposition with the tea bag method) over two years to better assess environmental risks of plant protection product use and their mixtures. Keywords: Cuprafor Micro®, Swing Gold®, agroecosystems, feeding activity

557 Toxicity of imidacloprid and thiacloprid towards four Colembolan species C. Lim, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Mainardi, Vrije Universiteit Amsterdam / Department of Ecological Science; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Folsomia candida has been used for assessing the toxicity towards non-target soil macroinvertebrates, during the whole spraying sequence; vine and apple orchards were dominated by fungicides and high-intensities. Risk exceedances became relevant if multiple individual TER-values (TERsingle) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixtures for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimens as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

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European Society 28th Annual Meeting Abstract Book
exhibited avoidance behaviour when exposed to acetoniprid or dimehtoate. 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 N. viridula by quantifying movement behaviour changes in T. pyri. We are also adding to the knowledge relating to movement avoidance, 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 Haploaspis aculeifer tests be considered in order to keep them in Tier I test battery for ecological risk assessment of PPPs? T. Natal-da-Luz, CFE - Centre for Functional Ecology / Department of Life Sciences; T. Gevaert, CFE Centre for Functional Ecology and Hogeschool Gent, Education, Health and Social Work, University College Ghent; C.S. Pereira, CFE - Centre for Functional Ecology / Department of Life Sciences University of Coimbra; M. Amorim, EFEA - 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 Haploaspis aculeifer (OECD 226) is currently being included in the new EU data requirements for the ecological risk assessment (ERA) of PPPs. However, the low sensitivity often shown by this mite towards PPPs, when compared to other invertebrates, makes the test with this species, as it is currently performed, not very useful for tier I test battery. The current test protocol does not take into account the fact that H. aculeifer is a predatory species, and only considers exposure to contaminants via ingesting contaminated food, but does not take into account exposure via feeding on contaminated preys. Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites Tyrophagus putrescentiae) from uncontaminated breeding containers over the test period but, in a real scenario, this exposure is simultaneous for H. aculeifer and their preys. Thus, through this protocol, the toxicity of contaminants to H. aculeifer might be underestimated. The present study aimed to evaluate the importance of oral exposure to the contaminant as an exposure route to be considered in reproduction tests. Two reproduction tests with H. aculeifer were performed (OECD 226) using artificial soil spiked with increasing concentrations of Cu (450–5126 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 reported in reproduction test H. aculeifer (OECD 226) is inappropriate for the species. Our results can be used as a basis in the elaboration of an EU proposal for inclusion of oral exposure via feed contamination in the reproduction test protocol, to improve its sensitivity for the detection of hazardous PPPs.

560 Plant protection products in agricultural soils - Do active ingredients show a comparable pattern in worms and in soil? T. Schmidt, IES Ltd / Ecotoxicology; H. Viric Gasparic, University of Zagreb Faculty of Agriculture / Department for Agricultural Zoology; R. Bazok, University of Zagreb Faculty of Agriculture / Department of Agricultural Zoology; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology, S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology

The environmental risk assessment of plant protection products on soil organisms is mainly based on the outcome of laboratory and extended laboratory studies (EFSA 2017). However, the link from the laboratory to realistic field conditions over several seasons is not well established. Currently no validated trigger for bioaccumulation studies according to OECD 317 is available (EFSA 2017). One possible approach for filling this gap is proposed by combining experimentally determined residue data from earthworms and data from degradation studies in the field. Earthworms were sampled at different seasons from eight fields in Croatia and analysed for 26 active ingredients. The concentrations of 26 analysed active ingredients were in the range from 0.000-0.247 mg/kg worm fresh weight with a mean of 0.005 mg/kg. The percentage of samples with values below the limit of detection (LOD), values below the level of quantification (LOQ) = 0.001 mg/kg) and values above LOQ was 29, 42 and 29 %, respectively. Based on publicly available draft assessment reports from EC and EFSA, degradation parameters (DT50, DT90) were used to calculate degradation curves and the current concentration in soil at the date of worm sampling. By comparing analysed residues in worms and calculated concentrations in soil, a substance-specific bioaccumulation factor could be calculated. In the case of imidaclopir, the analysed residues levels in earthworm samples from the fields tended to increase with time whereas the calculated concentrations in soil decreased with time as expected, resulting in a supposed increasing bioaccumulation potential of imidaclopir under field conditions. The procedure proposed here – in the absence of analysed soil data – is a simple estimation which combines field history data with data from publicly available draft assessment reports. This approach may be useful for the assessment of the bioaccumulation potential of an active ingredient from a plant protection product under realistic field conditions.


Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances 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 oligochaetes according to OECD 317 that are comparable to the BvB criteria in the scope of the PBTT guidance revision. For this aim, the study comprised the following soil via steps: 1) Literature research on available bioaccumulation factors (BAFs) both in open scientific literature and in regulatory data from several OECD 317 studies and performance of correlation analysis between soil-/substance-properties, BCF and BAF values. 2) Performance of bioaccumulation studies according to OECD 317 with the earthworm Eisenia fetida using the four model substances endosulfan, methoxychlor, o-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. Additionally, no correlation was found between substance-specific BCF from fish studies and BAF determined with earthworms. Therefore, lipid- and Cm-normalized BSAF should be used for the assessment of terrestrial BAF. Kinetic BSAF from both experimental studies and literature-derived values ranged from 0.21 to 14.8. Based on the data evaluated in the present work, a BSAF trigger value of 1.00 is proposed as a general trigger to index bioaccumulation in terrestrial organisms. Other objectives like non-deputed residues at the end of the elimination phase are discussed.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy

562 Developments and recommendations on the practical use of Social LCA S. Di Cesare, CBARD / Department of Economic Studies; A. Zamagni, Ecoinnovazione / LCA and Ecodesign Laboratory; J. Garcia, SCORE LCA; F. Silveri, University of Chieti-Pescara / Department of Economic Studies; A. Lanfranconi, Ecosan; C. Petri, University of Chieti-Pescara / Department of Economic Studies

Social Life Cycle Assessment (Social LCA) is a multi-criteria, multi-stakeholder and multi-step methodology that provides useful, transparent and science-based information on social and socioeconomic performance of a product throughout its entire life cycle. In this study, a systematic literature review was carried out dealt with within these aspects: the scope of S-LCA, its purpose, the social dimension outside S-LCA (i.e., analytical tools, procedural and managerial tools, currently used for monitoring, assessing, reporting and communicating social aspects, and their main differences with respect to S-LCA); impact assessment methods; users and uses of S-LCA. In addition, an experimentation was conducted through a practical case study based on literature, with the following goals: (1) to test the applicability and practicability of S-LCA in the case study, (2) to highlight the methodology to identify social hotspots along the whole life cycle, and in particular in the phases of the life cycle, such as raw material production and end-of-life; (3) to show how these results may complete environmental LCA and other social approaches. The product chosen is a Photovoltaic (PV) Module. The analysis carried out clearly pointed out that S-LCA is an evolving field, and main developments are envisaged, both at the level of methodology and results’ interpretation and communication. More in detail, the main limits of the S-LCA methodology identified in this analysis are...
related to: methodological framework for S-LCA, goals&scope definition (in particular regarding the system boundary definition), data access, and use of qualitative data, methodologies and selection of indicators for the impact assessment phase. The strengths of the methodology are related to its capability of making the assessment of the product more complete, adding its social aspects to the environmental and economic ones, in addition to the increased transparency and traceability of all 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

S. Neugebauer, RWTH Aachen University / INAB - Institute for Sustainability in Civil Engineering; M. Traverso, RWTH Aachen

Giving that extirpation is particularly challenging for 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 supply chain including social impacts considering negative as well as positive consequences. Existing social indicators are included, addressing relevant stakeholder groups and impact pathways, e.g. fair wage. New indicators are defined where needed, e.g. to represent the rights for indigenous people affected. The assessments are performed by means of secondary databases, e.g. Social Hotspot Database, and by including primary data gathered at production sites of the European leather producer. The results will provide the challenges and chances of European leather production including the different stakeholder groups affected (e.g. workers) but also positive/negative directions of each social impact category defined (e.g. fair wage as a positive and negative indicator and utility as a purely positive indicator). The SSA is based on the S-LCA of European leather production using life cycle impact assessment tools and 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. Hettinger, 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 ubiquity and complex supply chain, to promote 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. toggle next section

Over the past ten years, we have created a research team dedicated to sustainability and lifecycle assessment has been supporting the process and product research within the group. However, with more than 1,000 researchers in 12 research centers globally and hundreds of projects carried out every year, it is impossible for a single team to cover systematically the research performed. To this goal, the “Sustainable Innovation Tool” has been developed to enable the researchers of the group to self-assess their projects sustainability. Using the tool, they evaluate environmental and social aspects of their new processes and products and engage in a learning curve for an improved sustainable performance. The presentation will describe the collaborative development of the tool, the different phases of testing and the current start of the deployment across 6 research programs. We will draw on this experience to provide elements that supported its success, pitfalls to avoid. The company is at the start of this journey and seeks a continuous progress, and possible paths for a better integration between our current assessment of industrial research and generic frameworks such as the sustainable development goals will be discussed.

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

L. Mosqueda, 2.0 LCA consultants; B. Weidema, Aalborg University; A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCHUPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fullana, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI

We present a social footprint assessment of implementing a deposit-refund system (DRS) applied to beverage packaging waste in Spain. In a DRS consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. The social footprint developed by Weidema et al. (2010) is an example of how to carry a sum of social costs of income redistribution and the sum of all productivity-reducing externalities related to an activity. It is calculated by a top-down approach using input-output data. This method can be understood as a’ streamlined’ social LCA. We applied its two general components: the income redistribution impact (IR): the increase (or loss, if negative) in utility caused by the transfer of money from one societal group to another, and the productivity impact (loss) from missing governance (PG): the difference between the actual purchasing-power corrected value added and the potential value added when all productivity impacts are internalised. The social footprint of an activity can be defined as SF = IR + PI. 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 v3.3.10, 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). The social benefit of the deposit-refund system, 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 (EPQ) 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-polar organic chemicals under different scenarios (e.g., biotransformation, half-life) and then the results considered with a previously developed in vitro mass balance modeling tool based solely on equilibrium partitioning. We also applied the
EQP model to a specific ToxicCast 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 toxiconicokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable for predicting passive uptake and static exposure-relevant toxicity metrics for QIVIVE (e.g., membrane concentrations). Of the 306 chemicals included in the ACEA_T47D_80hr_negative assay simulations, approximately 2/3rd had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/narcosis). 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; M. 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 to static exposure-relevant toxicity concentrations (CeQIVIVE), which are considered more meaningful dose metrics than nominal concentrations. In vitro exposure assessment might be challenging for pesticides and pharmaceuticals that are active chemicals, 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 equilibrium partitioning behaviour of hydrophilic acids is assumed to be 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 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., CeQIVIVE). 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: diclofenac, 2,4-D, ibuprofen, naproxen, taroxamid, warfarin, tricosan, and gentamicin. Calculations for the equilibrium between 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 given with the predictions from a mass balance model approach. However, saturation of the medium was observed at high chemical concentrations and further experiments will be necessary to investigate for which chemicals and at which concentration levels saturation occurs and if it is required to incorporate non-linear binding into existing exposure models for in vitro bioassays.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; S. Steffens, RWTH Aachen University, Institute for Environmental Research / Institute of for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis; E. Salomons, OpWasser; N. Ruchter, Universität Duisburg-Essen / Aquatic Ecology; M. Schumann, University of Duisburg-Essen / Aquatic Ecology; R. Doering, RWTH Aachen University / Institute of Hydraulic Engineering and Water Resources Management; C. Bruell, RWTH Aachen University; H. Schuettumpf, RWTH Aachen University / Institute of Hydrochemistry; B. Rass, University of Osnabrück, Technion Israel Institute of Technology / Civil and Environmental Engineering; H. Holler, 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 ten-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) compared to static exposure, but also in comparison to the proposed automated semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the robot and system can be used for 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 made 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. Begnaud, Firmenich / DRAP; D. Debonneville, Firmenich / Research and Development; F. Berthaud, V. Laubscher, Firmenich SA / DRAP; J. 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, RTG-2, 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 RTG2GC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer combined diffusion controlled permeation and intestinal biotransformation. The involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of this model, which correlated with the logKow. The chamber enabled stable exposure concentrations and close to full recovery at the basolateral side. Therefore, the setup might be a valuable tool for screening toxicological and ecotoxicological endpoints for fish 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 in vitro technology for use 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. Schulz, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; L. Beckers, Helmholtz-Zentrum für Umweltforschung GmbH - UFZ / Directed Analysis; 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. muz, UFZ / 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. Valitato, Finnish Environment Institute / Laboratory Centre; K. Walz, MAXX Mess- und Probenahmeeinrichtung 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 (LVSPSE) as a

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promising technology to overcome the disadvantages of traditional sampling techniques with respect to EBM. The first challenge is the demand of water to be enriched which is dependent from the number and extracts consumption of the bioassays used for the assessment. The second challenge is the recovery and carry-over of the potential toxicity from the water sample to the vessels or wells of the bioassay. The third challenge is the representativeness of the sample. The successful implementation of EBM strategies requires the availability of automated sampling devices which allow the sampling of larger water volumes, guarantee the sampling integrity and makes it possible to take representative samples over a longer period or during events such as heavy-rain- and flood-events. A solution to overcome the disadvantages of classical sampling methods and devices is the recently released LVSPe approach and apparatus. It brings the SPE onshore, allows full control of the sampling process 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 earlier 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 400554-214).

From detection to action: advancements in assessing and managing highly fluorinated compounds
574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils
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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 prioritization of firefighting training activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFASs could surpass the concentrations of legacy PFASs by orders of magnitude, indicating the need for in-depth characterization of their transport potential and effects in ecosystems. The methods currently available for the analysis of perfluorooalkyl acids (such as PFOS or PFOA) could, however, seriously underperform for certain newly-identified PFASs. Severe discrepancies were noted as regards the extraction efficiency of cationic and zwitterionic PFASs between soils of variable textural class and organic matter (OM) content, which could not be compensated through soil digestion to the lack of matching internal standards. If consistent, a method recovering these compounds cannot be ensured in a set of environmental samples of variable physicochemical characteristics, any comparison drawn between samples (e.g., inter-site differences) could be questionable. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., AFFF-nonparticulate coefficients, soil sorption bioavailability factor). Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs from AFFF-impacted soils and 28 industrial textiles have been analyzed in-house with AFFFs and aged. The optimized method presented quantitave 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-like (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFHxSxN) PFASs at such sites.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination
R. Janssens, Hochschule Fresenius, University of Applied Sciences; S. Lebertz, SGS Institut Fresenius; T. P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology Perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their contribution to water contamination, there have been studies dealing 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
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Rapid declines in legacy poly- and perfluorooalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and this is particularly important for mitigation strategies. PFASs (SPFAS) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faro 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. Perfluorocarboxylic acids (PFCAs) with nine or more carbons (C≥9) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, r=0.72). Toxicokinetic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and this is particularly important for mitigation strategies. PFASs (SPFAS) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faro 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. Perfluorocarboxylic acids (PFCAs) with nine or more carbons (C≥9) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, r=0.72). Toxicokinetic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a
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 ionicogenic, and act as surfactants. As a result, octanol-water partition coefficients (K_{ow}) cannot be determined experimentally. Due to the lack of experimental data, QSARs to predict K_{ow} are not properly calibrated for any perfluorinated ionicogenic compounds. Furthermore, the dissociation constant (p_K_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 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 ionicogenic 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 require concentrations of ions in a solution, 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 p_K_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 p_K_a of alternative PFASs, e.g. GenX. The negative charge density on the electronegative fluorine atoms exerts a great pull on electrons of any ionizable group, thereby e.g. rendering perfluorooctanoic sulphonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

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

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Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctanoic sulphonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS residues, and high concentrations in marine environments, as revealed by time-series and 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 order to understand this 3D nature of emissions, we use the latest release data and 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 corresponding needs for research in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the past 25 years and many aspects were refined: the inclusion of nanomaterials among the modelled substances, the development of models at different spatial and temporal scales, the estimation of chemical properties and emission data, the incorporation of additional environmental media and processes, the integration of sensitivity and uncertainty analysis in the simulations, etc. However, some issues are still challenging and require research efforts and attention: the need of methods to estimate partition coefficients for polar and ionizable chemical in the environment, a better description of bioavailability in different environments as well as the requirement of injecting more ecological realism in exposure predictions to account for the complexity of ecosystems and effects and functions in risk assessment. Finally, to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for risk assessment.

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

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Introduction Both REACH Regulation and the Biocidal Products Regulation require 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) 2010 that has treated the assessment practices for these three policy areas at that time. EUSES last relevant update was in 2004, so that the tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function efficiently, both for applicants/registrants, MScAs and ECHA. EUSES has several modules (release estimation, fate and distribution, effect assessment and risk characterisation). 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.
582 Advances in exposure assessment of fertilizers: development of a fertilizers environmental exposure tool and generic exposure scenarios under REACH

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Fertilizers are considered as formulations and therefore no registration or chemical safety assessment is required under REACH. However, use of the individual constituents needs to be covered in the chemical safety reports (CSR) of the respective substances. Currently, exposure and risk assessment of fertilizer uses is mainly described in a qualitative way because of the lack of appropriate environmental release categories (ERCs) and exposure models. Under the umbrella of the European Fertilizer Industry and the FARM REACH consortium, the fertilizers sector has developed a fertilizer sector uses map. In addition, four sector specific ERCs (SPERCs) were developed, by grouping similar uses, mainly based upon their physical form and application mode. Next, a Fertilizers Environmental Exposure tool (FEE tool) was developed, since in the standard REACH models for environmental exposure assessment (EUSES, ECETOC TRA, CHESAR), no local scenarios for direct fertilization (such as hydrogen) was possible to test and the framework provided guidance for exposure assessment. The scheme serves as a useful base to guide additional exposure requirements and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. 


583 Bioaccessibility of grease thickeners and the implications for REACH regulation

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An intrinsic component of greases are the grease thickeners which include a diverse range of substances including metal soaps, metal-complex soaps and polyureas. These different thickeners impart different technical properties on the final grease. Although individually registered under REACH as isolated substances (i.e. extracted from base oil), grease thickeners are typically manufactured in situ in base oil and seldom exist except within a grease base. Under normal environmental conditions, grease thickeners would be expected to remain within the grease base because of their entrainment in a grease base. However, the persistence of grease thickeners in the environment depends on their behavior during the base oil manufacturing process, unique physicochemical properties (or matrix effects) occur between the grease thickener and the base oil. These interactions are important because, to be effective, the grease thickener matrix has to keep the lubricating base oil entrained. It is proposed that these matrix effects have a significant impact on the bioaccessibility of the grease thickener substances in situ in base oil in comparison to their isolated form. These matrix effects are expected to decrease the bioaccessibility of the grease thickener as it is not available to cross an organism’s cellular membrane. The European REACH Grease Thickeners Consortium (ERGTC) have characterised the bioaccessibility of their grease thickeners by conducting leaching studies based on a Water Available Fraction” (WAF) approach, but using relevant media i.e. deionised water for the environment or synthetic fed state intestinal fluid (FaSSIF – Biorelevant, Switzerland) to assess exposure routes via the gut (human health). Data is presented for different types of thickener substance which shows that most thickeners will not be bioaccessible and therefore, there will be minimal exposure to these substances. As the main form in which grease thickeners are manufactured and used, is

enttrained in a grease base, it is proposed that a lack of exposure based on low-solubilities and/or bioaccessibility is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed “limits for leaching”. This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil

584 The durability criteria: a pragmatic and sound approach to the exposure assessment of nano-enabled agrochemicals

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After many years of research and development, nano-enabled agrochemicals are starting to make their way into the market. Evaluating nano-enabled agrochemicals against conventional analogues is essential to assess the new risks and benefits associated with the technology, and this raises a number of issues for regulators. The ecological risk assessment of nano-enabled agrochemicals is likely to differ from that of conventional products and new parameters are needed to allow an adequate evaluation of the new products. The majority of products currently in development consists in nanocarrier systems loaded with a registered AI. For this type of products, a priority for assessment is to establish the time during which the AI remains associated with the nanocarrier, i.e. the “durability” of the AI–nanocarrier complex (1). Koopmans et al. (2) presented a series of guiding principles for the regulatory evaluation of environmental risk associated with nano-enabled pesticides, including a conceptual strategy relying on the durability parameter. A group drawn from regulatory agencies, academia, research, and the agrochemicals industry recently offered a perspective on relevant considerations pertaining to the problem formulation phase (3). A study case (pendimental PAH in an agricultural field) was considered to test and the framework proposed for exposure assessment. The study case serves as a useful base to guide additional exposure requirements and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. Kah M, Hofmann T. 2014. Environ. Int. 63:224–235. 2. Kookan RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

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

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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 regressed 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 Environmental Monitoring System (GEMS) collector 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, 798-805. M. MacLeod, et al., Environ. Pollut., 2011, 159, 1442–1445. G. Czb and M. S. McLachlan, Environ. Toxicol. Chem., 2004, 23, 2356–2366. https://undatalocagol.org/dataset/gemsofous-consumption-database M. van den
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

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


European Chemicals Agency (ECHA) implements the REACH Regulation (EC) No 1907/2006 (Registration, Evaluation and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC) No 1272/2008). Industry and authorities need to fulfil their obligations regarding these regulations also for nanomaterials as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH would benefit from nanomaterial-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(x). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 10). 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 in the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

587 Building a Risk Assessment Framework for Nanomaterials in Canada

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Despite the potential benefits associated with the use of nanomaterials, concerns also exist about 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 many years and 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 give users the possibility to select or sort based on examples. The inventory that approved the standard (and thereby indirectly the procedures followed to come to a standard), the level of evaluation and validation of the resources or the acceptance of the resource in view of the REACH legislation. During the project and after the duration of the project this overview will be updated when new information or updated versions of resources become available or when new resources are introduced by a mechanism later to be defined. More over 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 that can be used to promote the understanding of the risks and the potential 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 finances reasons) may fail to 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 contaminated. As a result, the addition of less conventional organisms to regulatory projects can promote the characterization of environmental risk nanomaterials pose. Mytilius species have a long history of being used as sentinel organisms to characterize ecosystem health and can be useful to promote the understanding of environmental risk and emerging contaminants like ENMs pose. This information can be particularly useful for the development of safer-by-design strategies as implementation in risk characterization can promote the identification of which products an industry creates pose the lowest environmental risk. In this context, under project the Horizon 2020 project NanoReg2, the aim of this study was to demonstrate the implementation of a safer-by-design strategy for ENM development. Three carbon nanofibers (CNFs) were provided by an industrial partner in order to characterize the potential environmental risk their products posed. The aim of the study was to compare the original product (GAF) to a new scaled up production process for the CNF (GATAM) as well a graphitized version of the product (GAFg). The study implemented regulatory testing using Daphnia magna and Pseudokirchneriella subcapitata as well as hemocytes from the marine mussel Mytilus edulis (M. edulis) following in vitro and in vivo testing on subcellular endpoints. The testing strategy was conducted in order to demonstrate the suitability of both regulatory testing (OECD tests) as well an in vitro screening strategy on M. edulis hemocytes to characterize the environmental risk pose by ENMs in the context of safer-by-design and its application to industry. In addition, recommendation and discussion on protocols used to test this CNF are provided.

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

D. Tarasconi, R Catala, Marseille Université; J. Hubaud, Heliocoscience; V. Bartolomei, S. Motellier, CENA Liten; D. Boutry, CENA - Grenoble; L. Hedouin, CNRS CRIOBE; C. Santaella, CNRS/CEA/Aix Marseille Université / Bioscience and biotechnology Institute of Aix Marseille; P. Hennébert, INERIS; A. Pisinino, IBIM CNR Palermo; S. Lehmann, University of Grenoble Alpes; J. Labilloy, CNRS Sunscreens are of emerging concern regarding both human and environmental health. While TiO2 nanoparticles used as UV-blockers may offer a safer alternative to organic filters, their fate and impact and resulting regulation are still under consideration, largely related to the potential risk of nanotechnology-based products. After leaving the skin either through bathing or cleaning, the TiO2
nanomaterials contained in the sunscreen can be released into rivers, lakes, sea shores, and/or sewage treatment plants. Their fate and impact in these different systems is largely determined by the surface properties, i.e. the coating type and lifetime. This project aims to develop the eco-design of sunscreens through the minimization of risks associated with nanomaterials incorporated into the formulation. All stages of the cream life cycle must be considered in this light, from its manufacture to its end of life, through its use by the consumer and its impact on the environment. By considering each development stage of the sunscreen, the choice from the option 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-A12O3, and quantum dots B. Nowak, EMPA; Y. Wang, Empa Swiss Federal Laboratories for Materials Science and Technology

Many research studies have aimed to investigate the ecotoxicalogical 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 database and the PNEC values were calculated using probabilistic species sensitivity distribution (PSSD). The order of the PNEC values was quantum dots < nano-CeO2 < nano iron oxides < nano-Al2O3 < nano-SiO2. The risks posed by these five ENMs were demonstrated to be in the reverse order: nano-Al2O3 > nano-SiO2 > nano iron oxides > nano-CeO2> quantum dots. However, all risk characterization values are four to eight orders of magnitude lower than one and no risk was therefore predicted for any of the investigated ENMs at the estimated release level in 2020. Compared to static models, the dynamic material flow model allowed us to use PEC values based on a more complex parameterization, considering a dynamic input over time and time-dependent release of ENMs. The PSSD approach makes it possible to include all available data to estimate hazards of ENMs by considering the whole range of variability between studies and material types. The risk assessment approach is therefore able to handle the uncertainty and variability associated with the collected data. The results of the current study are able to provide a scientific foundation for risk-based regulatory decisions of the investigated ENMs.

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

592 Occurrence of cyanotoxins in Greek lakes A. Costas, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology, S. Zervou, NCSR Demokritos / Institute of Nanoscience and Nanotechnology, K. Manolidi, NCSR Demokritos; T.M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology, T. Kalousis, EYDAP SA / WATER QUALITY CONTROL

Cyanotoxins (CTs) produced from cyanobacteria in surface water during harmful algal blooms can pose significant threat to human health and the environment. Their analytical determination in both biomass and water is a demanding task as CTs comprise a large variety of compounds with different structural and physiochemical properties, i.e. cyclic peptides (microcystins, MCs and nodularins, NODs) and alkaloids (cyclinodinopenismin, CYN, anatoxin-a, ANA-a and saxitoxins, STXs). The most important issues that make the CTs’ analysis challenging are 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 on 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 determination of multi-class CTs. As an example, an analysis of 12 MCs ([D-Asp]3MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp]3MC-LR, MC-LR, MC-HiR, 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 toxics efficiently. The aim of this study was to demonstrate the applicability and efficiency of a proposed workflow for multi-class/variant determination of CTs. Futhermore, 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 Greeks 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]3MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp]3MC-LR, MC-LR, MC-HiR, MC-WR, MC-LA, MC-LY, MC-LW and MC-LF), NOD, ANA-a, STX and neoSTX were identified in Greek lakes for the first time.

593 Interactions between cyanobacteria and daphnia G. Bjojaajir, UMR CNRS EcoBio; M. Bormans, UMR CNRS EcoBio / UMR EcoBio; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Physicotoxines / Unité SYNECO; Dept. ODE; C. Wieczek, University of Rennes 1 / UMR CNRS ECOCBIO

Thanks to their adaptation cyanobacteria organized aquatic, marine and terrestrial ecosystems. Eutrophication of waters has promoted and still increases cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither has the question, if the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 and A. minutum PCC7012 were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 μm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10⁷ cells/mL, reduced feeding and survival, moreover altered detoxication and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy- are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 reacts to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.

594 Teratogenic retinoid-like compounds produced by cyanobacteria into surface water K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; E. Sycharova, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment; M. Kraus, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; A. Jonas, Masaryk University, RECETOX / Faculty of Science; J. Priebojova, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment; J. Veerckova, Masaryk University, Faculty of Science, RECETOX; L. Sehnal, Masaryk University Faculty of Science RECETOX / RECETOX Research centre for toxic compounds in the environment; T. Prochazkova, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / Research centre for toxic compounds in the environment; S. Scholz, Helmholtz Centre for Environmental Research / Department of Biocatalytic Ecotoxicology; M. Smitna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research centre for Toxic Compounds in the Environment

One of the biggest worldwide problems in aquatic ecosystems is the formation of cyanobacterial water blooms that can have adverse effects on organisms. It has been well recognized that cyanobacteria are able to produce diverse groups of toxins. Recent reports show evidence of new toxic products of cyanobacterial metabolism - retinoid compounds, but there is very limited knowledge regarding to their producers, occurrence or potential associated risks. This research provides environmentally significant information about total retinoid-like activity in the biomass of cyanobacterial water blooms as well as in their surrounding water. It documented production of compounds with this bioactivity into the surface water by various cyanobacterial species. The level of retinoid-like activity reaches values that can cause adverse developmental effects in exposed organisms. Retinoid-like activity in cyanobacterial exudates was in a very good agreement with
developmental effects in zebrafish (Danio rerio) and frog (Xenopus laevis) embryos. Both the phenotypes and effective concentrations of exudates corresponded to all-trans retinoic acid (ATRA) equivalents, supporting the hypothesis that the teratogenic effects of cyanobacterial exudates are likely to be associated with retinoid-like activity. Non-target analyses and comparison of the spectra of compounds present in exudates with different retinoid-like activities pointed to structural features of compounds contributing to the retinoid-like activity. In the approach of a virtual EDA we have characterized in detail retinoid-like activity of 53 samples of exudates from 4 algal 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.18-15199S and FP7 SOLUTIONS project No. 603437.

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(Co)-Production Dynamics of Cyanobacterial Peptides
R. Sanchez Naturi, E. Vonwyi, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry; E.M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry
Cyanobacterial algal blooms are expanding temporally and spatially, which is promoted by eutrophication and likely climate change. Cyanobacteria can produce a wide range of bioactive compounds with different modes of action, including a variety of toxic metabolites. Information on the formation and production dynamics of the majority of novel cyanopeptides is mostly unknown even for common cyanobacterial strains. Such information is crucial to assess the risk of these emerging natural toxins for human health in evaluating their potential to reach drinking water supply plants. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides other than microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides from common cyanobacterial species including Microcystis aeruginosa and Anabaena flos-aquae strains. Batch culturing was done under various environmental conditions and the cell abundance was followed by optical density, cell counting, and biomass weight. Simultaneously, the cyanopeptide production was followed. Therefore, biomass extracts were purified and measured by liquid chromatography, high resolution mass spectrometry with refined analytical protocols. Comprehensive data analysis was performed to identify cyanopeptides and follow their abundance. These new insights of co-production dynamics are critical to better understand which peptides and peptide mixtures are present during cyanobacterial bloom events.

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Development of methods for Measuring Total Microcystins in Fish Tissue using the 2-methoxy-3-methyl-4-phenylbutyric acid (MMPB) procedure.
There are limited methods for the analyses of multiple algal toxins in aquatic food webs, phytoplankton, zooplankton, periphyton, macroinvertebrates, forage fish, bottom feeders and top carnivore fish. Algal toxins in freshwater systems do not necessarily occur as single contaminants; mixtures of toxins may be produced by Cyanobacteria, Prymnesium parvum (Prymnesins), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsin, anatoxin-a, prymnesins and euglenophycin. The objective of the first phase of this research was to spike 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
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Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self-identified as 35% academia, 35% government, 20% industries, 5% non-government, 2% business, 2% education and 3% other. After receipt of question solicitation, questions were separated into broad topic areas including, AOP networks, quantitative AOPs, collaboration and communication on AOPs, AOP discovery and development, extrapolation, exposure/toxicokinetics considerations, and AOP application. An expert-ranking exercise was then conducted to identify high-priority questions for each category and from this, four breakout groups emerged including further discussion of AOP research and regulatory initiatives. These themes were used as workgroup topics for a Pelliton™ Workshop, including: AOP networks and their applications; quantitative AOPs and
their applications; regulatory use of the AOP framework, and expanding awareness of, involvement in; and acceptance of AOPs to support aspects of predictive toxicology and regulatory decision-making. Charge questions for each workgroup were directly modified from those submitted during horizon scanning. Additionally, from the horizon scanning exercise, frequently asked questions (FAQs) were identified and addressed by experts in the field. Together the horizon scanning exercise and expert rankings of FAQs were used to set the stage for the SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway Concept: An International Horizon Scanning Approach,” that took place in Cornwall, Canada during April 2017. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

599 Adverse Outcome Pathway networks: development, analytics and applications


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 (i.e., mechanistic and functional information) generally across domains. 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 presentation employs expert comments across different AOP networks, and also on related topics such as mixture toxicity assessment and the implementation of feedback loops within the AOP framework. This presentation briefly outlines critical concepts concerning the development of AOP networks, how they may be analyzed, and illustrates how information derived from them can be applied. First, derivation of AOP networks is considered in the context of how it differs from development of animal AOPs (i.e., use of human, animal or general biological data). 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 and case studies is used to illustrate concepts underlying development and analysis of AOP networks, and how those concepts tie in with ultimate application. The contents of this presentation represent the personal opinions of the authors and neither constitute, nor necessarily reflect the policies or viewpoints of their employers or institutes.

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


An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway (AOP) Concept – An International Horizon Scanning Approach,” in April 2017. The workshop addressed key challenges and limitations of AOP constructs as tools for informing research and regulatory decisions that were identified by responses to a global Horizon Scanning survey. This presentation will summarize the findings of Pellston Workshop 3, which was tasked with the exploration of practical considerations for this use of AOP constructs in regulatory decision making. The use of AOPs and related concepts have increased in scientific and regulatory workgroups over the past decades, coinciding with pressures to find innovative solutions to evaluate chemical safety and risk management. This presentation focuses on how AOPs can be a useful tool for chemical decision makers in the government and private sector. At the various points where chemical decision making is employed across the “life” of a chemical – from research and development within the commercial sector, government registration and regulation, through to post-marketing use/stewardship – AOPs can be used as an organizing principle. Pragmatic evidence is provided for how AOPs can be and are currently being used in chemical decision-making processes. Considerations for evaluating the suitability of AOP for decision makers are discussed, recognizing that the acceptable level of uncertainty varies based upon the nature of the decision and the context in which it is being applied. The presentation provides multiple examples of AOP use and practical considerations for evaluating whether use of AOPs is fit-for-purpose in different circumstances. This abstract does not necessarily represent the views or policies of the U.S. EPA.

602 Ensuring Long-Term Utility of the AOP Framework and Knowledge for Regulatory Decision Makers

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The adverse outcome pathway (AOP) framework serves as a knowledge assembly 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.

603 Adverse Outcome Pathways: Moving from a scientific concept to a globally accepted framework

M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; C. LaLone, U.S. EPA / Mid Continent Ecology Division

The adverse outcome pathway (AOP) framework has gained significant international traction as a systematic approach for capturing existing knowledge to transparently link mechanistic data to apical toxicity endpoints as a means to inform research and risk assessment. While the framework has evolved significantly since
its introduction in 2010, it was recognized that a survey of the broader scientific community would be useful in identifying shortcomings and in guiding future initiatives. In 2016, we reached out to national and international scientific and regulatory communities to collect questions and provide an opportunity to discuss key outstanding challenges that must be addressed in order to realize the full potential of the AOP framework. Four key themes emerged from this “Horizon Scanning” exercise (see presentation “Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach” in this session), which were then addressed at a Society of Environmental Toxicology & Chemistry (SETAC) Pellanum® 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 Pellanum Workshop. In brief, common themes that spanned across these main topics included the need to simplify, translate, and better communicate the AOP framework to the broader international stakeholder community, and a consensus that the AOP framework does not represent a rigid tool but rather a knowledge repository for diverse stakeholders ranging from epidemiologists to mainstream experimental toxicologists to risk assessors and managers. Furthermore, while considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

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

604 Monitoring of POPs in the Swedish aquatic ecosystem and in human milk
E. Nyberg, A. Bignert, S. Danielsson, Swedish Museum of Natural History; C. Ek, Department of Applied Environmental Science / Department of applied environmental science

In the 1960s, the Baltic Sea was found to be severely polluted by persistent organic pollutants (POPs). These discoveries were the starting point of a continuous Swedish national monitoring program for contaminants in biological matrices, mainly from the marine and freshwater environment, with samples dated as far back in time as 1969. Today’s marine and freshwater monitoring programs consist of 32 lakes and 28 marine sites where matrices as perch, pike, arctic char, herrings, cod, eelpout, blue mussel and egg from guillemots, oystercatcher and common tern are annually collected. In 1967, examination of human exposure to POPs was initiated by Karolinska Institutet in Stockholm through measurements in human milk from the area, and since 2007 milk has also been collected from Gothenburg in the southwest of Sweden. The milk samples were in 1997 transferred to the Environmental Specimen Bank at the Swedish Museum of Natural History. 

The main objectives of the monitoring program are to investigate changes over time, to estimate geographical differences and to assess compliances with set target values. Moreover, the program is designed to answer these different questions with a high statistical power. Since the start of the monitoring, concentrations of PCBs, DDTs, HCHs and HCB have decreased in fish and bird eggs from both the Baltic Sea and the Swedish freshwater environment. Several of the classical POPs have also decreased considerably in human milk. However, the non-linear trends differ between the monitoring matrices for several contaminants. In some cases the peak differs, and in others, concentration is levelling out for one matrix but continues to decrease for another. In addition, the concentrations of PCBs, DDTs and HCHs are, despite continuous decreases since the 1970’s, still higher in the Baltic Sea compared to, for example, the North Sea.

605 Jumping out of the frying pan and into the fire? Spatial and temporal trends for PBDE, Dechlorane Plus and alternative flame retardants in samples of the German environmental specimen bank
A. Dreype, Eurofins GfA GmbH / Air Monitoring; F. Neugebauer, Eurofins GfA Lab Service GmbH / R&D; N. Lohmann, Eurofins GfA LabService GmbH; M. Paulus, Trier University; H. Ruedel, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Rauert, Umweltbundesamt / International Chemicals Management; J. Koschorreck, Umweltbundesamt

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 inland and marine matrices, their temporal trends ending back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves, and tooe deer will be used to illustrate time trends for regulated flame retardants and their substitutes. Recommendations will be given to European and international chemical management.

606 New Uses of Archived Specimens from the U.S.A. NIST Marine Environmental Specimen Bank

The National Institute of Standards and Technology (NIST) has been involved in the long-term archival of biological and environmental specimens for over 40 years. Specimens originally intended for monitoring geographic and temporal trends in emerging contaminants as well as changes in transport and accumulation of legacy contaminants have added value today. Tissue and fluid specimens from marine animals, including mammals, seabirds, sea turtles, bivalves, fish, coral and coral ecosystems, collected through various projects are archived at the Marine Ecosystems Specimen Bank (MESB) at Hollings Marine Laboratory, 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 expression studies and 2) are feasible in determining trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polystyrenefluoroethylen (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteomic profiling of tissues used to evaluate a new high-coverage well-scarified genome, and 2) the discovery of using total RNA as an alternate method to genetic species identification, have also been conducted and will be discussed.

607 Monitoring of the indoor environment of ESB laboratories with selected target and non-target screening methods
P. Bohlin Nizzetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkovski, 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 high importance that the ESBs are representative of 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 of CECs to the indoor environment. To evaluate trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polystyrenefluoroethylen (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteomic profiling of tissues used to evaluate a new high-coverage well-scarified genome, and 2) the discovery of using total RNA as an alternate method to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research
J. Astrin, Zoological Research Museum Alexander Koenig

Within their genomes, the organisms on our planet contain an immense wealth of information about the diversity of life. These genomes conserve the code to identify organisms, comprehend population structures, etc. Fast progress in molecular technologies dramatically speeds up research on genetic biodiversity and increases the demand for professionally preserved and managed genome-quality samples in many disciplines, e.g. in ecology, conservation biology, etc. Biodiversity biobanks cater specifically to these demands, and in a standardized way. Environmental specimen banks 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 throughput 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 the fast-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 bioavailability; time consuming and subjective effect data compilation and assumption of additivity of ionizing radiation and chemical stressors. The approach for estimating environmental risk of multiple stressors requires validation through experimental studies, but could already serve as a suitable tool for prioritization of stressors and organisms of concern, and to identify knowledge-gaps in terms of exposure and effect data. Acknowledgements: The project was funded from NRC project 223268 (CERAD) and in-kind from Norwegian Institute for Water Research (NIVA)

612 Assessing health risk associated with micro-pollutant mixtures in drinking water: an innovative combination of in vivo and in vitro assays and analytical screenings

Y. Levi, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRSEE Suez Environment; a. guillon, Suez / CIRSEE; m. favier, INSERM Institut Cochin; v. domengueneau, Université Paris Sud; M. Bimbot, V. Huteau, Univ. Paris-Sud / UMR ESE; m. pleva, b. marinas, University of Illinois at Urbana Champaign Assessing health risks associated with organic micropollutants in drinking water is a major challenge for public health and improvement of the drinking water production units. Given the low concentrations, the diversity of emerging contaminants and chronic exposure, it is essential to combine chemical analysis with biotests. In vitro bioassays or in vivo tests on aquatic animals allow effect screenings but interpretation for health risk assessment is difficult. We have designed an innovative research program (to our knowledge, the first of its kind applied to drinking water) that aimed to simulate human life-long exposure to micro-pollutants in drinking water for in vivo tests on mammals... Over 4 seasons, we have concentrated by 100 the organic fraction from large volumes of 4 types of water: river water, drinking water produced by a treatment plant with this raw water as input, and in the osmosis and reverse osmosis water. 2 generations of mice (10 males, 10 females for each type of water) were fed with concentrates during a 1 year period, in order to reproduce in the animals, the exposure as a man drinking the water over 70 years. We carried out complete chemical analysis (quantitative targeted analysis, innovative non-targeted screening by HPLC and GC-2D with mass spectrometry), offering a new vision of the contaminants diversity. In vitro bioassays were used to evaluate endocrine disrupting effects (ER and AR recept.), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st-generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropollutants. The presentation will show the detailed protocols, the major contaminants, the major health risk assessment with regard to long-term exposure to real mixtures of organic pollutants in drinking water.

613 The application of DGT to assess the risk of metal mixtures in polar environments

D. Koppel, University of Wollongong / Chemistry; M.S. Adams, CSIRO; C.K. King, Australian Antarctic Division; D.F. Jolley, University of Wollongong / School of Chemistry

Contaminants predominantly occur in mixtures, posing a challenge to environmental management practices which are usually based on single-contaminant toxicity. Chemical interactions of the contaminants and non-specific biological responses to these mixtures may result in effects that differ from the sum of the toxicity of individual components. These differences can be classed as antagonism (less toxicity than expected from the sum of the individual contaminants) or non-interaction (toxicity equal to that expected from the sum of the individual contaminants). Diffusive Gradients in Thin-films (DGT) has been established as a robust method for analysing the biologically-available contaminants in situ and is well-positioned to assess the toxicity of contaminant mixtures. This study explores the use of DGT (with a Chelax-100 resin) to assess the toxicity of Cd, Cu, Ni, Pb, and Zn in mixtures, to two common Antarctic marine microalgae, Phaeocystis antarctica and Coscinodiscus concilii. This work also provides a new framework for ERA of chemical mixtures. A non-interactive and synergistic toxicity were observed in the two algal species in response to increasing multiples of an environmental mixture (where the ratios of metals were based on reported concentrations at a historically contaminated Antarctic marine bay). Non-interactive toxicity was observed in response to an equitoxic mixture (five metals at their EC10 concentrations), as determined by Independent Action and Concentration Addition modelling. DGT measured concentrations were able to predict toxicity to the two algae at environmentally realistic contaminant concentrations. The use of DGT in Antarctica was validated by field deployments to sediments and waters of the near-shore coastal environment of a contaminated site around an Australian Antarctic research station. Their use in assessing the risk of historical contaminants to the polar environment is discussed.

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?

H. Zhao, Ghent University / V/Gent / Laboratory for Environmental Toxicology and Aquatic Ecology; F. Vautvyckeghem, Ghent University / Sustainable Organic Chemistry and Technology; S. Huysman, Ghent University; K. Demestere, Ghent University / Sustainable Organic Chemistry and Technology - Research Group EnVOC; L. Vanhaecke, Ghent University / Veterinary Public Health and Food Safety; H. Van Langenhove, Ghent University / Sustainable Organic Chemistry and Technology - Research Group EnVOC; D. Koppel, University of Wollongong / School of Chemistry; S. Moeris, Australian Antarctic Division / Centre for Environmental Risk Assessment (CERAD) and in-kind from Norwegian Institute for Water Research (NIVA)

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 integrated samplers). Our research objective was to investigate whether or not environmentally realistic contaminant mixtures...
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; S. Balzano, M. Potalivo, ISPRA Institute for Environmental Protection and Research; R. Loos, European Commission Joint Research Centre; D. Marinov, T. Lettieri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

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

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

616 How predictive is the current risk assessment for soil invertebrates? P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roemhke, ECT Oekotoxikologie GmbH; I. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Costa, University of Coimbra; N. Folsom, University of Coimbra; S. Chelinho, CFE Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; N. Capela, CFE Centre for Functional Ecology; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products

The present risk assessment evaluating effects from plant protection products (PPP) as well as other chemicals towards soil organisms encloses uncertainties. According to the current guidance on terrestrial ecotoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms, for example test organisms (e.g. Eisenia fetida or Folsomia sp.) exposed to different metal mixtures (Cd, Co, Pb, 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 risk assessment for no effect concentrations (PNEC) for soil organisms in order to create conceptual models allowing the extrapolation from the lab towards the field situation.

617 Risk assessment of soil organisms in field: dealing with earthworm community Y. Bayona, F. Brulle, ANSES / IWTU; B. Bonvin, ANSES / IWTU; E. Geymonat, F. Puygiron, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Costa, University of Coimbra; A. Lahm, Bioinformatic consultant; S. Tasselli, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Our test results over an extended time period of 16 months. In the presented research we used extracts of Speediek™ passive samplers deployed in and outside of the harbour of Zeebrugge (Belgium) to spike several 72 h growth inhibition tests with the marine diatom Phaeodactylum tricornutum following ISO 10253. The different growth inhibition tests were performed over a period of 16 months with tests 0, 8 and 16 months after extraction. We observed statistically significant (p < 0.05) growth stimulation of up to 6.4 ± 0.5 % and 11 ± 2 % (in the harbour) and 7.0 ± 0.5 % and 14 ± 3 % (outside of the harbour) after an extract storage time of 0 and 8 months, respectively. After 16 months the previously observed effects disappeared completely. In order to explain the differing ecotoxicological responses a targeted analysis was performed in order to identify significant compounds contained in the extracts. A high throughput screening on a total of 100 personal care products, pesticides, pharmaceuticals, (alkyl)phenols, phthalates and steroids. The analysis revealed that testing occurred at contaminant concentrations similar to those measured in water grab samples taken during sampler deployment. Remarkably the observed stimulation effects remained above 5 % when diluting the extracts up to 125 times. These findings suggest that P. tricornutum would remain affected by ERCMs even if their environmental concentrations would be reduced considerably. The disappearance of the observed stimulation effects after an extract storage time of 16 months led to the hypothesis that the main contributing contaminants causing stimulation must have degraded over time. In future work it would be of high interest to apply multivariate analysis (i.e. principal component analysis) to identify main contributing contaminants to the observed effects.

618 Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals K. Oorts, E. Geymonat, F. Puygiron, ECT Oekotoxikologie GmbH; I. Schoeters, Rio Tinto; J. Chowdhury, International Lead Association / Senior Scientist -Environment

During the last 2 decades, intensive research has been performed to improve the risk assessment of metals in soil and numerous chronic metal toxicity data were generated for various terrestrial species and microbial functions in different soil types. Models were developed for correction for differences in bioavailability among soils and for differences between laboratory and field conditions. For many metals, the large amount of chronic toxicity data for different species and functions allow the application of the species sensitivity distribution approach (SSD) to derive soil quality standards. This work was mainly triggered by the European legislative on chemical management (REACH) and the data were therefore primarily used to derive risk assessment for no effect concentrations (PNEC) for soil organisms in order to create conceptual models allowing the extrapolation from the lab towards the field situation. The recent EFSA opinion proposed a framework for risk assessment of soil organisms and definition of protection goals. Still, no statistical tool was proposed when dealing with field studies as higher tier. The aim of this communication is to test tools routinely used for regulatory risk assessment of communities. The tools for the ecological communities were mostly developed for aquatic organisms risk assessment. The multivariate analysis (PRC) is used for the community comparison. Individual populations are compared date-by-date using various statistical analysis commonly including Dunnett test and Williams t-test. The main idea of this tool is to propose a conservative estimates and toxicity laboratory studies) to the most realistic assessment (i.e. field studies). The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6.4. The highest differences were detected for Folsomia sp. exposed to the active substance Pendimethalin in OECD10% and Lafa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species Eisenia sp. as well as Folsomia sp. is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be set on the identification of key parameters influencing toxicity in different groups of species in higher-tier regulatory conceptual models allowing the extrapolation from the lab towards the field situation.
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

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

M. Cesena, Università degli Studi di Palermo; S. Bobba, G.A. Blengini, Politecnico di Torino; M. Cellura, M. Mistrutta, University of Palermo


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

J. Roembke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

TH155, TH156

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.

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SETAC Europe 28th Annual Meeting Abstract Book

Effect levels from the original dose 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 tracked through the whole life operating range must be defined. As 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.

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Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking
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 station is characterised by 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 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, with the aim of 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

L. Ciaia, C. Chiappini, P. Porta, ENEA; M. La Monica, C. Scaglirano, CINigi
The automotive fleet is gradually changing from internal combustion to hybrid and electric engines. This is fostered by the European policies concerning the need of reduction in pollutant emissions and in the improving of urban air quality. Currently most of the analyses carried out focus on the comparison of the emissions related to the different typologies of cars and on the CO2 emission cut generated by the consumption of electricity produced from renewable sources in the use phase of the car. The proposed approach wants to investigate the need of raw materials in future scenarios of electric technology penetration in the urban vehicle fleet. Focusing on the Italian urban vehicle situation and considering the current technology used for the electric batteries and the recharging systems, the study account for the raw materials needed for the electric mobility penetration scenarios in the Italian urban fleet, wants to highlight the market dynamics especially for 3 primary materials widely required in the electric mobility focusing also on the possibility offered by a transition to a circular economy, investigating the green mining potential available for these materials both for their recovering in the same technology and in others fields.

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

A. Alberg, P. Collet, D. Lorne, IFPEN / Econometrics & Technology Intelligence; A. Benoist, CIRAD / UPR BioWooEB ELSA research group; A. Hélia, Montpellier SupAgro / LBE ELSA
The automotive fleet is gradually changing from internal combustion to hybrid and electric engines. This is fostered by the European policies concerning the need of reduction in pollutant emissions and in the improving of urban air quality. Currently most of the analyses carried out focus on the comparison of the emissions related to the different typologies of cars and on the CO2 emission cut generated by the consumption of electricity produced from renewable sources in the use phase of the car. The proposed approach wants to investigate the need of raw materials in future scenarios of electric technology penetration in the urban vehicle fleet. Focusing on the Italian urban vehicle situation and considering the current technology used for the electric batteries and the recharging systems, the study account for the raw materials needed for the 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.

Developments in the use of bioassays for chemical and environmental risk assessment (II)

628 SIMONI: Smart integrated monitoring of the water quality

R. van der Oost, Wateren / Onderzoek en Advies; G. Sileno, Wateren / Research and Development; M. Thao Nguyen, Waterproof, L. Moria, Wateren / Water Systems
At present, regular water quality assessment is almost exclusively performed by target chemical analysis of substances. Scientific research over the last decades, however, demonstrated that water quality assessment with only chemical analyses is not reliable. Since over 100,000 harmful substances may be present in the aquatic environment, a paradigm shift from ‘substances’ to ‘effects’ has to be encouraged in order to implement a more holistic approach in regular monitoring. Therefore, an alternative Smart Integrated Monitoring (SIMONI) strategy has been developed by Dutch water research institutes. The purpose of this 2-tiered strategy is to obtain more reliable information on the chemical water 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 micropolutant 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 envisaged that this method will be increasingly used in agricultural sites. In addition, increased ecological risks were also observed at waters receiving wwtp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for results that potentially affected fraction of water organisms due to multiple stress end points. 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 most to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedisk passive sampler extracts

M. de Baat, University of Amsterdam / IBED; Waternet / Research and Validation; P. de Voogt, University of Amsterdam / IBED
Bioassays are widely used in many fields 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 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 micropolutant 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 envisaged that this method will be increasingly used in agricultural sites. In addition, increased ecological risks were also observed at waters receiving wwtp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for results that potentially affected fraction of water organisms due to multiple stress end points. 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 most to the increased environmental risks.

Poster spotlight: TH304, TH309, TH314
samples, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced SpeedIs, POCIS and SpeedIs 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 RIKILT WaterSCAN for antibiotics activity. In addition, the Microtost test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger values exceeded; and thereby to the detection of ecotoxicological risks. Hence, POCIS outperformed SpeedIs in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

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

631 Current status of in vitro bioassay approach in environmental risk assessment of endocrine 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. Srzváková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Neča, M. Ciganek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Banečková, Z. Dvorák, Faculty of Science, Palacky University, Olomouc / Toxicology; J. Tomka, Experimental Medicine, CAS, Prague; J. Vondráček, 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 in ZFL and OC extracts from diesel exhaust particles and octocrylene (OC) were four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larvae and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BPs and OC and the molecular mechanism underlying the toxic effects. Docking analyses, 24 h and 96 h chemical exposures will be conducted on the ZFL cells to determine the potential binding affinities to the estrogen receptor (ER) and the half-lethal concentration (LC50) for the UV filter chemicals. The gene expression profiles on the ER pathway and the aryl-hydrocarbon receptor (AhR) pathway will also be measured by quantitative real-time PCR in ZFL and larvae exposed to the sunscreen chemicals. A dual-luciferase reporter gene system with AhR and ER clones transfected in ZFL cells will be used to confirm the biological activities of these sunscreen chemicals in ZFL cells.

632 Hormone-like activities in waste water characterized by CALUX bioassays, including chemical analysis and Effect-directed Analysis Y. van Oorschot, R. ten Broek, The Water Laboratory; M. Lamoree, VU University, Department Environment & Health / Department Environment & Health; N. Zwart, VU University Department Environment & Health; C.J. Houtman, The Water Laboratory Emission of compounds with biological activities from waste water treatment plant (WWTP) into the receiving environment is a potentially important topic, especially in the case of river and drinking water companies. We investigated the occurrence of hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC-tQ-MS target analysis method for hormones used in high volumes in pharmacy were applied. In addition, a novel high throughput Effect-directed Analysis (HT-EDA) platform was used to separate compounds in the extracts with high resolution LC-fractionation creating 288 4,79 sec.-fractions that were tested in the bioassays. In parallel, QToF high resolution MS data were recorded to correlate compound identity to peaks from the ‘bioassay chromatograms’ reconstructed from the bioassayed fractions. All five types of activities tested were observed in the WWTP samples. Androgenic and estrogenic activities were almost completely removed during WW treatment, anti-androgenic and anti-estrogenic activities were observed in treated WW and effluent could predominantly be attributed to the presence of unknown androstenedione and testosterone. Application of the HT-EDA-platform delivered bioassay chromatograms of the WWTP effluent in which active compounds were separated into sharp peaks. The glucocorticoid activity appeared to be caused by at least four different compounds (peaks), not being dexamethasone. The androgenic activity was fractionated into a small peak probably attributable to co-elution of testosterone and androstenedione. The QToF MS data are currently interpreted to elucidate the identity of the unknown glucocorticoids. Also bioassaychromatograms of other endpoints will be discussed. This study demonstrates the value of toxicity profiling with bioassays as first tier in the monitoring of water quality. In case observed activities exceed trigger values, additional risk assessment is needed and the HT-EDA platform can help to characterize and ultimately identify the responsible compounds.

633 Non-target screening and identification of emerging pharmaceuticals and their transformation products in wastewaters c.g. Pauw, only found in Bordeaux, France / LPTC / LMU / DRHC / UMR 5805 CNRS; M. Dévér, University of Bordeaux / EPOC / LPTC / UMR 5805 CNRS; E. Mailhot-Maréchal, INERIS / UMR SEBIO ECOT; E. Geneste, University of Bordeaux / EPOC / LPTC / UMR 5805 CNRS; S. Ait-Assia, INERIS / UMR SEBIO ECOT; H. Budzinski, University of Bordeaux Wastewater samples represent a major pathway of introduction of EDCs into the aquatic environment. Considering the large number of pharmaceuticals and 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 micropollutants to the overall biological or toxic activity of a sample. In this study, a systematic approach combining effect-directed analysis (EDA) and high resolution spectrometry was applied to several urban WWTPs to establish an overall contamination diagnostic and to identify major contaminant that could be released in environment. For this purpose, crude extract from influent and effluent of an urban WWTP were analyzed by LC-QTOf and tested on estrogen, 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 not detected in influent. Few compounds were introduced 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

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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. Shekar, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (Acipenser transmontanus) are a genetically unique population of fish which have inhabited the Nechako watershed for roughly 10,000 years. Within the last 50 years this population has suffered significantly because of anthropogenic activities. In the Status of the Nechako White Sturgeon in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional governments, industry, and public volunteers. The CWG plays a vital role in communication, public outreach, and promoting community involvement. Activities of TWG and CWG support the mandate of the NWSRI through direct involvement of First Nation communities, volunteers and students. The Emergency Sturgeon Live Release Boat Kit program is an example of multiple First Nation communities working in union with the NWSRI to promote conservation and stewardship of Nechako white sturgeon. The annual Juvenile Sturgeon Release event involves students, volunteers and First Nations who release thousands of juvenile sturgeons, which were reared from eggs by the TWG, back into the Nechako watershed. The NWSRI is a unique conservation effort that promotes and utilizes the support of scientists, First Nations, volunteers and students to engage the community in the conservation of an endangered species.

635 The NSERC CREATE H2O Program on First Nations Water and Sanitation Security: Case Studies on Drinking Water Quality

A. Farenhorst, University of Manitoba / Soil Science; W. Ross, University of Manitoba / Centre for Human Rights Research; R. Mi, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amaranwansa, K. Anderson, University of Manitoba / Department of Soil Science; E. Khafipour, University of Manitoba / Department of Animal Science; A. Kumar, University of Manitoba / Department of Microbiology

The NSERC CREATE H2O program is the first science-engineering research training program in Canada that combines technical water and wastewater management training with Indigenous theory, law and methodological skills training. Since its inaugural year in 2013, the program has trained 86 students who have collectively worked with 30 First Nations communities in the provinces of Manitoba, Ontario and Saskatchewan, Canada. 33% of the university students and postdocs enrolled in the program self-identify as Indigenous. This presentation provides an overview of the approaches the program uses for: engaging communities and students in research training activities, Indigenizing scientific and engineering curricula, and designing advocacy strategies to support clean drinking water as a human right in First Nations communities in Canada. Case studies are presented to demonstrate the community-based monitoring programs implemented to examine drinking water quality in First Nations homes. First Nations communities participating in the research had various types of water distribution systems. Overall, water samples were collected from: lakes and groundwater (source water); water treatment plants, water trucks and community standpipes; homes relying on piped water, wells, above-ground cisterns and underground cisterns; and buckets/drums in homes without running water. Water analysis included standard measures of chemical and bacterial parameters, DNA and RNA techniques for microbial profiling, and the quantification of antibiotic-resistance genes in water samples. The main findings are that despite effective water treatment plants in communities, the tap water in many First Nations homes contained fecal bacteria at alarmingly high levels and antibiotic-resistance genes were also detected in a range of drinking water samples. The issue of poor drinking water quality in First Nations communities in Canada remains unsolved and there is an urgent need for improved monitoring and upgrading of infrastructure, especially in communities relying heavily on cisterns and community standpipes for drinking water supplies. Most importantly, investments to connect homes directly to water treatment plants via improved pipelines is key to reducing human exposure to waterborne illnesses, while enhancing options for families to participate in economic development, food security and spiritual and cultural wellbeing in their communities.

636 Rare earth elements (REEs) in the Canadian Subarctic: scientific perspectives and community engagement with environmental monitoring in Nunavik, Northern Quebec

G. Gagnon-Millan, Centre détudes nordiques, Université de Montréal / Department of Biological Sciences; J. Gérin-Lajoie, Université du Québec à Trois-Rivières / Centre détudes nordiques, Département des sciences de l'environnement; J. Chetelat, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; E. Hébert-Houle, Université du Québec à Trois-Rivières / Département des sciences de l'environnement; J. Rowell, University of Montreal / Department of Chemistry; J. Heath, The Arctic Elders Society; H. Snowball, The Northern Village of Kangiqsualujuaq; R. Mickpegak, Santiago Landholding Corporation Kuujjuaraapik; M. Amiot, Universite de Montreal / Département de sciences biologiques

Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and injustices important on both bio- and social level. One of the communities is the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed in northern Canada. Rare earth elements (REEs) are a chemically-similar group of contaminants of emerging concern, which includes the 15 trivalent lanthanide metals. Not particularly rare, REEs are increasingly exploited for essential uses in high-tech industries, including electronics, clean energy, and agriculture. Although knowledge of the fate of REEs and their impact on natural ecosystems is critically needed as emissions increase, few ecotoxicological studies exist for REEs particularly field studies on their bioaccumulation and food web dynamics. To investigate how REEs behave in remote northern food webs, samples were collected from community-driven collaborative research projects with the Inuit communities of Kuujjuaq and Kangiqsualujuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. With the help of Indigenous perspectives from communities, we can enhance community engagement: 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 and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We will explore perspectives from Indigenous communities: 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 and...
Drinking water advisory levels have been adopted by many regulatory agencies to derive chronic exposure to persistent fluorochemicals. However, most U.S. advisory levels are based on the assumption of approximately 20% of overall PFAS intake comes from drinking water. Better characterizing the relative importance of drinking water to overall human exposures is important for developing health protective guidelines. Most previous investigations that have associated drinking water PFAS exposures and total body burdens of these compounds have focused on high contamination sites. Exposure to PFASs for the general population of individuals from geographically diverse areas are thus less understood. Here we investigate the relative importance of drinking water for total PFAS exposure among women in the Nurses’ Health Study (NHS), a large U.S. based cohort study. Our analysis included U.S. women who provided a residential drinking water sample in 1989-1990. We measured concentrations of 11 PFASs in a subset (n=111) of archived drinking water samples and serum samples. We evaluated the relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that home tap water is a significant exposure source for general American women. In 1989-1990, the median contribution of drinking water to serum PFASs in women in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies across individuals and is highly contaminated sites. Exposures to PFASs for the general population of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.

641 Consideration of the bioavailability of metals and metal compounds in freshwaters in regulatory frameworks

H. Stuebel, Framboerhke EM, Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Diaz Muñiz, Cantabrian Basin Authority; H. Garelick, Middlesex University; N. Kandile, Ain Shams University / Department of Chemistry, Faculty of Women; B.W. Miller, US Environmental Protection Agency / National Enforcement Investigations Center; L. Pantoja, Middlesex University / Natural sciences; W. Peijnenburg, RIVM / Center for Safety of Chemicals and Products; A. Serdar, Institute of Natural Sciences, Faulty of Science and Technology; Y. Shevah, Consulting Engineers and Planners Ltd; P. Van Sprang, ARCHE. M.G. Vijver, CML Leiden University / Conservation Biology; J. Vink, DELTARES / Dept Soil and Groundwater systems

Recent research has demonstrated that both total and dissolved metal concentrations are not the most appropriate parameters for the risk assessment of metals in aquatic systems. There is an increasing awareness by leading regulatory bodies in the USA, Europe and other countries that the bioavailable fractions of metals could be better descriptors of their risks. The principal concept of metal bioavailability is the Biotic Ligand Model (BLM) which allows site-specific assessments of metals’ risks by considering the environmental factors which affect the bioavailability of dissolved metals in the aquatic environment. For many metals bioavailability in freshwaters is modulated by dissolved organic carbon (DOC) concentrations, water hardness, the pH of the water and other factors such as temperature, concentrations of further ions and suspended solids as well as metal speciation. Metal-specific BLMs were proposed for different biological species and both, acute and chronic exposures. The BLM approach has been described extensively in the scientific literature, and BLMs have been applied for the risk assessment of metals and metal compounds (e.g., for copper and zinc in the EU). In the past, the broader use of the BLM approach for the site-specific evaluation of surface water monitoring data was hampered by the huge data requirements of the original BLMs (several site-specific water parameters). But the recent development of user-friendly BLM-based bioavailability tools (e.g., www.Bio-met.net, www.PNEC-pro.com) now allows the consideration of metal bioavailability for the evaluation of freshwater monitoring data of relevant metals. Such tools, which only need a basic set of easily available water parameters as input (mostly pH, Ca concentration, DOC, and dissolved metal concentration), are currently available for metals such as lead, nickel, copper and zinc. The new EU Water Framework environmental quality standards for lead and nickel according to Directive 2013/39/EU now consider the bioavailable fractions of these metals. In this contribution, the advantages and possible drawbacks of BLM-based bioavailability tools are presented highlighting feasibility, ranges of validity, and comparability between tools. Finally, recommendations for the regulatory implementation are given. This contribution is based on the outcome of the IUFAC-supported project “Consideration of bioavailability of metals/metal compounds in the aquatic environment” (#2011-060-1600).

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

640 Tap water intake of poly- and perfluoralkyl substances (P Frances) 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 fluorochemicals. However, most U.S. advisory levels are based on the assumption of approximately 20% of overall PFAS intake comes from drinking water. Better characterizing the relative importance of drinking water to overall human exposures is important for developing health protective guidelines. Most previous investigations that have associated drinking water PFAS exposures and total body burdens of these compounds have focused on high contamination sites. Exposure to PFASs for the general population of individuals from geographically diverse areas are thus less understood. Here we investigate the relative importance of drinking water for total PFAS exposure among women in the Nurses’ Health Study (NHS), a large U.S. based cohort study. Our analysis included U.S. women who provided a residential drinking water sample in 1989-1990. We measured concentrations of 11 PFASs in a subset (n=111) of archived drinking water samples and serum samples. We evaluated the relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that home tap water is a significant exposure source for general American women. In 1989-1990, the median contribution of drinking water to serum PFASs in women in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies across individuals and is highly contaminated sites. Exposures to PFASs for the general population of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.

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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 Environmental Health Sciences; J. Kostyshyn, 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 influence of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product usage. In addition, an overarching systematic approach to studying the exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistence of chemical biomarkers from 16 different classes of chemicals from databases, literature review, and Quantitative Structure Activity Relationships (QSAR) when needed. To compare differences in chemical biomarker concentrations across the age groups, we partitioned the distribution of each chemical biomarker by 12 different age groups, which were defined based on age-specific behaviors. To evaluate the influence of age on the chemical exposure biomarker concentrations, we performed a series of biomarkers that have attracted a great 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 (Microspogonius furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments in northeastern Brazil.

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

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In attempt to define and measure the effects of pollutants in the aquatic ecosystem, biomarkers have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism's responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Microspogonius furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments in northeastern Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like protein 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 responses are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure biomarkers from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

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

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Natural resource extraction has supported the development of Canada’s far north for many decades, but the legacy of these extraction processes remains apparent in northern Canadian landscapes today. From 1948-2004 Giant Mine operated 5 km north of the City of Yellowknife, and contributed to the economic growth of one of Canada’s largest northern cities. Giant Mine roasted arsenopyrite ore at high temperatures to liberate gold, however a by-product of this roasting process was over 20,000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which fish species are most appropriate? Which age/size class is appropriate? Which tissue is appropriate? Which chemical is appropriate? Which time span of potential exposure should be considered? In this contribution, influences of factors on fish levels of AS (e.g., sediment, 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.
approaches to understand their risk for the environment and human health.

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

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The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e. plasticizers, colorants, or fire retardants that can be toxic, have been largely underestimated. Nevertheless, it is well established that these chemicals migrate from consumer products, thus representing a source of exposure to wildlife and humans. The aim of the current study is to investigate the in vitro toxicity of chemicals leaching from various plastic products and to characterize them using non-targeted chemical analysis.

Differing plastic types shall be ranked according to the toxicity of their leachates. Thirty-four plastic consumer products made of high-density polyethylene (HD/LDPE), polypropylene (PS), polyethylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polystyrene 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 AREc32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and four slightly estrogenic. Overall, PVC and PUR extracts induced the highest toxicity in terms of potency and number of affected endpoints as almost all extracts triggered a high 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. We observed a novel validated sampler 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 to 0.2 microplastics/L after tertiary treatment.

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

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Plastic pollution is a serious global concern in these days due to their world-wide distribution, persistence, and increasing amount of small-sized plastic products due to degradation of larger plastic debris. However, little is known about their impacts on marine organisms, particularly at the molecular level. Here the dependence of microplastic toxicity to the monogonont rotifer (Brachionus koreanaus) on particle size was investigated by studying the ingestion and egestion of particles. A 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 mechanism 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)

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The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 μm. MPs can result from runoff and degradation (e.g., of seaweed) or weathering (e.g., of marine debris). In cosmetics, industries and domestic sources. Virgin plastic polymers are, in principle, biologically inert and thus non-toxic. However, plastic production includes additives such as plasticizers, colorants or fire retardants that can be toxic.

In addition to the potential toxicity caused by additives, MPs offer surfaces where hydrophobic pollutants can be adsorbed, including persistent organic pollutants (POPs). In marine environments, such chemicals are found at high concentrations in the surface layer, where low-density microplastics are most abundant. Indeed, these small particles can act as vectors and carriers for a wide range of pollutants and be ingested directly by organisms, causing chronic physical and/or toxicological effects. While accumulation of MPs in aquatic ecosystems is a growing concern in society, the toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two models pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of PFOs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity 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, phagotrophic response (PR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or control algae. 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

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Plastic particles within the microns range (microplastics, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine
habits 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 muscle. With that aim, CPF pre-exposed MP and MA were offered to the mussels in a batch injury. Changes in biomarkers, such as antioxidants and bioluminescence, 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 ptaquiloside in water resources

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Ptaquiloside (PTA) is a natural carcinogen found in a number of ferns Worldwide. The distribution and occurrence of PTA is best known from the Bracken ferns (genus Pteridium) which are classified in Group 2B Possibly carcinogenic to humans by WHO/IARC. The content of PTA in Bracken is highly variable (up to 5 – 6%). PTA is readily leached from Bracken stands from where it can enter the soil, waterways or potentially contaminate groundwater. Several records of PTA contamination of surface water and upper groundwater exist from Denmark and Great Britain. The fate of PTA in surface and ground water has not been studied. Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: \[ k_{obs} = k_{H} = k_{H+} + k_{H2O} \times [H_2O] \times [H^+] \]. The rate constants are: \[ k_{H+} = 25.7±1.0 \times 10^{-4} \text{ mol}^{-1} \times 	ext{h}^{-1} \]; \[ k_{H2O} = 9.5±6.0 \times 10^{-4} \text{ mol}^{-1} \times 	ext{h}^{-1} \] and \[ k_{obs} = 4.8±0.1 \times 10^{-3} \text{ mol}^{-1} \times 	ext{h}^{-1} \]. The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol\(^{-1}\). Hence, hydrolysis is a function of both pH and temperature. The purpose of this investigation was to study the degradation of PTA under natural environmental conditions using 10 different surface and groundwater samples from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e. no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline waters. The existing model for hydrolysis could generally predict the rate of degradation in groundwater. However, the model did not perform well at low or high pH. Pterosin B was formed as the end product by hydrolysis in the tested groundwaters at a molar ratio of approx. 1:1 for PTA:Pterosin B. However, under weak acid conditions, only approx. 10% of the potential pterosin B were formed. The risk of leaching from Bracken stands and contamination of surface waters is highest during the winter season. PTA has the potential of contaminating mainly shallow aquifers as the compound can persist for up to several months in contact with groundwater. The risk is expected to be highest at near-neutral conditions in aquifers.

653 On-line detection of algal toxins in sea water

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Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and 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 gap, it was developed and tested a direct Enzyme-Linked Immuno-Magnetic Capture microplate assay for the detection of Domoic Acid, Sargassotoxin 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 the assay. 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 most 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-pbM concentrations of the algal toxins. The obtained calibration lines were consistent with the strict requirements limiting the presence of the toxins in environmental waters. On-line suitability was demonstrated by a field installation on a floating platform in the port of La Spezia, Italy, for daily monitoring of real marine water samples, in which the instrument was integrated together with the device for real-time data transmission to a control center. In conclusion, results obtained showed that the automated measurements are repeatable and sensitive. Further work must go into developing additional specific antibodies to extend the application on other natural pollutants released by plants, algae and microorganisms, with a particular eye on freshwater cyanotoxins.

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 irritation were observed together with death of marine invertebrates. Only the 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. Seconded, although PLTX itself was reported as one of the most potent marine toxins known, its role was tentatively assigned 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- and intra-species variability, structure-activity relationships and the detected toxins and, in some cases, linking such differences to the risk that PLTX congeners pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favour O. cf. ovata proliferation and toxin production will be also provided based on laboratory and field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.

655 Untangling the geosmin appearance in a Mediterranean river: relationship of geosmin concentration and physicochemical parameters over a year

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The Mediterranean region is one of the most densely populated and industrially developed area in Spain. As a consequence, most of the rivers in this region are impacted by multiple anthropogenic stressors. One of these rivers is the Ter River (NE Spain), where human pressures are diverse and have increased in the last decades because farming, urban development and industry practices depends on its water. In addition, fluctuations in water discharge due to the Mediterranean climate create a high variability of conditions along the Ter River. One of the major problems detected in Ter River in the recent years is the appearance of geosmin. This is a metabolite generated mainly by cyanobacteria and actinomycetes that, when die, is released into the water, giving it a bad smell and taste. Although some studies have described that the production of this metabolite depends on environmental conditions, the factors associated with its production are still not clear. This suggests an economic utility for water supply companies, since they cannot predict its appearance and have to act when customers complain. The aim of this study is to evaluate the co-relation between physicochemical parameters and geosmin appearance along the Ter River during one year, and to study seasonal variability of geosmin concentration. The study has been performed in four sampling sites across the upper-middle part of the Ter basin. The sampling frequency varied throughout the year, depending on the potential risk to human health in several 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 cyanobacteria population and 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 mesocosm experiment that tests the influence of the N/P ratio on the geosmin formation within the biofilm could be the next step to follow.

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


Many species of cyanobacteria thrive in different aquatic environments, where they can produce cyanotoxins with different toxicological profile. The still growing anthetic pressure and climate changes are causing the expansion in terms of space and time of their blooms, increasing the concerns for human health in several exposure scenarios. The Italian guidelines for the management of cyanobacterial blooms in bathing water, firstly drew up for the implementation of European bathing water directive (Directive 2006/7/ECE), have been recently updated. A risk-based approach has been developed after a thorough revision of the current scientific knowledge on cyanobacteria distribution in the Italian Lakes and on chlorophyll a concentration, cyanobacteria concentration higher in winter. The possible exposure scenarios have been considered: oral, dermal and inhalation exposure to cyanotoxins, during recreational activities, have been individually examined, to develop a framework of thresholds and actions aimed at preventing harmful effects for bathers. Three phases of attention relative to monitoring plans for cyanobacteria blooms have been consequently defined: routine, alert and emergency, suggesting the need of an economic utility for water supply companies, since they cannot predict its appearance and have to act when customers complain.

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

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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.

Advances in evaluating and regulating endocrine disruptors

658 Hazard identification of endocrine disrupting properties of pesticides on non-target organisms: state of the art and future perspectives

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According to the Regulation (EU) no 283/2013, setting out the data requirements for active substances, in accordance with Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market, the endocrine disrupting properties of pesticides should always be assessed, as substance identified as an endocrine disruptor should not be approved. Most of the current knowledge about endocrine disruption is related to EATS (Estragon, Androgen, Thyroid and Steroidogenesis) modalities in vertebrate organisms i.e. there is a good mechanistic understanding on how those modalities can lead to an adverse effects. The OECD conceptual framework and the OECD 150 provide an overview of the existing assays for the endocrine disruptors (ED) hazard identification and guidance on how to interpret the results of those tests. A suitable testing strategy which allows the identification of ED properties of pesticides through EATS modalities is available for some taxa of non-target organisms (i.e fish and amphibians). The analysis confirmed that the available test methods and knowledge on birds’ endocrinology do not allow a full ED assessment although they can provide supportive information. In the case of reptiles, appropriate standard test methods are completely missing. In some circumstances, extrapolation between taxa could be scientifically supported. However, consideration should be given to other taxon-specific differences. Extrapolation between mammals and amphibians regarding the ED hazard identification through the thyroidal modality has been investigated in the past. A similar analyses has not been done for EAS modalities, however, in some cases extrapolation among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunction (more specifically egg production). The main scope of this work is to present a critical overview of the available standardised test methodology for the ED assessment of non-target organisms, including consideration on the extrapolation between taxa. In addition, possible future perspective and research needs are discussed.

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

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Analysis of nearly 500 surface water samples collected as part of the Great Lakes Restoration Initiative at 54 sites in tributaries of the North American Great Lakes Watershed confirmed the ubiquitous presence of Contaminants of Emerging Concerns (CECs) in anthropogenically impacted aquatic environments. Cluster analyses of commonly detected CECs in this data matrix suggests that the co-occurrence of approximately half of the CECs can be attributed to dichotomous urban or agricultural upstream land use. Mixtures found in watersheds with urban influences commonly contained steroidal estrogens, BPA, alkylphenols, pharmaceuticals and personal care products. Agriculturally influenced sampling sites contained herbicides and pesticides in addition to BPA and alkylphenols, but mostly lacked pharmaceuticals and personal care products. Almost 3,000 resident and caged sunfish (Lepomis spp.) were collected from 27 of the 54 sampling sites and analyzed for indicators of stress associated with CEC exposure. In the presence of high aqueous CEC concentrations, glucose concentrations spiked in sunfish
plasma and liver cells exhibited toxic stress response. Canonical correspondence analyses revealed that concurrent with indicators of toxic stress, biomarkers of reproductive potential declined. To further examine the population level consequences, fathead minnows (*Pimephales promelas*) were exposed in the laboratory for three generations to the empirically derived urban CEC mixture at three environmentally relevant concentrations. Mixtures at environmentally meaningful concentrations enhanced fecundity in the F2 and 3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicates that CECs in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans

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A number of exogenous compounds have the potential to interfere with the endocrine system of animals and may perturb vital endocrine processes to a degree causing an adverse effect (outcome) on ecologically relevant endpoints such as growth, development and reproduction. These endocrine disrupting (ED) effects have been well characterised in aquatic vertebrates and mammals due to their 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 in crustaceans. In the present paper focus on the application of AOPs to 1) develop linkage between endocrine mechanisms and adverse outcomes, 2) identify knowledge gaps and inform testing strategies, 3) identify sensitive species/taxa, 4) identify likely define toxicity endpoints suitable for Integrated Approaches for Testing and Assessment, IATA, 5) identify potential EDCs and 6) practical implementation of AOP in linked mechanistic testing. For these endpoints, a number of ED-related marker genes (fabp10a, apoa1, cyp2k19 and cytochrome P450) have been selected for testing in the liver: - a) nuclear receptors: e.g. estrogen receptor (ESR1) and hepatotoxicity-related marker genes (fabp10a, apoa1, cyp2k19 and cytochrome P450); - estrogenic activity: e.g. aromatase, cytochrome P450 and 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 structure and function, can influence VTG as a biomarker, since it is synthesized in the liver. Changes in VTG caused by non-endocrine hepatoxicity 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 the liver / exposed fish. Thus, we investigated the effects of two well-known hepatotoxicans, 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 (vgl1, vtg3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoA1, cyp2k19 and cytochrome P450); - hyaluronic acid (a biomarker for liver toxicity) levels in head/tail homogenates; - liver histology and ultrastructure; Both APAP and INZ had different effects on exposed fish. While APAP did not cause any histopathological alterations in the liver, INZ significantly induced hepatocyte degeneration. VTG levels in APAP-exposed females were elevated, while no effect was observed in INZ-exposed fish. Likewise, transcriptional responses in the liver differed between both compounds and indicate that both did interact with different endocrine- and hepatotoxicity-related pathways. The results from both studies will further be evaluated with respect to their potential for the development of an adverse outcome pathway (AOP) for interference of hepatotoxicity with the VTG response in fish.

663 Single Pulse Exposure of Different Life Stages of Zebrafish to the Selective Estrogen Receptor Modulator Tamoxifen Citrate


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 might generate - 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 endpoints, to assess growth and reproduction, as well as adult growth, sex ratio, vitellogenin levels and F1-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 (300 µg/L, 1000 µg/L). In sexually mature fish (group C) mortality was higher in males. A decline in fertility could be observed for group C, possibly related to the higher male mortality. Total egg numbers appeared unaffected. The results were mirrored for fish introduced as juveniles (group B): While fertility rates were not influenced negatively, fecundity was lower in remaining concentrations (125 µg/L, 250 µg/L). Changes in egg morphology were noticed shortly after exposure. Furthermore, F1-generation sex ratios, to assess reproduction, were disbalanced. Concerning F1-generation, a dose-dependent decrease in survival rates and growth. Although reproduction data are difficult to be attributed to endocrine activity, an influence on the endocrine system of the test animals seems apparent. Particularly sex specific effects in F0-animals as well as an impaired early-life stage in F1-animals are of highest interest. Further data on vitellogenin and reproduction will help clarifying pending questions. Additionally, several other accessible datasets from zebrafish research 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 assessment
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 biotransformation rate constants (kH) and half-lives (HLA) are also critical determinants of bioaccumulation. Here we present a tiered approach for screening the bioaccumulation potential of organic chemicals in air-breathing organisms. The tiered approach progresses from screening-level conservative assumptions based on Kow and Koa only to more realistic assumptions for, internal distribution, chemical properties and biotransformation (Tiers from 1 to 4 respectively). Biomagnification Factor (BMF) derived from a typical human diet as calculated by the Risk Assessment Identification And Ranking (RAIDAR) mode is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13W. Nicholls, U.S. EPA / ORD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology.

665 Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals
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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 phenoxy herbicide which acts by interrupting the photosynthetic electron transport chain. Like other phenoxy herbicides diuron is bio-transformed to 3,4-dichloroaniline (3,4-DCA) which occurs in plants, the liver of vertebrae 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 their toxicokinetics 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 phenoxy herbicides to fish embryos. For determining tissue concentrations after different times of exposure, freshly fertilized zebrafish eggs were exposed to the EC20, i.e., for diuron 2.86 mg/L and for 3,4-DCA 1.41 mg/L, pools of 7 embryos were shock-frozen at 13 time points from 1.5 to 120 hours post fertilization (hpf). The test compounds were extracted from the embryo tissue with MeOH/H2O and quantified using liquid chromatography coupled mass spectrometry (LC/MSMS). Depuration of test chemicals from the embryo tissue was examined in five different developmental stages of embryos that upon exposure to chemicals were transferred to clean medium and then sampled after 0.5, 1.5, 3, 6 and 24 hrs. The tissue concentrations for diuron reached 1Tmax around 48 hpf, Tmax 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 (k1, k2) were determined. Both elimination rates and residual of initial concentration after 24 hrs. of depuration differed between embryo stages. The search for possible metabolites showed that 3,4-DCA was transformed into 3,4-dichloroanilinid in the embryo and two products of N-demethylation of diuron were found. This confirms that both phase I and phase II metabolic enzymes are active from the first hours of embryo development and pinpoint 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 (freshwater oligochaete and estuarine polychaete) in NERIS/METo
A. Grech, C. Brochot, INERIS / Models for Ecosystem Toxicology and Toxicology METO

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 fulfil 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 assessment.
assessment of single chemicals. (iii) Development of PBTK models for environmental risk assessment of multiple chemicals. Generic PBTK models for single compounds in rainbow trout (Oncorhynchus mykiss), fathead minnow (Pimephales promelas), stickleback (Gasterosteus aculeatus) and zebrafish (Danio rerio) have been developed. Physiological description and parameters proposed by Nichols et al. [1] were updated by an extensive literature search. New mathematical functions were proposed to integrate the main factors influencing the toxicokinetics (water temperature, growth dilution, reproduction cycle,…). Default values for compound-specific parameters were estimated by QSAR models based on hydrobicity [2, 3]. An optional interaction terms was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998.. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

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

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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.
Poster Abstracts

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

MO001
An in-situ amphibian metamorphosis assay to evaluate oil spill-related toxicity in receiving freshwater systems
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Oil spills in different environmental conditions using zebrafish embryos

Oil spills are a global concern due to their capacity to affect wide areas of the ocean and the wellbeing of the subsequent restoration of the ecosystem. Early life stages of fish are especially sensitive to oil spills as they are unable to flee the area and lack mature detoxification systems to withstand the chemicals. They also represent a direct link to population consequences and resilience. The addition of chemical dispersants can facilitate the dissolution of some chemicals present in the oil and make them more bioavailable. In addition, some chemical dispersants have been proven to be toxic chemicals. The impact of crude oil on a specific ecosystem and its recovery potential are determined by the biotic and abiotic elements of the ecosystem such as species composition, temperature, oxygen level and salinity. At low temperatures the persistence of hydrocarbons in the environment increases. Based on the standard OECD test with zebrafish embryos, we have tested the toxicity of the chemical dispersant FINOSOL OSR52 and of the water accommodated fraction of a naphtenic North Sea crude oil produced with dispersant (WAF<sub>OL</sub>) or without dispersant (WAF<sub>OL-D</sub>) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAF<sub>OL</sub> or WAF<sub>OL-D</sub> and then used as passive dossiers. Exposure to the dispersant caused 100% of mortality at concentrations ≤50 mg/L. Increased prevalence of malformations were observed at concentrations ≤10 mg/L. In addition, higher tier tools, such as Microtox. In addition higher tier tools, such as Microtox. In addition higher tier tools, such as Microtox. In addition higher tier tools, such as Microtox. In addition higher tier tools, such as Microtox.

MO002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF PRODUCED WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
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The pursuit of excellence in managing risks associated with produced water discharges has led to continuous innovation of internationally acceptable risks assessment tools for determining the risks associated with produced water discharges. This study utilized a structured risk assessment framework for the assessment of potential risks from water discharges. At the centre of this structure is a comparative analysis of predicted environmental concentrations (PECs) of chemicals and effluents to predicted no effect concentrations (PNECs) of environmental receptors. However, the determination of the likelihood and severity of effects is complicated and based on an integrated evaluation of several Lines of Evidence (LoEs). This study utilized risk-based assessment tools from Shell’s tiered assessment framework for discharges. This framework was developed based on international good practice and includes screening tools that allow for a rapid assessment of discharges properties and associated risks like SMPE-GC and Microtox. In addition higher tier tools were applied like two way GCxGC, PETROTOX modelling and several levels of plume dispersion assessment. The objective is to determine the applicability of risk-based practice to the specific shallow offshore discharge, with possible replication to other shallow offshore or near shore discharges in Nigeria. It also assessed if discharges would be acceptable from an international perspective and whether indeed the risks are tolerable and as low as reasonably practicable (ALARP). Results of the assessment indicate that oil in water levels at or below 25mg/l there is low concern related to the environmental risk of the hydrocarbons in the PW discharge. Phenols and BTX came up as the highest risk contributors but Tier-2 modelling indicated that these substances quickly dissipate after discharge. PETROTOX modelling showed that the hydrocarbon fraction in the PW could not fully explain the observed PW toxicity. This led to a recommendation for qualification and registration of offshore chemicals and identified a need for the alignment considerations of future Biological Monitoring programs to international protocols such as OECD and ISO. Application of smart screening tools (Tier-1) for frequent PBT monitoring to address variability and for tuning and focusing the larger Tier-2 and 3 assessments.

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

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

MO004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea

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 small 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 different PAHs, accumulated in mussel tissues, and a battery of biomarkers in Baltic Sea mussels (Mytilus spp.) exposed to a common type of low-sulphur marine diesel oil produced by Neste Oil’s Poroovo refinery in Finland. The diesel oil was applied to mussel aquaria as a water accommodated fraction (WAF). The exposure setup 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 Envirolu 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 monitored from mussels of exposed treatments after a one week recovery period in clean water. Water and mussel tissue samples were also taken to chemical analysis of PAHs. Based on the sensor fluorescence data the initial PAH concentrations were ca. 30µg/L in WAF-high and 15µg/L in WAF-low treatments. In a semi-static system with mussels the concentrations decreased during 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 Eugenes brasiliensis along four tropical estuaries in the Brazilian Northeast
J.S. Silva, R.N. Alves, UFPE Universidad Federal de Pernambuco / Zoology;
MO006 Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances

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A recent study aimed to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heterocyclic compounds were detected in the EROD, GST, and CAT activities. These results were used to determine the potential of these compounds in the bioaccumulation of sulfur and nitrogen containing compounds.

MO007 Biochemical biomarkers and histopathology in juvenile Solea senegalensis for early warning assessment of marine ecosystem health

T. Briandieu, University of the Basque country UPV/EHU; A. Alves Dos Santos, University of the Basque country UPV/EHU / CEBET Research Group Dept Zoology; P. Alcalá, University of the Basque country UPV/EHU / CEBET Research Group Dept Zoology and Animal Cell Biology. The present study used juvenile Solea senegalensis, a species recognized as sentinel species in pollution monitoring programmes. The present study uses Solea senegalensis was exposed to three different experimental set-ups: (a) contaminated sediments; waterborne metal (Cd) and (c) waterborne organic pollutant (Benzo(a)pyrene). A battery of biochemical biomarkers was analysed in samples of liver and brain: Catalase, glutathione S-transferase, acetylenicinesterase and superoxide dismutase. Exposure to contaminated sediments led to reduction of catalase, glutathione S-transferase and superoxide dismutase activities and induction of acetylenicinesterase activities. Exposure to waterborne toxicants provoked a reduction of catalase and glutathione S-transferase activities. Biochemical biomarkers in sole were sensitive enough to differentiate degree of response after three days of exposure. Histopathological responses were detected after long-term exposures showing higher prevalence of liver alterations such as hyperaemia, melanomacrophage centres and necrosis.

MO008 BIOMARKER AND GENE TRANSCRIPTION VARIABILITY IN PERCH IN REFERENCE SITES USED FOR BIOMonitoring STUDIES

L. Förlin, N. Askar, University of Gothenburg / Department of Biological and Environmental Sciences; M. Töpel, University of Gothenburg / Department of Marine Sciences; T. Osterlund, Chalmers University of Technology / Mathematical Sciences; J. Parkkonen, J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences. The present study uses juvenile Perch (Perca fluviatilis) that has been used in biological effect monitoring of point sources in Sweden for many years, for example in studies of effects of industrial effluents. Since 1988, perch has also annually been included in a program for integrated coastal fish monitoring in three reference sites along the Swedish east coast, sites characterized by no or minor local anthropogenic influences. Long term studies of reference sites have identified patterns that were consistent with the natural variability of both physiological and biochemical endpoint (i.e. biomarkers) as indicators of change in relevant parameters. Using a set of physiological and biochemical endpoints (i.e. biomarkers) closer time trends for “early warning” signs of impaired health are noted in the perch from these three reference sites possibly as a result of increased baseline pollution. The data sets also show relatively large variations between years. To further investigate these trends and to identify E. S. Carvalho, UFRPE - Universidade Federal de Pernambuco / Zoologia. POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) are oil derived compounds known for their toxicity to aquatic organisms. Estuarine regions are frequently contaminated with PAHs as a result of urbanization processes and industrial activities, including the oil production chain. This study aimed to evaluate PAH biliary bioconversion and biochemical effects in the fish *Eugene brasiliensis* sampled along four estuaries in the state of Pernambuco, northeastern Brazilian coast. Fish were sampled in the Aquidinha river, Formoso River Estuarine System (AR-FRES), Massangana river, inside Sapu Estuarine Complex (MA-SEC), Barra de Jangada Estuarine System (BJS) and Bacia do Pina Estuarine Complex (BPEC). Bile fish samples were analyzed using fixed wavelength fluorescence to estimate equivalent concentrations of the PAHs naphthalene, phenanthrene and chrysene. Liver samples were analyzed for activities of biotransformation enzymes. Ethoxyresorufin-O-deethylase (EROD), and glutathione S-transferase (GST), antioxidant defense enzymes catalase (CAT) and glutathione reductase (GR), and acetylcholinesterase (AChE). Bile PAHs and biochemical biomarkers in fish sampled during an annual cycle in AR-FRES and MA-SEC indicated similar bile PAH concentrations and enzymatic activity levels between these estuaries, despite the different anthropogenic activity patterns. Sapu Estuarine Complex includes a developing industrial port complex, while-awesome text content extracted from the image. The text is about the effects of contaminants on fish, including the use of biochemical markers and histopathology to assess the impact of pollution. It also discusses the bioaccumulation of sulfur and nitrogen containing hydrocarbons in petroleum substances, and the variability of biochemical markers and gene transcription in perch from reference sites used for biomonitoring studies. The text is relevant to the study of marine ecosystems and the impact of pollution on fish populations.
Marine Biology and Biotechnology PIE/UPV/EHU
Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to know it has not been commonly used in high latitude study areas. In order to establish reference values of cellular- and tissue-level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm; large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromsø (69°40' N) and Trondheim (63°26' N) were sampled in the autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvBAS) in digestive gland epithelium, structural changes of digestive alveoli (MLR/MErr), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation in hepatopancreas 'relevant fatty acid signature', melanosis, parasitic burdens and atresia, higher weighed prevalence values than in the reference site were recorded in the two polluted sites from Trondheim. Differences between the two mussel sizes were recorded in parasitic burden, large mussels exhibiting a higher level of 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. Lyso and alkali lipases were a direct indicator of two effects of oil spills. In biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT10-13) and UPV/EHU (UFI 11/37).

MO010
Cytoxicity 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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MO010
Cytoxicity 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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MO012
Distribution and ecological risk assessment of palm stearin in coastal marine environments of Hong Kong after an accidental pollution in Pearl River Estuary, South China
G. Zhou, R.W. Lai, R.C. Sham, C. Lam, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K. Yeung, J.C. Astudillo, The University of Hong Kong; K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; M.M. Yun, Y.K. Yau, The University of Hong Kong / The University of Hong Kong / The Swire Institute of Marine Science
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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 reaching oil spill impacts in the Arctic areas, the effects of oil smothering of the macroalgae Fucus distichus, which is a dominant species in the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea, were studied. Effects of four different oil types were tested, including crude oil types, bunker oil and marine 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 seaweed surface was considered as relatively fast (T½ > 3–4 days).

MO015
Effects of oil spill on marine invertebrates and their potential to recover
M.F. Lemos, S. Silva, Instituto Politécnico de Leiria / MARE ILEIRIA

There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and 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 and isoenzyme activities were determined, for instance, the neurotoxicosis > 1 from exposure to larvicidal oil using Monte Carlo simulation, indicating that the current risk was unacceptable high. Hence, monitoring and control on the use of larvicidal oil as mosquito control pesticide would be urgently needed to mitigate its ecological risks.

MO016
Effects of oil on visual function and image processing. The present study provides evidence with a reduction in retinal layers and neuronal connections that play an important role in visual function and image processing. The results indicate that during the application of dispersants salinity plays a key role being different related to oil concentrations in water as well as biological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

MO007
Effects of water accommodated fractions of crude oil on the Baltic Sea blue mussel Mytilus trossulus at different salinities
A. Ahvo, Finnisk Environment Institute / Marine Research Centre; R. Turja, Finnish Environment Institute, SYKE / Marine Research Centre; A. Reunamo, Finnish Environment Institute / Marine Research Centre; J. Luhtinen, Finnish Environment Institute / Laboratory Centre; K.K. Lehtonen, K.S. Jorgensen, Finnish Environment Institute / Marine Research Centre

In the Baltic Sea accidental oil spills are mainly combated using mechanical collection. However, this method is insufficient in harsh weather conditions such as high waves or in the presence of ice. The use of dispersants is an alternative counteractive method but in the Baltic Sea their use is restricted by HELCOM recommendations since the chemically dispersed oil may cause severe toxic effects on the marine biota. In addition, the use of dispersants in areas where the use is restricted by HELCOM is not well studied. In the present study, impacts of a crude oil and the dispersant Finsol 51 on marine biota were investigated under cold conditions (5°C) 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-vertical aquarium experiment. Concentrations of WAF or WAF-D in the aquarium 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 acetylhioneinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial communities extracted from the gills and digestive glands of the mussels were investigated by sequencing of 16S rRNA genes and quantitative PCR targeted to bacterial PAH-degradation genes. Water samples from the exposure aquarium 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 C10-C40). A significantly higher oil concentration was observed at the lower salinity WAF-D 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 being different related to oil concentrations in water as well as biological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

MO008
Multiple biomarkers on the estuarine guppy Poecilia vivipara to monitor two Integrates of tropical estuarine ecosystems
A.G. Torreiro-Melo, UFPE - Universidade Federal de Pernambuco / Department of Zoology; J.S. Silva, UFPE - Universidade Federal de Pernambuco / Zoology; E. Zanardini-Lamarndo, Universidade Federal de Pernambuco / Department of Oceanography; P.S. Carvalho, UFPE - Universidade Federal de Pernambuco / Zoology

Integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuarine ecosystems 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

MO014
Effects of a coastal oil spill on marine invertebrates and their potential to recover
M.F. Lemos, S. Silva, Instituto Politécnico de Leiria / MARE ILEIRIA

There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and 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 and isoenzyme activities were determined, for instance, the neurotoxicosis > 1 from exposure to acetylhioneinesterase, oxidative stress enzyme catalase and superoxide dismutate, oxidative damage DNA damage and lipid peroxidation, energy metabolism lactate and isocitrate dehydrogenase, and electron transfer system, and carbohydrates, lipids and proteins energy reserves were assessed. The impacts of this oil spill over the two coastal invertebrate species’ biomarkers was compared over the differentially PAH contaminated sites and their sensitivity evaluated. Also, organism’s ability to recover over time was also addressed and these tools and species potential for costal monitoring pollution scenarios discussed.

MO019
Effects of oil exposure on visual function in early life stage fishes
J.F. Magnusson, University of North Texas / Biology; A.J. Klurisgara, The University of Texas at Austin / Marine Science Institute; E. Allmon, The University of Texas at Austin; A. Esbaugh, University of Texas Marine Science Institute / Department of Marine Science; R.M. Heuer, University of Miami / Marine Biology and Ecology; J.D. Stiegitz, M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; A.P. Roberts, University of North Texas / Advanced Environmental Research Institute

The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico, coinciding with peak spawning periods of ecologically important fish species, such as the mahi-mahi (Coryphaena hippurus), red drum (Sciaenops ocellatus), and sheepshead minnow (Cyprinodon variegatus). Downregulation of genes important in eye development and function, as well as morphological abnormalities have resulted from polycyclic aromatic hydrocarbons (PAHs) present in the oil at concentrations less than 10 µg/L, affecting fish vision. Mahi-mahi, red drum, and sheepshead minnow embryos were exposed to weathered crude oil and assessed for visual function using the flicker-fusion principle to monitor an optomotor response, with subsequent histological analysis taken of each larvae’s retina. Oil-exposed larvae exhibited a reduced PAH-dependent optomotor response with a reduction in retinal layers and neuronal connections that play an important role in visual function and image processing. The present study provides evidence that weathered crude oil affects the visual system in developing larval fish, and relates oil-induced histological effects to behavioral endpoints. 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).
The aim of our research was to determine the presence of petroleum pollutants for the alluvial area of the river, groundwater as well as Sava river. The methodology was developed using appropriate protocols and applied in contaminated areas for the analysis of soils contaminated with petroleum. Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are detectable compounds in contaminated soils, gas and soil. BTEX is ubiquitous in the aquatic environment due to both natural and anthropogenic sources (i.e. oil spills and rivers flowing over surface bitumen, and pipeline ruptures, grounded ships, storage tank leaks and soil contamination with gasoline). It is intended to validate the step process. The steps are based on a standard method where a dichloromethane extract is used as a mobile phase methanol and H2O acidified with 250μL of H2PO4 (70:30, v/v), Eclipse XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 mL min⁻¹, λ = 205 nm and T = 50 °C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a photodiode array detector and a diode array detector. Data was acquired using OpenLAB A.01.02 software. A calibration curve for BTEX standards was constructed in 7 concentration levels: 1 to 68 ppb for benzene, 1 to 80 ppb for toluene, 1 to 80 ethylbenzene and 1 to 85 for xylene. The curves were submitted to inter- and intra-assay repeatability analyses. Standard curves with adjustments above 0.991 relative standard deviations (% RSD) of less than 1.9% were obtained.

Reproductibility 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 analyses of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and to 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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Habitat plant “New Belgrade” is located on the left coast of the Sava River, about 1km from its estuary in the Danube, and represents a potential source of petroleum pollutants for the alluvial area of the river, ground water as well as Sava River. The aim of our research was to determine the presence of petroleum pollutants and their vertical migration in the alluvial area of Sava River. The investigation was started in the summer of 2015. The soil was sampled in three different microlocations (Z1, Z3 and Z5, see appendix) 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 fractionated by column chromatography into fractions of: saturated hydrocarbons (Fraction I), aromatic hydrocarbons (Fraction II), and polyaromatic compounds (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 polyaromatic compounds (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 and composition of the environment. References: Miletic S., Ilic M., Avdalovic J., Sovevic Knudsen T., Belkoski V.P., Braminij Jovancivevic B., Vrvice M.M. (2015) Oil pollution in the vicinity of a heating plant in New Belgrade (Serbia) – influence on the quality of the surrounding soil and sediments. 16th European Meeting on Environmental Chemistry, EMCAS, Book of Abstracts. November 30 – December 03. 2015. Torino, Italy.
MO023
Risk-based assessment of produced water discharges - need for alignment
M.G. Smit, Shell International
Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water reinjection (PWRI), discharge of treated produced water is a commonly used disposal route applied in line with ALARP principles (As Low As Practicable). 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 tests 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, another method might accept 100m (USEPA). 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 implemented by the industry to offshore produced water disposal, showing main assumptions, input requirements, risk endpoints applied and corresponding assessment objectives. Examples will be used to highlight the need for further harmonization of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

MO024
Spatial and temporal analysis of the risks posed by total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait
E.E. Nicolaus, Cefas Lowestoft Laboratory / Environment and Ecosystems
Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb and Zn, and total petroleum hydrocarbons were analysed from water samples collected from 23 stations since 1984 from Kuwaiti coastal waters. Here it was investigated whether concentrations of these determinates are at levels above Kuwaiti and internationally established assessment criteria (AC). The results indicate that Cu and Cd had the most Kuwaiti AC breaches over time. Comparing the data of the last sampled year to the least stringent international AC, then Cu and Cd showed breaches at all stations. The trend in trace metal concentrations was significantly downwards in Cd and Hg. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

MO025
Temperature-dependent toxicity of Naphthenic North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
L.d. Miguel, University of the Basque country (UPV/EHU) / Department of Zoology and Animal Cell Biology, U. Izagirre, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biotechnology and Biotechnology PIE; L Mariani, Eusko Herriko Unibertsitatea / Zoology & Animal Cell Biology (Sci & Tech Fac)
Maritime traffic and oil platforms in the North and Baltic Sea have been growing during the last years and the risk of spill accidents is correspondingly increased. Drastically 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 GISHELL a more detailed present work was assembled 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-dependent toxicity, acute toxicity bioassays using larval and embryos of the sea urchin Paracentrotus lividus (Lamarck) were performed. After the exposure period, EC₅₀ values were calculated and length of larvae was measured to assess 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, dispersant and chemical dispersant toxicity. In the study, larvae abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in 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 LDM FPUI/505137 grant) and the Basque Government (Consolidated Research Group GIC IT10-13).

MO026
Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentrarchus labrax L., 1758) larvae
E.E. Nicolaus, Cefas Lowestoft Laboratory / Environment and Ecosystems; L. Mariani, CNR-IRSA / IRSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Virno Lamberti, ISPIRA Institute for Environmental Protection and Research The Higher Institute for Environmental Protection and Research (ISPIRA) is responsible for the evaluation of the potential environmental impact on marine ecosystems caused by the Produced Formation Water (PFW) discharged from Italian gas offshore platforms. A multidisciplinary approach has been applied through the monitoring of chemical-physical characteristics of water and sediment, matched with biological investigations, such as ecotoxicological bioassays on bacteria, algae, rotifiers, crustaceans, echnidine and fishes. The PFW is an efficient containing complex mixtures of contaminants, the composition of which may change with time. It is therefore necessary to analyse a large number of samples taken over a long period of time in order to adequately assess the toxicity of this effluent. The present paper describes the specific toxic in within the whole study; that the variability of the acute toxicity responses of fish to PFW collected on two offshore gas platforms in three years (2003-2005). More sensitive life stages (post larva of 25-45 days old) of European sea bass (Dicentrarchus labrax L., 1758) were used. Tests were performed over 24h and 96h and the dilutions 6.25-12.5-25-50.0-100.0 % PFW were used. The LC50™ on post larva ranged from 17.67 ± 37.42 % PFW. The LC50™ on post larva ranged from 6.68 ± 16.51 % PFW. The PFW acute toxicity responses showed a temporal variability of PFW as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.02% PFW); 96h (10.84 ± 3.37 % PFW).In accordance with GESAMP recommendations (2007), the work stresses the importance of accurate estimates and measures of oil inputs into the sea, by increasing the number and frequency of samples needed to estimate the environmental hazard of PFW.

MO027
Tentative identification of halogenated polyyclic aromatic hydrocarbons in biota
Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francisco, I. Idowa, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry Polyyclic aromatic compounds (PACs) are a complex class of compounds that are present in fossil material such as petroleum oils. The most common PACs are the polycyclic aromatic hydrocarbons (PAH). PACs include many halogenated, especially the halogenated PAHs, non-halogenated alkylated PAHs and heterocyclic aromatic compounds that contain S-, O- and N-atoms. Halogenated PACs especially those containing chlorine atoms are likely to be more environmentally persistent than their non-halogenated analogues because of the presence of the halogen atoms. In addition, the toxicity of some halogenated PACs have been found to be similar to dibenzo-p-dioxins and dibenzofurans. Because Cl and Br ions are present in the marine environment, we hypothesize that halogenated PACs can be formed and will be bioaccumulate in biota samples. Here we present a method used on high-resolution gas chromatography coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in the electron ionization mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chlorophenone is present in this sample. In addition, we observed multiple peak reports on a GC/MS chromatogram coupled to mass spectrometry with specific multiple reaction monitoring (MRM) ion transitions in the electron ionization mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chlorophenone is present in this sample. In addition, we observed multiple peak reports on a GC/MS chromatogram coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in the electron

MO028
The experience with the use of biomarkers as Risk Indicators in Environmental Risk Assessment of oil based discharges offshore
S. Sanni, International Research Institute of Stavanger / Environment; E. Lyng, D.M. Pampanin, International Research Institute of Stavanger / Environment

150 SETAC Europe 28th Annual Meeting Abstract Book
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 in an oil leakage monitoring study in a Norwegian oil field. Research Centre for Columnar Monitoring (WCM) program on the Norwegian Continental Shelf for assessment of PW effects. Cases including both a typical PW discharge and an alternative discharge make the data set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the study, concentration data from the latest surveys in the biomarker program and ecotoxicological experiences obtained in mussels observed at the baseline site indicate that during the early winter the health status of native mussels in the very low salinity central 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 Nº679266) and a Basque Gov. fellowship to EGU

**MO029**

**Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil**

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The brackish Baltic Sea is a fragile ecosystem potentially sensitive to oil spills. Chemical dispersants are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on biota. The Baltic Sea blue mussel (Mytilus trossulus) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and acclimated at the experimental temperature of 5°C to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern Arctic species. The central position of the Baltic Sea and experiences obtained in the Baltic Sea and corresponding environmental risk assessments demonstrated that PW toxicity may be associated with compounds that are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that compounds not amenable to GC, or that contained in the apolar fraction this was 35%. This suggests that PW toxicity is not directly correlated with the GC quantifiable fractions, 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 PWs where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates that PW toxicity may be associated with compounds that are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that contribute to the PW–based fractionation of oil in water. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

**MO030**

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

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Regulation of produced water (PW) discharges on the Norwegian continental shelf is largely based on a maximum 0% toxicity may be associated with compounds that are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that compounds not amenable to GC, or that contained in the apolar fraction this was 35%. This study demonstrates 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**


To comprehend the implications of large oil spills in the Arctic marine environment, we need a better understanding of the toxicokinetics of oil in true Arctic species. The central position of the Baltic 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 Nº679266) and a Basque Gov. fellowship to EGU

**MO030**

**Toxicity of diluted bitumen to freshwater fish and invertebrates**

P.Y. Robidoux, V. Bérubé, AGAT Laboratories Ltd / Specialty services Division; J. Leblanc, Fisheries and Oceans Canada / Biologist, Contaminated Sites; M. Desrosiers, Public Services and Procurement Canada

The acute and chronic toxicity of two blends of diluted bitumen ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to different concentrations of physically-dispersed (water accommodated fraction; WAF)and chemically-dispersed (chemically-enhanced WAF; CEWAF), Toxicity of weathered, unweathered and dispersed Access Western Blend (AWB) dilbit was evaluated on fathead minnnow (Pimephales promelas). Toxicity of weathered and unweathered Cold Lake Blend (CLB) dilbit was assessed on Rainbow trout (Oncorhynchus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceriodaphnia (Ceriodaphnia dubia). For fathead minnow, 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 loss 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 = 1.86 g/L). Temperature was marginally affected by CLB toxicity; fish mortality was observed with the weathered CLB. The reproductive effects on ceriodaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC50 = 1.99 g/L). Volatile organic compounds (VOC), poly cyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

**MO031**

**Regulation of produced water (PW) discharges on the Norwegian continental shelf**

P.Y. Robidoux, V. Bérubé, AGAT Laboratories Ltd / Specialty services Division; J. Børresen, K. Østensen, K. Bratberg, SINTEF Ocean / Environmental Technology; T. Jager, DEBtox Research / Dept of Theoretical Biology; J. Farkas, SINTEF Ocean / Environmental Technology; D. Altin, BioTrix; T. Nordtug, SINTEF Ocean / Environmental Technology

Regulation of produced water (PW) discharges on the Norwegian continental shelf is largely based on a maximum 0% toxicity may be associated with compounds that are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that contained in the apolar fraction this was 35%. This study demonstrates that PW toxicity is not directly correlated with the GC quantifiable fractions, 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 PWs where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates 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.
CLIs, 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 CLIs than the CVs, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors that may contribute to this difference.

MO035
Seabird-derived contaminants and genotoxicity in 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 biovecors 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 and play a vital role in the decomposition and mineralization of the organic matter. 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 isotope ratios 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 δ13N) 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 of different seabird influence, no association between δ13N 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 polybrominated diphenyl ethers (PBDEs), and chlordanes (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 micronucleus frequency were associated with both Hg and contaminant load, increasing with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

MO036
Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013 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; E. Borga, Department of Biosciences, University of Oslo / Department of Biosciences.

Antarctic 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 biovecors 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 and play a vital role in the decomposition and mineralization of the organic matter. 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 isotope ratios 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 δ13N) 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 of different seabird influence, no association between δ13N 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 polybrominated diphenyl ethers (PBDEs), and chlordanes (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 micronucleus frequency were associated with both Hg and contaminant load, increasing with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

MO034
Using the hagfish (Myxine glutinosa) to study biological effects of a wet 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. Tørnes, Norwegian Defense Research Establishment; P. Vaitukaitis, Finnish Institute for Verification of CWC Chemical Weapons Convention / Department of Chemistry, University of Helsinki; T. Lang, Thünen Institute of Fisheries Ecology; A. Lastumäki, K.K. Lehtonen, Finnish Environment Institute / Marine Research Centre.

The sea bottom of the Skagerrak Strait (North Sea) contains ca. 45,000 tonnes of chemical warfare agents (CWA) dumped after the Second World War. Entire ships loaded with CWAs were sunk and slowly sunk are still laying on the bottom, used as lubricating oil and coal samples. Resolution of individual isomers of interest was observed on the 30m primary column and much more evident on the 60m column. Undoubtedly, the peak capacity and vast database of information provided by 2DGC-HRTOF/MS for different sample matrices is an asset in the field of environmental research. This will aid isomer-specific measurements of known toxic alkyl homologues in environmental samples as well as proper identification of prominent ones. Also, PAHs and alkyl-PAHs profiling patterns have proven to be useful in source apportionment.

MO033
Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples I. Idowu, University of Manitoba; W. Johnson, University of Manitoba / Chemistry; O. Francisco, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; J. Stetefeld, University of Manitoba / Chemistry; C. Sandau, Chemistry Matters; T. Obal, Maxam Analytics International Corporation / Scientific Services; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry.

Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and identification of polycyclic aromatic compounds in environmental samples were performed from muscle samples and separate whole fish samples, and the results indicated, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors that may contribute to this difference.

Wildlife ecotoxicology: laboratory dosing studies to field
of south polar skua during the breeding season. Keywords: Antarctic, south polar skua, stable isotopes, temporal variation, OHC

MO037 Evaluation of malformations induced by a hospital effluent of Tolucu (Estado de México) in Lithobates catesbeianus
H. Islas-Flores, Instituto de Ecología, Universidad de la Sabana, Instituto de Ecología, University of the State of Mexico / Toxicology; I. Pérez-Alvarez, Universidad Autónoma del Estado de México / Environmental Toxicology; L. Gómez-Oliván, Autonomous University of the State of Mexico / Chemistry; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. Sanjuan-Reyes, Autonomous University of the State of Mexico / Chemistry; O. Dublan-Garcia, Universidad Autónoma del Estado De México / Experimental Chemoecology. The main aim of this study was to determine the health parameters of fish from the River Nidda and its tributaries Horloff and Usa in Central Germany. The Nidda river system is monitored fish upstream and downstream in general showed vacuolisations, unsatisfactory condition throughout most of its stretch, whereas upstream areas exposed to this hospital effluent will be malformed in the absence of mortality compared to X. laevis and, therefore, can be considered as a sensitive and useful species to evaluate toxic effects of contaminants with the FETAAX assay.

MO038 Monitoring fish health in a densely populated catchment in Central Germany
M. Schweizer, University of Tuebingen / Animal Physiological Ecology; A. Dieterich, S. Betz, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; N. Corral Morillas, Eberhard Karls Universität Tübingen; C. Dewald, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; D. Leim, Eberhard Karls Universität Tübingen; L. Miksch, S. Nelson, V. Prozmann, J. Rösch, Horloff, Eberhard Karls Universität Tübingen / Physiological Ecology; R. Triebkom, University of Tuebingen / Animal Physiological Ecology; H. Köhler, University of Tuebingen / Animal Physiological Ecology
In the frame of the joint project Nidda Man coordinated by the Goethe University Frankfurt/Main we investigated health parameters of fish from the River Nidda and its tributaries Horloff and Usa in Central Germany. The Nidda river system is regarded as a typical river system for central Europe as it passes a very densely populated area and as it is heavily influenced by anthropogenic factors including agriculture, communal waste water and industrial discharges. To get a broad overview of the situation fish face in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment 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 and aryl hydrocarbon) and cholinesterase (EC50, and the teratogenic index (TI) was obtained. Results indicates that lower concentrations of the hospital effluent induced slightly higher malformations and lethal effects in X. laevis (EC50=0,132%, LC50=0,508%, IT=3,8) and in L. catesbeianus (EC50=0,351%, LC50=1,431%, IT=4,0), the main alterations being microcephaly, cardiac and intestinal defects. Results show that the river system from a biological point of view is not in a good (as defined by the EU Water Framework Directive) but rather in a moderate to unsatisfactory condition throughout most of its stretch, whereas upstream areas mainly perform worse than sampling sites downstream. This is noticeable in results obtained by the Dar-T, in particular. However, histopathology of the liver from fish exposed to this hospital effluent indicates that general showed vacuolisations, inflammations, haemorrhages in the tissue, and even some necrosis. Our results revealed that, in the case of the Nidda and its tributaries, there is an urgent demand for action to strongly improve the biological integrity of this system.

MO039 Multigenerational toxicity of Fipronil to Folsomia candida
D.D. Oliveira, C.M. Reganhan Congelain, SCHOOL OF TECHNOLOGY UNICAMP; V. B. Menezes-Oliveira, Universidade de Sao Paulo / Department of Hydraulic and Sanitation
Fipronil is a pesticide widely used on agricultural pest control, especially in sugarcane crops. This compound acts as an inhibitor of nerve signals in insects, and pose as a risk to non-target terrestrial organisms (i.e. the collombolan 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 variation 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 Migelus flavus in sugarcane crops (RD = 1.3 mg of the commercial product / kg of dw soil), what means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (mg kg-1) of soil, for the first, second and third generation, respectively. 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 Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities
J. Val, D. Ballestero, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. López-Martínez, A.M. Mainar, Universidad de Zaragoza; M. Pino, San Jorge University / Facultad ciencias de la salud Universidad de La Laguna
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 scant 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 a ChE level of 0,74 mg/l (0,63-0,89) (p> 0,001), exposing periphyton to fipronil under standard medium. However, toxicity was almost inexistent when assays were done using natural river water. In this last case, the bioavailability of the fipronil was hypothesized to be reduced by natural substances present in the river water (solid suspended solids, organic matter, etc...). These results would contribute to a more realistic assessment of the environmental impacts of the use of this kind of pesticides.

MO041 Use of organophosphorus insecticides in agriculture lands, in a simple test birds says please no!
A.N. HUIDUD LEON, Universidad Juzerel del Estado de Durango / Facultad de Medicina Veterinaria y Zootecnia; M. Pereda Solís, Universidad Juzerel del Estado de Durango / FMVZ; J.H. Martínez-Guerrero, Universidad Juzerel del Estado de Durango / Facultad de Medicina Veterinaria y Zootecnia; M. GUERRERO CERVANTES, Universidad Juzerel del Estado de Durango / FMVZ
Due to the human population increase and the consequent high demand for food, each day a larger area of the planet is dedicated to the practice of agriculture. Crops favor the reproduction of various organisms (invertebrates and vertebrates) that are combated with large amounts of pesticides, it are chemical compounds used extensively, and so all organisms are exposed from different sources such as food, water and soil, therefore the toxicity of agrochemicals, as well as the patterns of use and abuse that is made to them are of general concern. These pesticides are a great threat to 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 inhaling the crop fields and its surroundings. The OP affects the nervous system by inhibiting the function of the 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 decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrows showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

MO042 Implementation of a worst-case landscape scenario for population modelling of a fungicide applied in cereals
M. Wang, WSC Scientific Grobocik / Dept Efate; Modelling; T. Preuss, Bayer Ag / Environmental Safety; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team
In many cases EU member states prefer the use of country specific scenarios for the exposure or risk assessment of pesticides. This is sometimes requested due to specific geographical features or agricultural practice. In the present example, we demonstrate how the specific agricultural situation of the Netherlands was taken into account for the selection of landscape scenarios for use in population modelling. It is first shown how a country specific landscape scenario is developed. Then, the dose response obtained in a rat reproduction study with an azole fungicide is employed in a population-level risk assessment on small herbivorous mammals (Common vole, Microtus arvalis). The margins of safety obtained in that assessment were found to be lower than the non-effect levels expected under realistic worst-case field conditions.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in freshwater turtle carapace scales
L. Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC) / UCLM-CSIC-JCCM
The mobilization of metals from the earth’s crust due to anthropogenic activities, such as mining, is one of the main contamination routes for wildlife. With the objective of biomonitoring and validating non-invasive methods for metal analysis in reptiles, levels of lead (Pb) and mercury (Hg) in blood, faeces and carapace scales of freshwater turtles (Mauremys leprosa, n=86) from historical mining areas (i.e. Valle de Alcudia-Sierra Madrona district for Pb, Almadén district for Hg) in Central Spain were analysed. The highest levels of blood Pb were found in the animals collected from the area of Valle de Alcudia-Sierra Madrona, more specifically from Solana del Pino, with an average (±SD) of 5.59±3.66 μg/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 blood metal concentrations and body weight or sex of the animals. The highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.83±8.44 μg/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 activated as a defense mechanism. Blood levels of these two elements were above those reported as susceptible to cause sublethal effects in reptiles for the vast majority of terrapins from the most contaminated sites (100% of terrapins from Solana del Pino with blood Pb levels > 15 μg/dl; 70.3% from Almadenejos with blood Hg levels > 2.76 μg/dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R²=0.765, P<0.001), but not for Hg (R²=0.1362, 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 Santaliestra, 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 hazards for amphibians; 4) Identify proposed non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. For amphibians, greater coverage or surrogacy exists for the aquatic larval stage and short term effects, with less coverage of the adult terrestrial stage, reproductive toxicity, and the potential for the pesticides to impact reproduction routes. To cover important life stages, exposure routes and effects, tests addressing dermal overspray and reproductive toxicity in amphibians may be needed. The analysis for reptiles will be presented in a separate poster. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of amphibians within the remit of the PPP authorization.

MO045 European common frog (Rana temporaria) larvae show subcellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bt) exposure levels used in mosquito control
S. Allégier, 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 agent for use in either health-related mosquito control or the reduction of nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to 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 irrespectively 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
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Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to increased seawater intrusion. Coastal low-lying ecosystems are considered very vulnerable to salinity changes. Among coastal ecosystems that will be impacted with seawater intrusion are wetlands, which constitute hotspots of biodiversity and represent relevant ecosystems for amphibians. This class of vertebrates holds the highest potential of endangerment due to such salinization. This class of vertebrates holds the highest potential of endangerment due to such salinization. Among coastal ecosystems that will be impacted with seawater intrusion are wetlands, which constitute hotspots of biodiversity and represent relevant ecosystems for amphibians. This class of vertebrates holds the highest potential of endangerment due to such salinization. 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 hazards for amphibians; 4) Identify proposed non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. For amphibians, greater coverage or surrogacy exists for the aquatic larval stage and short term effects, with less coverage of the adult terrestrial stage, reproductive toxicity, and the potential for the pesticides to impact reproduction routes. To cover important life stages, exposure routes and effects, tests addressing dermal overspray and reproductive toxicity in amphibians may be needed. The analysis for reptiles will be presented in a separate poster. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of amphibians within the remit of the PPP authorization.
with increasing salinity. Although significant interactions between temperature and salt concentration were registered, a pattern of influence in the temperature was not observed. Adverse effects were observed at the lowest tested salinity levels, which suggest that these species are highly vulnerable to small salinity increases and would be at high risk under seawater intrusion scenarios. Keywords: Salinity; toxicity; amphibia

MO047  
**EFFECTS OF THE EXPOSURE OF LARVAS OF Dendropsophus columbianus (ANURA: HYLIDAE) TO WATERS CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES**  
V. Rojas, Santa Maria University of 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. colombianus* 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 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%), both over the length of the 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 reveal metamorphic arrest of metamorphosis, show a time of this process that approximates to the time that the species experimented in the control (134 days) and probably, to the time of this in situ.

MO048  
**Risks for amphibians and reptiles by dermal exposure to pesticides**  
F. Stremmel, EFSA / Pesticides Unit; P.J. Adrianiuse, Alterra Wageningen University and Research Centre; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Physopharmacy, Athens, Greece

Amphibian and reptilian species are found in agricultural landscapes. Some inhabit water bodies either permanently or during some time of their life cycle. Others use predominantly land or water bodies. Some amphibians and reptiles show a greater dermal exposure through fields and some reside in fields and field margins where they can be exposed to pesticide residues in food items, water, soil and plant surfaces. A number of studies indicate that pesticide exposure can lead to severe impacts with up to 100% mortality from overspray at field rates for some 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: *Disclaimer: The views expressed in this presentation do not necessarily represent the views of the U.S. EPA or the United States.*

MO050  
**Long-term survival of mancozeb exposed common vole populations from one to the following reproductive season**  
F. Von Blanckenhagen, 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 delayed or that the reproduction in the following season might be affected by exposure during a previous application season. Against this background we monitored individually marked common vole populations from a long term effect study on spray applications of Dithane M-45 (Mancozeb 80% WP) during one reproductive season further on into the following reproductive season. The test item Dithane M-45 was applied four times in June according to Good Agricultural Practice at an application rate of 2 kg a.s./ha. Trapping and marking of voles in the same investigation plots was conducted until September, followed by further trapping until spring of the following year and the onset of the new reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects resulted in very similar patterns in treatment and control plots, and the data show no indication that common voles were negatively affected by multiple applications of the test item also in the following year. Furthermore and up to now not documented for wild living common voles, the data gives evidence that free-living common vole individuals can reproduce for more than one reproductive season.

MO051  
**An analysis of important life stages, exposure routes and test endpoints in reptiles with regard to coverage by existing risk assessment regulatory requirements for pesticides**  
A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC); R. Sharp, EFSA / Pesticides Unit; J. Kiwiet, University of South Alabama / Biology; S. Santaliestra, Institute for Game and Wildlife Research (IREC); B. Toro, Universidad de Caldas / Biological Sciences

A central task of the EFSA working group was to analyse the exposure of amphibians and reptiles to pesticides in the environment and to evaluate the method to determine 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: *Disclaimer: The views expressed in 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. Kiwiet, University of South Alabama; C. Aubee, US Environmental Protection Agency / Risk Assessment Division Office of Pollution Prevention and Toxics

Concerns have been raised that the current risk assessment of pesticides may not adequately cover amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion for screening studies (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 method. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for these groups; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide suitable information allowing for extrapolation to assess the hazard/risk for amphibians and reptiles; 4) Identify proposed
non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians and reptiles. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. Reptiles have very little data with which to assess the coverage of important life stages and exposure routes. Current knowledge suggests that surrogacy based on bird or mammal data may not be appropriate for the juvenile and adult stages of reptiles, though data are very limited. Reptile eggs are not covered by any aspect of the current risk assessment paradigm, but it is unknown to what extent reptile tadpoles lay eggs in crop fields, and how likely exposures are to occur to eggs under realistic scenarios. Therefore, more data are needed to determine if this is a vulnerable life stage that needs specific consideration. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to reptiles were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of reptiles within the remit of the pesticide authorization.

**MO052 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 and society. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecology (e.g., aquatic and terrestrial life-stages in general, life-history patterns and habitat preferences) make this taxon in particular vulnerable to pesticide applications in agricultural landscapes. It is emphasized that detailed ecological data of especially terrestrial amphibians is still under-represented but required for a comprehensive risk evaluation of all amphibian life-stages. The aim of the project Amphimove is to fill the gap on terrestrial life-stage events 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**

A. Sowards, 1, 2, 3 S. Tomé sea turtles of São Tomé and Príncipe

This study investigated sensitivities to activation of AHRs in an in vitro test system using embryonic Xenopus laevis and African clawed frog. 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, PeCDF, PCDF, and 3,3',4,4',5-pentachlorobiphenyl (PCB 126), or 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Further, in vitro AHR transcription assays were used to determine sensitivity to activation of the AHR1 isoform of African clawed frog and common snapping turtle to these selected DLCs. It is anticipated that this research will result in a single qAOP linking in vitro activation of the AHR to embryo-mortality with taxonomic applicability across phylogenetically diverse oviparous vertebrates, including birds, reptiles, amphibians, and fishes. This qAOP could guide more objective ecological risk assessments of DLCs to diverse taxa which are not easily studied, such as native species of reptiles and amphibians.

**MO054 Do historically metal-exposed amphibian populations acquire resistance to lethal levels?**

I. F. Morão, S.C. Novaes, Politecnico Institute of Leiria / MARE IPELeiria; I. Vieira, A. Ribeiro, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The aim of this work was to determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and 2) assess if tadpoles from impacted sites showed increased tolerance to metals relative to tadpoles from reference sites. Metal body burden, oxidative stress biomarkers and metallothioneins (MT) were measured in Pelophylax perezi tadpoles from reference and metal contaminated sites. Additional tadpoles (20 per site) were collected and exposed in lab conditions during 24h to Hg or Pb levels above the median lethal concentrations reported for amphibians (1.5 and 10.5 mg/l, respectively). The parameters mentioned above plus mortality were monitored at the end of the assay. Field-collected tadpoles from Pb and Hg polluted sites had higher metal body burden than those from reference sites (median per site as d.w. 540.4-708.1 vs 2.6-9.5 mg Pb/g, 768.2-3103.5 vs 0.1-11.6 mg Hg/g; p<0.01). Levels of MT (median, μg/g tissue) were significantly higher in tadpoles from Hg polluted sites than in the rest of locations (248.5-307.7 vs. 63.9-136.6 vs p<0.01), suggesting that MT can be induced in natural populations, by the sum of environmental stress factors. Exposure to Hg caused mortality of all individuals, while Pb did not result lethal to tadpoles. Laboratory exposure revealed that experimental treatment rather than pollution at the origin site determined Pb body burden (controls: from reference site 96.7-120.4 mg, from Pb site 118-491.6 mg; Pb-exposed: from reference site 369.79-35670.4 mg from Pb site: 9043.5-78452.4 mg), showing that Pb was readily bioavailable for exposed tadpoles. Lab exposure to Pb increased MT levels in tadpoles from reference sites (exposed vs. non-exposed: 116.3 vs. 41.70 μg/g; p< 0.001), but not in those from Pb-polluted areas. Oxidative stress biomarkers did not differ either between origin sites or because of experimental exposure to Pb. MT levels in tadpoles from reference populations were taken to that laboratory and kept during the exposure periods. The Protective capacity of MT was assessed in the laboratory (105.99-138.66 vs 29.72-41.70 μg/g; p< 0.05). This could be a consequence of a reduction in the laboratory of stress sources other than metals that can also induce MT synthesis (e.g., thermal stress). The fact that this decrease was not observed in tadpoles from Pb-polluted sites (105.61-109.41 vs 193.50-130.23 μg/g; p< 0.05) would suggest that these animals may have high constitutive MT levels.

**MO055 Assessment of metal contamination levels and stress responses of endangered sea turtles of São Tomé and Príncipe**

I. F. Morão, S.C. Novaes, Politecnico Institute of Leiria / MARE IPELeiria; I. Vieira, A. Ribeiro, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

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

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egg spawning and its success. Results showed significant correlations between expression of some genes and metal contaminant levels, pinpointing some candidate genes to be used as biomarkers of interest for biomonitoring campaigns, which worrying function highlights the need for a close follow-up of these organisms. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these turtle species nesting in S. Tomé which, given their classification as endangered species (IUCN red list), is of paramount importance to contribute for conservation measures and management.

MO056 Ecotoxicology of Africa’s three largest reptiles: POPs, metals, eggs, and eggshells H. 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 Leatherback 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 (37 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, lead, and cadmium concentrations were monitored in the Turtle population, but these elements were not found to be among the elements contributing to the high concentrations in crocodile eggs. 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.

M0059 Improving knowledge flow: from consumer to environmental risk assessment L. Villamar Bouza, s. barmaz, R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; M. Arena, EFSA - European Food Safety Authority / Pesticides; D. A. de la Torre, EFSA - European Food Safety Authority / Pesticides

The assessment of pesticide residues levels in environmental matrices is part of the risk assessment for non-target organisms under Regulation (EC) no 1107/2009. In the case of risk assessments for birds and mammals, according to EFSA (2009), the Tier 1 risk assessment uses default values for residues levels (in terms of residue per unit dose, RUD) and residue decline (in terms of a time weighted average factor, TWA). When the Tier 1 risk assessment indicates a high risk a high tier assessment is required. One option is to refine the estimate for the level of residues that wildlife consume through their diet by calculating specific RUDs or by deriving substance/crop specific DT50 values which are then used to recalculate the TWA factor used in the risk assessment. Often the residues studied subjects in the consumer assessment are not the same as those in the environmental assessment. These are then further evaluated with specific kinetic tools (FOCUS kinetics). It should be noted that the refinement of the RUD values is done only in rare cases since the dataset at the basis of the default values is relatively large. These refinements allow for a more realistic assessment accounting for the differences in residues decline due to the crop type, growth stage, climatic conditions across EU zones and to specific characteristics of the substance under assessment. Other parts of the data used for the consumer risk assessment for pesticides can also provide information for the environmental risk assessment. In particular, metabolism studies in plants are used for the identification of the pertinent metabolites to be further considered in the risk assessment of birds and mammals. The metabolism data for hen and rat/ goats can also be used for addressing such metabolites. The main scope of this work is to further analyse the standard dataset available and the specific guidance in use for the consumer risk assessment in order to better define how the data and knowledge developed in the context of the consumer risk assessments (internationally agreed methodologies, existing guidance documents) could be integrated in the environmental risk assessment. Particular consideration is given to the possibility of extrapolation between crops, use patterns (e.g. growth stages, application number) and European zones.

MO058 Increasing salinisation effects on Pelophylax perezi populations - Could historical exposure drive modern risk 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 environmental levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of P. perezi originated from reference and salinized natural populations. Embryos (Gosner stage h-10) were exposed for 96h, and in what concerns to this input of pollutants in several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mM/cm2 for seawater and NaCl, respectively). As well, for the sub-lethal monitored endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.

MO060 Estrogenic effects of an Organophosphorous Flame Retardant (TCP) on Edible Sea Urchin "Paracentrotus lividus" P.C. Lóceo, University of Vigo / Ecology and Animal Biology; E. Pereira-Pinto, University of Basque Country; L. Mantilla-Aldana, University of Vigo / Ecology and Animal Biology; r. beiras, University of Vigo / Toralla marine sciences station (ecimat)

Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.
Abstract: 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 disrupters, 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 different levels of genetic DNA damage. Behavioural responses also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO061
Short-term effects of fluoxetine exposure on biomarker and behavioural responses of an estuarine fish
I.A. Duarte, M.P. Paix, P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE Marine and Environmental Sciences Centre; Pharmacological compounds are routinely discharged into the aquatic environment. There is growing concern whether they elicit deleterious effects on aquatic organisms, following point source acute exposure as well as chronic exposure. Antidepressants, like fluoxetine, are frequently detected in both freshwater and coastal systems and have deleterious biological effects at very low concentrations. Nonetheless, contradicting evidence has been reported with lack of consistency in responses across studies. In this context, short-term effects of fluoxetine exposure were analysed in common goby Pomatoschistus microps, an estuarine resident species. Two experiments were conducted: where 1) fish were exposed to environmental concentrations of fluoxetine for 96h (0.1 - 100 µg/L) and 2) fish were exposed to high fluoxetine concentrations for 1h (1, 5, and 10 µg/L). Acute toxicity was assessed via multiple biomarker responses, namely antioxidant enzymes activity, detoxification enzymes activity, neurotoxicity and biomarkers of deleterious effects (e.g. catalase, glutathione S-transferase, acetylcholinesterase, lipid peroxidation). Behavioral responses were also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO062
Assessment of PCDFs, dioxin-like PCBs and PBDEs in Mediterranean striped dolphins
F. Capanni, University of Trieste / Department of Life Sciences; J. Muñoz-Armazn, IQOQ-CSC/ - Department of Instrumental Analysis and Environmental Chemistry; L. Marsili, M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; B. Jorqe, P.C. Simões, MARE - Marine and Environmental Sciences Centre; Pharmacological compounds are routinely discharged into the aquatic environment. There is growing concern whether they elicit deleterious effects on aquatic organisms, following point source acute exposure as well as chronic exposure. Antidepressants, like fluoxetine, are frequently detected in both freshwater and coastal systems and have deleterious biological effects at very low concentrations. Nonetheless, contradicting evidence has been reported with lack of consistency in responses across studies. In this context, short-term effects of fluoxetine exposure were analysed in common goby Pomatoschistus microps, an estuarine resident species. Two experiments were conducted: where 1) fish were exposed to environmental concentrations of fluoxetine for 96h (0.1 - 100 µg/L) and 2) fish were exposed to high fluoxetine concentrations for 1h (1, 5, and 10 µg/L). Acute toxicity was assessed via multiple biomarker responses, namely antioxidant enzymes activity, detoxification enzymes activity, neurotoxicity and biomarkers of deleterious effects (e.g. catalase, glutathione S-transferase, acetylcholinesterase, lipid peroxidation). Behavioral responses were also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO063
Assessment of POs in stranded sperm whales (Physeter macrocephalus) from the Mediterranean Sea
A. Battalini, University of Siena / Department of Environmental, Earth and Physical Sciences; I. Muñoz-Armazn, IQOQ-CSC/ - Department of Instrumental Analysis and Environmental Chemistry; L. Marsili, University of Siena / Department of Physical Sciences, Earth and Environment; S. Mazzarol, University of Padova / Department of Public Health, Comparative Pathology and Veterinary Hygiene; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; B. Jimenez, IQOQ-CSC/ - Department of Instrumental Analysis and Environmental Chemistry; The sperm whale (Physeter macrocephalus) is a large toothed whale inhabiting the Mediterranean Sea. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Several studies show high levels of persistent organic pollutants (POPs) in dolphin tissues from the Mediterranean Sea, but data on sperm whales from the same area are much more scarce. In this study, we assessed POPs in blubber samples from 39 individuals stranded in the Mediterranean Sea from 2009 to 2016. Fresh samples were spiked with a surit of PCDD/Fs, PCBs, and PBDEs with 13C-labelled standards prior to Soxhlet extraction, and then cleaned-up by using the automated sample preparation system. Samples were analyzed for seventeen PCDD/Fs, twelve DL-PCBs and twenty-seven PBDEs. Quantification was carried out by the isotope 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⁻² (45.8-83.5 pg g⁻²) 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 than those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower that those reported for sperm whales from North-Atlantic. The PCDF congener profile of Tetrabromobiphenyls (TBBs) (hexa=penta>hepta>octa) was quite different from those with a lower contribution of higher chlorinated congeners and a higher contribution of lower chlorinated congeners. Total calculated TEQs ranged from 275 to 987 pg g⁻¹ lw. and surpassing the threshold of 210 pg g⁻¹ lw. for the “global” and “western” criteria. This result could be considered as an indication of low contamination of the Mediterranean Sea.
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, IL-1 and MT-2 genes correlated positively with increasing levels of blubber 2PCBs, supporting the occurrence of biological response to this class of contaminants. GLMs for MT-2 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 metal inputs. However, although individuals from the region 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 biomass response might be due to low contaminant levels in sampled dolphins. This influence might also have been overshadowed by the effects sampling season. Non-parametric 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

V. Tsarpali, University of Patras / Department of Biology; C. Barboutis, Hellenic Ornithological Society / Antikythera Bird Observatory; C. Kassara, University of Patras / Department of Biology; M. Papadimitriaki, S. Giokas, University of Patras / Biology; S. Dailianas, University of Patras / Forestry / Forests / Forests for the Future. Monitoring Eleonora’s falcon (Falco eleonorae Géne, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AcChE) 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 m·l⁻¹·min⁻¹ in May and 1.44±0.079 - 9.31±1.618 nmol m·l⁻¹·min⁻¹ in September. AcChE 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 in than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQs values. All heavy metals measured in liver were generally releva

MO066 Assessing impacts of legacy pollutants on waterfowl of the Trinity River (Texas, USA) using Neotropical Cormorants as indicator species

M.A. Mora, Texas A&M University / Wildlife and Fisheries Sciences; C. Sandoval, Texas A&M University / Wildlife and Fisheries Sciences. Monitoring for the assessment of aquatic stressors using Neotropical Cormorants (Phalacrocorax brasilianus) as indicator species. 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 of liver and kidney were analyzed for the presence of heavy metals. Additionally, heavy metals were 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 m·l⁻¹·min⁻¹ in May and 1.44±0.079 - 9.31±1.618 nmol m·l⁻¹·min⁻¹ in September. AcChE 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 in than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQs values. All heavy metals measured in liver were generally releva

MO067 Tracking the effects of a neonicotinoid insecticide on songbird migration

M.L. Eng, University of Saskatchewan / Toxicology; B. Stutchbury, York University; C.A. Morrissey, University of Saskatchewan / Biology. Recent decades have seen a dramatic increase in the application of neonicotinoid insecticides, which are now the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly susceptible to the negative effects associated to neonicotinoids. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to OC pesticides, PBDEs, and Mirex to be more reluctant to leave a safe environment, and experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radiotagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed to imidacloprid via gavage to a single dose of imidacloprid (either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.

MO068 Testing the effects of a neonicotinoid insecticide on songbird migration

M.L. Eng, University of Saskatchewan / Toxicology; B. Stutchbury, York University; C.A. Morrissey, University of Saskatchewan / Biology. Recent decades have seen a dramatic increase in the application of neonicotinoid insecticides, which are now the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly susceptible to the negative effects associated to neonicotinoids. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to OC pesticides, PBDEs, and Mirex to be more reluctant to leave a safe environment, and experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radiotagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed to imidacloprid via gavage to a single dose of imidacloprid (either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.
Anticoagulant rodenticides have some similarities with other bioaccumulative compounds. Environmental determinants of the exposure to anticoagulant rodenticides in red kites (Milvus milvus) in Britain R. Shore, Centre for Ecology & Hydrology (NERC); L. Walker, Centre for Ecology & Hydrology; J. Jaffe, Zoological Society of London / Institute of Zoology; L. Barnett, Fera Science Ltd; J.S. Chaplow, Centre for Ecology & Hydrology; S. Chaloner, Fera Science Ltd; A. Gielis, Science and Advice for Scottish Agriculture; A. Jones, Fera Science Ltd; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; A. Sainsbury, Zoological Society of London / Institute of Zoology; D. Sleep, N.J. Thompson, C. Senior, NERC Centre for Ecology & Hydrology; E. Sharp, SASA Scottish Government / Pesticides and Wildlife Management; and Fera Science Ltd. 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 scavenge dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites was conducted using independent case material and liver SGAR residues were detected in 83 (34%) of the analysed red kites. 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 10 μg/g wet wt. (arithmetic mean: 372 ± 20 for WTE) in the nest when they were circa 4 weeks old. The samples were analysed for novel brominated flame retardants (nBFRs), organophosphate flame retardants (PFRs) and per- and polyfluoroalkyl substances (PFASs), along with trace elements and legacy persistent organic pollutants (POPs). Significant differences were found between the two species (with WTE generally showing higher levels of pollutants), but also within species, depending on the location. PFASs were generally found at the highest concentrations, with perfluorooctane sulfonate (PFOS) being the most important compound. nBFRs and PFRs were found at very low or non-detectable levels in blood plasma. Further, pollutant effects on different biochemical, immunological and endocrine parameters were assessed. We have performed controlled exposure studies in Japan (Chemosphere; Catharanthus roseus and chrysanthemum oleander) andOwn University of Tartu, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; D. Herze, NILU Norwegian Institute for Air Research; B. Styrishave, University of Bergen / Section of Analytical Biosciences Department of Pharmacy; V. Jaspers, Norwegian University of Science & Technology / Biology. The international research project NewRaptor (ID 230465/E20, funded by the Norwegian Research Council and the Norwegian University of Science and Technology) aims to investigate the exposure and effects of emerging chemicals in birds of prey. The raptors under investigation include the terrestrial Northern goshawk (NG - Accipiter gentilis) and the marine White-tailed eagle (WTE - Haliaeetus albicilla) from Norway and NG from Spain. During the breeding seasons of 2015 and 2016, blood and body feathers were obtained from the chicks from the four raptor species (NG n = 160 for NG and WTE; for NG and WTE) were kept in a controlled environment to investigate the effects of SGARs and PFASs on gene expression and enzyme activities. We have used the marine white-tailed eagle as our model species, both with single compounds and in a mixture scenario. The compounds for the quail exposure study included Dichlorane Plus (DP), tris(1,3-dichloro-2-propyl) phosphate (TDCIPP) and their 1:1 mixture, while PFOS, F-53B (PFOS replacement product) and their 1:1 mixture were used in chickens. Effects on gene expression and activity of anti-oxidative enzymes (catalase, superoxide dismutase, esterase), DNA repair enzymes (alkyltransferase, phosphatase), lipid- and protein oxidative damage and biotransformation (cytochrome P450A) were investigated. Further, hormonal analysis of corticosterone and progesterone was performed using HPLC-MS/MS. Gene expression and enzyme assays on similar endpoints will be performed on NG samples in January 2018 and will be presented alongside the results from the m oxy exposure studies at SETAC. This will enable discussing the potential usefulness and pitfalls when extrapolating from laboratory dosing studies using model species to field assessments in raptors.
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds
S.E. Whitlock, Environment Department, University of York / Environment; K. Arnold, University of York / Environment; J. Lane, Animal and Plant Health Agency; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shore, Centre for Ecology & Hydrology (NERC).

The antidepressant fluoxetine has been identified as a contaminant which may pose a risk to wild birds. However there is little empirical evidence regarding which bird species are most at risk of exposure to fluoxetine, in terms of concentration levels in wild bird samples. A significant barrier to sampling wild birds is that fluoxetine is cleared very quickly from systemic circulation and plasma concentrations might be expected to fall to levels below the limit of detection in less than one hour post exposure. Fecal sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an avian study with wild caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 μg d⁻¹) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC-MS/MS. A positive quality control and recovery sample were also run, before and after the major occurrence of moult. We then repeated the study on the same individuals of a larger sample size (n=27) 12 months later in Spring 2021. The analysis of the results showed decreases and increases in concentration between the two studies. According to the performed test, our conclusions were that the concentration levels increased between the two studies, and the differences were likely due to contaminant exposure. In general, the method followed was similar to all other studies that had been carried out in the same country. However, the data obtained in this study showed a clear improvement in the analytical techniques used, which allowed for more precise and accurate measurements of fluoxetine levels in the feathers. This study has shown that feathers can be a useful tool for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

MO076 Different approaches for evaluation of hypophyseal glands (HPG) in honeybees (Apis mellifera L.)

Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in natural environments, agriculture, and the pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers. Hypophyseal glands (HPG) play a crucial role in the regulation of various physiological processes in honeybees. However, there is limited information on the effects of pesticide exposure on the HPG. To address this issue, we conducted a comprehensive literature review on the effects of pesticide exposure on the HPG of honeybees, with a focus on the methods used to assess the impact of contaminants. We found that different methods are used for the assessment of pesticide exposure on the HPG. Different approaches for HPG evaluation, which investigate effects under real use conditions and 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 (sum of PA from the HPG of the head, HP) (linear and quantitative measurements, imaging), the linear measurements (small and big axis of symmetry) were taken from ten acini from left and right HPG, however for SEM only left HPG were included. The quantitative measurements (number of acini per 1 mm²) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from the HPG of the head (HP), the HPG of the head (HP) and the HPG of the head (HP) of the head (HP). The statistical 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 hypophyseal glands development the linear measurement combined with imaging should be used.

MO077 Bird and mammal focal species for pesticide risk assessment in rice
M. Vallon, C. Dietzen, S. Laucht, F. Sotti, J. Ludwiks, Rifcon GmbH

Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through ingestion and 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 recommended for rice are thus those known from the dry environments of cereal fields. To address this issue, we conducted a comprehensive literature review on bird and mammal species regularly occurring in rice paddies at the relevant time periods of 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 site-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 the reintroduction and one of these factors is lead (Pb) contamination used for hunting. An exposure to lead, even at sub-lethal levels, can be a stressful situation that implies an increase in circulating corticosterone levels. In birds that are rare and difficult to capture, blood sampling for both lead and corticosterone analysis can be a difficult task and with some risk for birds. For this reason, we evaluate and contribute to the study of exposure to pollutants and their respective biomarkers is being directed towards the analysis of easy-to-collect samples, such as feathers moulted by birds. The objectives of this study are to quantify the degree of exposure to lead that the bearded vultures have in the Alps by analysing moulted feathers found in the field, relating them to corticosterone levels in the same feather and defining the factors that affect the fluctuations of these two components along transverse segments of feathers. The analysis of the segments of 20 different feathers from different bearded vultures revealed that the abnormal exposure to lead (probably due to the ingestion of ammunition) had a prevalence of 15% (three feathers with levels above 2 µg/g of Pb in racahs), and that the annual incidence of such exposure was 30% (a feather with an abnormal exposure during its development of approximately two months). The conclusions of this study are that the post mortem tissue of two euthanized bearded vultures, Cytosolic and microsomal fractions were obtained in individual closed tubes at 25 °C for 0, 1, 2, 3, 6, 12, 18 and 24 h post mortem before liquid nitrogen freezing. Cytosolic and microsomal fractions were obtained from 150 mg of each sample individually. EROD activity decreased abruptly after the first hour and one half of the measurements, respectively. GST activity proved to be stable after 24 h (85 % of the initial activity). EROD activity decreased abruptly after the first hour post mortem of both animals. After 3 hours EROD activity presented 65 to 71 % of initial activity and 28 to 50% of its initial activity after 6h, showing an exponential decrease along post mortem period. Our results indicate that time elapsed since death until sample collection plays an essential role for biotransformation enzymes, especially concerning EROD activity. GST seemed to be more resistant to degradation over time, and it thus appears possible to make valid GST activity measurement in selected post mortem liver tissue of kelp gull. Overall, our findings demonstrate that caution is warranted in monitoring programs when comparing biological samples with different intervals between collection and analysis procedures.

MO080 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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Anthropic activities have led to a global increase of Mercury (Hg) in the environment. Due to its accumulation in the tissue of long-lived birds, exposure to Hg has been taken to reduce the levels. To assess the effectiveness of such restrictions and the current levels of these chemicals in the environment, biomonitoring using birds is very useful. Hg has caused detrimental effects in birds such as haematotoxicity, immunotoxicity and endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the exposure to Hg and its effects at the biochemical/physiological level in White-tailed eagles (WTE) and Northern goshawks (NG) from Norway. Samples were obtained in 2014 from nesting WTE (n=14) and NG (n=1) in northern Norway (Nordland-N 68.30 – 68.47; E 24.54 – 25.27°- and Troms- N 68.67 – 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/biochemical parameters (BCPs): albumin, creatinine, cholesterol, total protein, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, triglycerides, total proteins, uric acid, and nitrophenol. The analyses of thyroid hormones have been carried out and the results will be presented at the conference, along with physiological and biochemical BCPs.

MO081 Thyroid-related gene expression, hormones, and thyroid gland histology in American kestrels exposed in ovo to two persistent organic pollutants, SCCPs and TBBPA-BDBPF

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Patuxent Wildlife Research Center
Highly brominated flame retardants are being replaced by alternative flame retardants such as Tetrabromobisphenol 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, paints, textiles, 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 (EPA). 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 indicated 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. Minia, A. Alves da Silva, C.FE - Centre for Functional Ecology, / Department of Life Sciences, University of Coimbra; T. Natal de Lala, University of Coimbra / Centre for Study of Environmental Consequences, Unit for A. Barros, CITAB - Centre for Research and Technology of Agro-Environment and Biological Sciences / Laboratory of Applied Ecology, University of Trás-os-Montes e Alto Douro; C.J. Topping, Aarhus University / Department of Bioscience; J. Sousa, University of Coimbra / Department of Life Sciences

More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on the effects of contaminants in bats are focused on organic substances (particularly pesticides), metals and other 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 (nontidal samples: liver, heart, bone and brain; and non-tidal samples: wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savii, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmaeus). 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 non-tidal samples and tidal samples, indicating that metals are higher in organ and fur samples. Significant differences were also found between concentrations of metals in the different tissues, with higher concentrations in the liver, followed by heart and bone, and brain. Significant differences were also found between concentrations of metals in different organs, with higher concentrations in the liver, followed by heart and bone, and brain. Significant differences were also found between concentrations of metals in different organs, with higher concentrations in the liver, followed by heart and bone, and brain. Significant differences were also found between concentrations of metals in different organs, with higher concentrations in the liver, followed by heart and bone, and brain. Significant differences were also found between concentrations of metals in different organs, with higher concentrations in the liver, followed by heart and bone, and brain. Significant differences were also found between concentrations of metals in different organs, with higher concentrations in the liver, followed by heart and bone, and brain.

MO084 Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus J.D. van Asweggen, 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 Swartkops River Estuary near Port Elizabeth, South Africa, is an important recreational, industrial, residential, and ecological asset, but under severe pressure. Seabirds are good indicators of trace elements within their environments. Seabirds tend to feed at different trophic levels at different distances from the land and they are long-lived. Pollutants that have accumulated in the seabirds can be excreted in various ways from the body, one being deposition into eggs. Sixteen eggs of the Kelp Gull (Larus dominicanus) were analysed using ICP-MS (EPA 3050h method) for 30 trace elements, for both the contents and eggshells. We selected five elements (Cr, Sr, Ti, U, Zn) to compare and assess the absolute and relative compositional patterns in egg contents and shells. Mean concentrations for Cr in eggshells and egg contents were 3.8 and 18 mg/kg dm, for Sr it was 880 and 120 mg/kg dm, for Ti it was 0.00017 and 0.00022 mg/kg dm, for U it was 0.000057 and 0.000084 mg/kg dm, and for Zn it was 2.1 and 62 mg/kg dm, respectively. Of the five elements, only Sr (p = 0.0141) and Ti (p = 0.0013) concentrations showed significant (P < 0.05) positive correlations between egg contents and eggshells. Chromium and Zn showed a positive regression, but the correlations were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.

MO085 Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part F. Monti, University of Siena / Department of Physical Sciences, Earth and Environment; A. Sforzi, Maremman Natural History Museum, Grosseto; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Leonzio, University of Siena / Department of Physical Sciences, Earth and Environment

The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species for the 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 relic and vulnerable populations exist. In this study, we analyzed heavy metals concentrations in osprey eggs from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected, over a period spanning from 2005 to 2016. Mercury (Hg), Cadmium (Cd), Copper (Cu) and Chlorine (Cl) concentrations in the eggs were analysed with the aim to: 1) evaluate geographical patterns of for possible identification of inputs at the regional scale; 2) to evaluate differences in concentrations between samples from different habitats (marine environments and wetlands); and 3) to investigate any differences in concentrations among different parts of the egg (i.e., content, membrane and shell). Samples from the Balearic Islands showed higher Hg concentrations (1.4 ± 1.2 mg/kg on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearic) 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 attempt at a 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 in

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 Science and Policy; C.D. Possenti, B. De Felice, Università degli Studi di Milano; N. Saino, University of Milano

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

T. BELAMY, University of Bordeaux; A. LEGEAY, University of Bordeaux / UMR EPOC CNRS 5805; B. ETCHERRIA, University of Bordeaux / UMR CNRS 5805 EPOC; M. Baudrinmont, Université de Bordeaux / UMR EPOC CNRS 5805

Margaritifera margaritifera is a freshwater bivalve mollusk threatened with extinction in Europe. The population of this freshwater pearl mussel has declined by 90% in Europe, during the XIXth century because of pearl fishing and from the XXth century due to habitat degradation, decrease in water quality and pollution. Nowadays, french population of M. margaritifera is estimated at 100,000 individuals with the largest population found in the river Dronne (Bordogne - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels 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 M. margaritifera juveniles to different environmental and contamination factors, since they are considered as the most sensitive lifespan of this species. Acute toxicity tests were carried out on one-year-old juveniles in order to determine toxicity thresholds (LC50) of several factors such as temperature, dissolved oxygen, nitrates, phosphates and metals. Those data will allow to target reintroduction areas of juveniles produced in the farm and help the conservation strategies of Margaritifera margaritifera in the Upper Dronne river.

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

M. Wang, WSC Scientific GmbH / Dept 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.

SETAC Wildlife Toxicology Interest Group

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

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

MO098

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

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

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freshwater as a resource. In order to clearly define what is to be protected, the freshwater resource is put in perspective through the lens of three safeguards subjects. Considering the current scope of the AoP natural resources, the complex nature of freshwater resources and the dimension of freshwater to safeguard, a definition of freshwater resource is proposed. Also, a wide range of possible impact pathways to freshwater resources is identified, establishing the link between direct and indirect pathways that could eventually impact their potential to cause freshwater depletion or pollution in the long-term. The concept of recovery period is used to operationalize this framework: when the recovery period lasts longer than a given period of time, impacts are considered as being irreversible and fall into the concern of freshwater resources protection (i.e. affecting future generations). The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts, as some dynamic fate models already do. Recommendations are also given for freshwater resource impact indicator(s). Therefore, such an indicator would allow LCIA to capture potential long-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

MO094 Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts M. Jouini, Montpellier SupAgro / Département de génie rural; R. Campalini, IRD, UMR LISAH, S. Follain, Montpellier SupAgro, UMR LISAH, J. Burte, CIRAD / UMR GEAN; N. Benaisa, National Agronomic Institute of Tunisia / Science de la production végétale; C. Sinfort, ITAP, Irstea, Montpellier SupAgro, Univ. Montpellier / PACT Industrial Chair

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 commonly used to protect soil from erosion. The financial and environmental cost the WSCW construction is very high. However, the positive impacts of WSCW are not taken into account in Life Cycle Assessment (LCA). The objectives of this study is to integrate the impact of WSCW on soil quality in LCA. There are different types of WSCW with different functions and they act differently on erosion process. In this study we focussed on contour ridges as a type of conservation works because they are associated to crop systems. Contour ridges 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, contour ridges were tested. For life cycle impact assessment, we focussed on two midpoint impact categories on soil quality of LANCA model: erosion resistance and mechanical filtration. The results showed how contour ridges can modify topsoil erosion process and thus the impact on soil ecological functions for several production systems. In conclusion, it is necessary to integrate the positive impacts of conservation works in LCA. 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 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 exposure have been poorly characterized. This poster will describe the research needed, 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 many exposure pathways being characterized, the many exposure pathways being characterized. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than 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 exposure have been poorly characterized. 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Impacts of Chemicals
R. Calvo-Sehrano, 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 obstructions when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for a few and relatively simple processes and only information of a few hundreds. In these cases, when a full LCA cannot be applied, a simplified version is used instead. These streamlined LCA (SLCA) follow the same basis as LCA, but generally either simplify the scope of the analysis and/or reduce the amount of information required in the assessment. The precise simplifications to be made (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the α-effect and other descriptors 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 significant impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 α-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Indicator99 (EIP)(18.34%).

MO100 Development of USEtox characterisation factors for micropollutants in effluents
E. Maillard, ELSA-PACT Industrial Chair

Many substances are increasingly detected in surface waters, after their use by the human population. In most cases, these substances will exert the same effects as desired when they are originally applied, only now affecting different organisms. These effects can occur at concentrations of µg/l, which is why these substances are called micropollutants. In the context of Life Cycle Assessment, there is a need of characterising the toxicity potential of these micropollutants affecting ecosystems and/or the human population. A substance which is not characterised will not be considered in a LCA study, which may result in misguided decisions and the omission of essential environmental issues related to biodiversity and human health. The aim of this project is to develop a database of characterisation factors for the most 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 significant impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 α-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Indicator99 (EIP)(18.34%).

MO101 Adjustment of freshwater ecotoxicity with USEtox
M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; S. Sahigara, KREATIS; M. Jacob, TOTAL SA

USEtox is determined as the reference tool for freshwater ecotoxicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEF/OEF project, by JRC-IES in ILCD handbook, by IELCD in ILCD technical report and by US-EPA in TRACI tool manual. An assessment of the relevance of the Characterisation Factor (CF) with its associated factors was realized. We found that CF appears to be significantly influenced by the effect factor (EF), implying that the 2 others factors, XF (Exposure Factor) and FF (Fate Factor), do not intervene, or very little, in the final calculation of CF. This finding is surprising because the XF and FF factors show influence the calculation of CF as they represent, significant fate and exposure adjustments: substance bioavailability (XF) and its presence in the medium (FF). Hence, the influence of each factor was analysed in more detail and some inconsistencies were noted. For EF, USEtox includes an extrapolation calculation for acute to chronic toxicity (called Acute-to-Chronic Ratio). This extrapolation is not always reliable and will certainly not be applicable for substances with a log Kow>6 where acute toxicity is superior to solubility but chronic toxicity may still occur. Moreover, the value used for the ACR seems inappropriately low and should be different according to the mode of action of the substance. For XF, adsorption starts to reduce XF at log Koc around 5 whereas adsorption of organic substances is generally considered to become highly significant in ecotoxicological studies performed at low concentrations from log Koc of 4. Overall, the XF seems to be overestimated in this model for the majority of substances with a log Kow between 3 and 5. For FF, one of the parameters that most influences its calculation seems to be the biodegradation, which alone can alter the relationship between the EF and the CF by an order of magnitude (between a highly persistent and a highly biodegradable compound). However, the relative influence of biodegradation (and the other FF parameters) on the CF is too limited compared to the EF value. Indeed, the difference between the minimum and maximum biodegradation on CF is approximately 2 orders of magnitude while the EF itself spans at least 8 log units. Thus, because of these inconsistencies, it is crucial to discuss the relevance of each factor with the aim of improving the model providing a more realistic approach.

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

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 review 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 highly 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 include sources of nutrient loading to each environmental compartment (e.g., water, sediments, soil, 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 factors. 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, Persson 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 the consequence for marine ecosystems. Science 321: 926–929. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the US Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
Determined to have a lower environmental footprint in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a maximum sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FSₘₛₚ) and the current fish stock (FS) for the characterisation of the use of fish resources. The eco-factors were calculated for each fish species and fishing area. The inclusion of the eco-factors shows the relevant contribution to the total environmental impact of fish compared to fishing and fish processing. Depending on the fish species, fish can have significantly higher overall impacts compared to different types of meat. The contribution of the eco-factors for by-catch is minor compared to fish resources but still relevant for the comparison with dietary alternatives. Distance to target based eco-factors using regionalised data for FS and FSₘₛₚ not only follow a comparable underlying approach as suggested in literature but also enable aggregation into a single-score with other environmental impacts. The overexploitation of fish resources is highly variable for different fish species and fishing areas as well as for by-catch. When comparing fish to equivalent dietary alternatives like chicken, pork, lamb, beef or veal, consideration of the overexploitation of fish resources results in some fish species exceeding the environmental impact of dietary alternatives. Therefore, the overexploitation of fish resources is relevant in the Life Cycle Assessment of fish products in different diets. The suggested approach can be implemented in full single-score LCA of meat and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.

MO104 Application of LCA water use methods to renewable energy systems in Spain
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 their calculation of water flows. After having studied the current state of art of the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: (1) Water Footprint standard harmonized by means of ISO 14046, and (2) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Retaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint
Pinkinbarge, University of Aveiro / Department of Environment and Planning; b.) Ridoutt, CSIRO; L. Arroja, 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 cushion groundwater). After having studied the current state of art of the methodologies to consider this impact category, this work presents the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: (1) Water Footprint standard harmonized by means of ISO 14046, and (2) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Retaining per area in a watershed.

MO106 Filling the Gap of Overfishing in LCA: Eco-factors for Global Fish Resources
M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences; L. Eymann, ETHZ Swiss Federal Institute of Technology; B. Keller, R. Iten, Zurich University of Applied Sciences / Institute of Natural Resource Sciences
There is a lack of LCA methods to assess the contribution of fish consumption to the global problem of overfishing. Due to this methodological gap, fish is often determined to have a lower environmental footprint than other sources of animal protein in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a maximum sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FSₘₛₚ) and the current fish stock (FS) for the characterisation of the use of fish resources. The eco-factors were calculated for each fish species and fishing area. The inclusion of the eco-factors shows the relevant contribution to the total environmental impact of fish compared to fishing and fish processing. Depending on the fish species, fish can have significantly higher overall impacts compared to different types of meat. The contribution of the eco-factors for by-catch is minor compared to fish resources but still relevant for the comparison with dietary alternatives. Distance to target based eco-factors using regionalised data for FS and FSₘₛₚ not only follow a comparable underlying approach as suggested in literature but also enable aggregation into a single-score with other environmental impacts. The overexploitation of fish resources is highly variable for different fish species and fishing areas as well as for by-catch. When comparing fish to equivalent dietary alternatives like chicken, pork, lamb, beef or veal, consideration of the overexploitation of fish resources results in some fish species exceeding the environmental impact of dietary alternatives. Therefore, the overexploitation of fish resources is relevant in the Life Cycle Assessment of fish products in different diets. The suggested approach can be implemented in full single-score LCA of meat and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.

MO107 Constructing life cycle inventories for the hydroelectric sector in Peru: methodological considerations and environmental impacts
L. Vázquez-Rowe, Pontificia Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science
According to recent reports, hydropower currently accounts for 16% of worldwide electricity generation. Low carbon emissions are usually related to this source of energy, making it an attractive option for nations with hydropower potential to meet increasing electricity demand without relying on burning fossil fuels. However, the new wave of hydropower plant construction is occurring mainly in three tropical river basins: Amazon, Congo and Mekong; therefore, an additional environmental impact must be considered: biogenic greenhouse gas emissions due to deforestation of biogeochemical sinks. Peru is planning on installing up to 2,000 MW of installed capacity in hydropower until 2021, but the input and output flows, as well as the environmental impacts that these generate have not been explored. In this context, a set of three run-of-river hydropower plants built in the past decade located along the Peruvian Andes were analyzed from a life-cycle perspective. The main objective of the study was to present a methodology to construct life cycle inventories for each of these three hydropower plants with the aim of having specific information for real conditions in Peru. This information was used to compute the environmental impacts linked to the generation of electricity at the plants. Although the main aim was to determine the GHG emissions linked to this process, considering the important policy implications of decarbonizing the Peruvian electricity grid, other environmental cascades, such as eutrophication and nutrients due to degradations of biogeochemical sinks were also considered. The results computed show that GHG emissions per kWh of electricity produced were in the lower range of emissions observed in the literature, in all three cases below 3 g CO₂eq per kWh. Biogenic emissions represented less than 5% of the total GHG emissions despite their location in a tropical nation, due to the arid conditions of the landscape in the Highlands, as well as the mild temperatures that are present in the reservoirs. Results intend to be of utility for an array of applications, including relevance in decision-making in the energy sector, policy-making at a national level, considering the implications in terms of meeting the Nationally-Determined Contributions to mitigate climate change in the frame of the Treaty of Paris, and for the international LCA community in an effort to expand the amount of inventories available for different geographical and technological conditions.

MO108 Global scale characterization factors for freshwater eutrophication from nitrogen and phosphorus emissions to water and soil
F. Bhandari, Redbud University / Department of Environmental Science; A. Beusen, PBL; R. Van Zelm, Redbud University / Department of Environmental Science
Eutrophication is a key water quality issue triggered by increasing nitrogen (N) and phosphorus (P) levels and potentially posing risks to freshwater biota. In life cycle impact assessment, spatially explicit characterization factors (CFs) of phosphorus emissions to freshwater causing eutrophication have been derived. However, for nitrogen impacts, no efforts have been undertaken yet. Moreover, neither for agricultural emissions of P nor for N spatially explicit CFs have been derived. Therefore, the goal of this research was to determine spatially explicit CFs for...
freshwater eutrophication due to nitrogen as well as phosphorus emissions from wastewater treatment plants (WWTPs) and agriculture on the global scale. SCFs were defined as the change in not potentially occurring fraction of species (PNOF) due to a change in the river basin-specific emission of P or N to freshwater (via WWTPs) or agricultural soil and consist of a fate and an effect factor. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as freshwater emissions from year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on log–logistic relationships between the PNOF (dimensionless) of heterotrophic species and total P (TP) or NO3 concentrations. The PNOF – concentration relationships were determined using data on the highest concentration where a species was observed in field surveys. Our work provides the opportunity to quantify worldwide spatially-explicit and all-time 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)

MOI09 Carbon and material footprint of consumption in Flanders - an input-output based assessment
A. Dietzenbacher, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten, VMM-MIRA
Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks, based on the Flemish environmentally extended input-output model. The Flemish EE-O model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an 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 Eixobase. A monetary consumption matrix for households divides the final demand vector of households in different consumption categories. In 2010 the carbon footprint of Flanders amounted to about 20 tonnes per inhabitant. Nearly three quarters of the carbon footprint are linked to household consumption, mainly caused by the production and transport of the goods and services consumed. Three quarters of the carbon footprint of goods and services purchased by households are linked to housing, food and personal transport. Whilst the majority of the greenhouse gas emissions, primary materials and employment is outsourced, the added value linked to Flemish consumption is mainly created in Flanders. The presentation will introduce the overall results of the carbon and material footprint assessment of Flemish consumption in 2010 and go more in detail into the value chain impact of some household consumption activities e.g. food consumption. The relation between carbon footprint and material footprint, geographical and sectoral distribution of different production chains and consumption activities, and the relation with added value and employment created by Flemish consumption will be discussed. As the model is available for 2003, 2007 and 2010, the evolution over these years will also be presented. Conclusions will mainly focus on methodological issues and policy implications that follow from this analysis. To achieve the greatest possible global environmental benefit, it is not enough to focus on a country or region’s boundaries alone. There is also a need for a policy that is aimed at making production chains and consumer behaviour more sustainable, including internationally harmonised calculation methods and targets of footprints to evaluate the results.

MOI10 A cross-country analysis of relationship between economic structural change and CO2 emissions
K. Shironitta, 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 demonstrated the considerable stochastic changes including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether or not the development levels of countries can explain those environmental effects. Specifically, we employed a multi-output 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 sectors 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.

MOI11 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 Division for Quantitative Sustainability Assessment; R. Wood, Norwegian University of Science and Technology / Biology; A. Laurent, DTU / Division for Quantitative Sustainability Assessment- DTU Management Engineering
The electricity sector is a major source of emissions of greenhouse gas, but also heavy metals, dioxins or radioactive isotopes. However, most environmental assessments of the electricity sector at national or global scale focus solely on climate change and do not include other environmental impact categories such as particulate matter formation or toxic impacts on human health. At the national scale, the few available databases are limited to a narrow substance coverage. For example, official reports of pollutants emissions to the European Monitoring and Evaluation Programme (EMEP) should cover 23 substances in 51 countries, but they are not always complete. The Multi-Regional Input-Output database ECOBASI (ESE) includes emissions to air in 44 countries and 5 regions but only for 33 substances. In comparison, the database Ecoinvent provides emission data for hundreds of substances in the unit process inventories for electricity and heat generation. Here, we aim to develop a globally consistent and extensive dataset of airborne emissions from electricity production to get a more realistic coverage of toxicity impacts in large-scale life cycle assessments (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (ENEI) by upscaling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we show that ESE as well as Ecoinvent 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.

MOI13 Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains
K. Kanemoto, Shinshu University / Faculty of Economics and Law; D. Moran, Norwegian University of Science and Technology
"Spatial footprinting" is an approach for locating the actual hotspots where impacts due to consumption occur. Understanding the potential to link carbon, air pollution or biodiversity footprints 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.

MOI14 LCA data machine applied
A. Ciroth, GreenDelta; M. Stroeka, GreenDelta GmbH
In any LCA study, finding data sets that are “fit for purpose” is probably one of the aspects which consumes most time and effort, and the data sets which are used have obviously a direct implication on the stability of the result achieved. This high effort for finding and creating data sets is true despite the existence of several comprehensive, generic databases for LCA. It is underlined by the presence of intransparent, outdated, or out-of-region and context data set in these databases. For this reason, an “LCA data machine” has been developed at GreenDelta in the last 3 years, and was already presented earlier at conferences. The LCA data machine automatizes creation, update, and to some extent also review of data sets in LCA and sustainability assessment. Data sets are created to meet several specific requirements, e.g. related to region, time, or nomenclature system, but can also be

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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 process, to adapt to specific, local needs. 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

Tilting on 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 the local power generation sources. Our LCA models incorporate hourly and region-specific electrical grids and data sources (Environmental Protection Agency, Department of Energy). Our results illustrate that the use of photovoltaics at the NZEB produced excess electricity by on-site renewables which is distributed back to the grid and can be interpreted as avoided upstream emissions (generation at the power plant), which in some cases may offset or erase initial material phase impacts. The marginal consequential model improved the payback period by an order of magnitude (12.5 years to 3.0 years). Additionally, the dynamic scenarios explored in this study were able to effectively account for the growth in natural gas generation, assigning or ignoring emissions based on a marginal increase or decrease load during the building’s energy use. The LEED Gold building is solely reliant on the regional electricity grid, making 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 LCA 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 impacts across different commuting modes. 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 whole life cycle impact of construction, maintenance of transport infrastructure, manufacturing and maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PKT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PKT environmental impact of public transport systems are highly sensitive to ridership levels, the environmental impact of public transport systems and IPT modes has been compared for off-peak, average and peak hour levels of ridership. This framework has been developed on the basis of extensive data collected for the material and energy required for the construction and maintenance of infrastructure, manufacturing and maintenance of rolling stock, use phase impacts of fuel/energy production and tail-pipe emissions, in addition to the transport of raw materials. Therefore, this framework is highly comprehensive but it is also amenable to future additions and expansions. The regional transport authorities can proactively address the target areas for improving the environmental performance of their transportation system, and ultimately the competitiveness of their network. The regulatory authorities will have the information to improve on their policies to reduce environmental impacts associated with each mode at each stage.

MO117 Environmental impact assessment of rail freight intermediality in Belgium using the Life Cycle Assessment methodology A. L. MERCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslandert, 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 freight transport from an interdisciplinary perspective. The objective is to increase the rail freight transport by linking 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 transport routes, depending on the freight transport mode chosen (rail or road transport) for the major part of the intermodal route. Finally, we have analysed how the increase of rail freight transport in the modal split as a result of the possible development of the intermodal rail freight transport affects the environmental impacts of inland freight transport in Belgium. For this, three divergent Belgian scenarios with a time frame set in the year 2030 have been built for further analysis. These scenarios are directly linked to the third strategic goal of the European Commission’s White Paper on transport (2011). As a result, a best, worst and medium case scenarios have been developed, depending on whether the 30% shift will have been successfully accomplished, the status quo will have been maintained or the goal will not have been completely reached by 2030, respectively. The results obtained in this research can help to build plausible scenarios for rail freight development in order to define the sustainability impact of future intermodal transport. They could help in making optimised policy decisions relative to the development of intermodal transport in Europe, including environmental aspects and allowing the reduction of emissions in the transport sector.

MO118 Modelling and monitoring of pesticides fate and exposure in a regulatory context (P)

MO119 Quantifying visual assessment of kinetics - Development of an objective criterion to support visual assessment of SFO fits of parent soil degradation J. Witt, Bayer AG / Environmental Safety; S. Bourke, Envirosys Ltd.; S. Ford, JSC International Limited; D. Patterson, Syngenta; B. Erzgraber, BASF SE; M.A. Thomas, Monsanto Company; I. Hardy, Batelle; R.L. Jones, K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; J.A. Hesting, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi-phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err may lead misleading as it does not account for systematic deviations, while 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, discounting the subjective nature of visual assessment. Based on group discussions, we derived group consensus scores. Consensus scores showed little correlation with Chi2err (R^2 = 0.23). Among several proposed criteria, the SWARC (scaled and weighted area under the residue curve) criterion showed the best correlation to the consensus scores (R^2 = 0.77). SWARC was specifically developed for this task. The residue curve is split into blocks of the same sign (i.e., over- or underestimating the residual data). The area of each block is weighted, depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data
MO120 "Southside"- Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe.

B. Gottesbaeren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASFSE; K. Plat, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modeling; B. Erzgraeber, BASF SE; F.P. Donaldson, BASF Corporation / APD/PEFR; J. Goulet-Fontin, BASF SA; F. Kröger, Eurofins Agrosience Services GmbH.

In European regulations degradation rates in soil (DegT50) from terrestrial field dissipation studies TFD studies considered for exposure modeling may originate from "any" sites with soil and climatic conditions similar to Europe. An OECD Ecoregion similarity model (ENASGISP) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. However, it was found that climatic conditions, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFO should also be assessed. Testing of the criterion for metabolite fits showed that it was not reliable in most cases but can also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MO122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?

P.I. Adriaanse, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR.

DegT50 endpoints from TFD studies conducted in the Southern hemisphere (i.e. New Zealand, Chile) under climatic, soil and cropping conditions similar to conditions in the Northern hemisphere may deliver similar soil degradation rates and DegT50 endpoints than those from Europe. Similar similarity zones were identified between the New Zealand and Chilean sites and EU/NAFTA using the OECD ENASGISP tool as well as an adapted GIS crosswalk with JRC-EFSA climate and soil maps for EU. The trial sites had soil types ranging from loamy sands, sandy loam, loam and silty loams. In New Zealand the sites were located on the Northern Island having an average annual air temperature of ~ 12-13 °C and an average annual cumulative rainfall of ~ 780-970 mm. In Chile the sites were located in the Región del Bio-Bio east of Concepción having an average annual air temperature of ~ 14 °C and an average cumulative annual rainfall of ~ 800-900 mm. The terrestrial field dissipation (TFD) trials were conducted according to OECD 232 (DegT50 module, soil covered with sand) with different pesticides at 3 sites in New Zealand and in Chile, having no historic use of these pesticides. All pesticides were applied in commercial formulations as a tank mix together in the same spraying on the same field plots at the same time. The field DegT50 were normalised to reference conditions (20°C, moisture pF2) during kinetic analysis according to FOCUS, considering local soil conditions and weather data to estimate soil temperature and soil moisture with the PEARL model (as had been done with the EU studies). The quality indicator values of curve fit to data (Chi-error) were found to be acceptable. The normalized SFO DegT50 in the “Southside” trials in New Zealand were found to be in the range of those from TFD studies in Europe using the same study design.

MO121 Residues of currently used pesticides in Central Europe arable soils: status quo, dissolutions and consequences

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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 due to common use, 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.

MO123 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessments

W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Recent development of approaches for quantitative use of surface water monitoring data in aquatic 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 or 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/form model. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure conditions and the context sensitivity of the vulnerability of the monitoring locations 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.
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. Bolekhant, Bayer AG, Research & Development, Crop Science; G. Spickerman, ADAMA Deutschland GmbH; D. Schafer, Bayer Crop Science / Environmental Safety

The calculations of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goerlitz, 2015; Bach et al., 2016, Poulsen, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e. any comments from official side (EFSA FOCUS Repair Group) or from other sources can be addressed according to given consensus. The aim is to contribute to the development of an improved and generally accepted approach for surface water calculations representing a realistic worst case based on a robust evaluation. Bach et al. (2016): Pesticide exposure assessment for surface waters in the EU. Part 1: Some comments on the current exposure model. Pestic. Manage. Sci. 72: 1277-1296. CMF: Core functions of CMF are developed which allows for stepwise adaption of model structures. These approaches should be sufficient to meet the demands allowing thereby a good spatial resolution. However, passive sampling still suffers from a lack of confidence of regulators and investigators with regard to the reliability of the ambient concentrations it represents and the supposed variability of sampling rates in the field. This contribution will show a rational monitoring strategy that has been applied in several catchments in Luxembourg and validated with parallel autosampling of flood events during application periods. It establishes that passive sampling is essentially time proportional and that base- and high flows can be separated for their contribution in terms of time-weighted averages and event mean concentrations. The biases and uncertainties in terms of load calculations are addressed. Based on monitoring in different hydrogeological contexts the approach is intended to derive land and crop specific loads in catchments and exceedence probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO127 Quantitative exploitation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation

M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittois, V. Hück, Luxembourg Institute of Science and Technology LIST

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

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

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The impact of agricultural practices on water pollution can be assessed by process-based reactive transport modelling using catchment scale models. Most models are not able to address the spatial partitioning of pesticide transport to surface water and baseflow. In this study we address the spatial partitioning of pesticide fluxes to surface water and baseflow to surface water. We used a spatially distributed reactive transport model Zin-AGrITra in the mesoscale (78 km²) catchment of the Wark River in Luxembourg in order to simulate concentrations of terbutylazine in river water. In contrast to former studies, we used six sampling points, equipped with passive samplers, for pesticide model validation. At each sampling point, event mean concentration of six events from May to July 2011 were calculated by subtraction of baseflow-mass from total collected mass assuming time-proportional uptake by passive samplers. Continuous discharge measurements and high-resolution automated sampling were allowed for accurate load calculations at the outlet. Detailed information about maize cultivation in the cultivation and nation-wide terbutylazine application statistics (average of 341 g/a in the 3rd week of May) were used for a definition of the pesticide input function of the model. The hydrological model was manually calibrated to fit baseflow and spring/summer events. Substance fluxes were calibrated using 1000 Monte-Carlo simulations of physical-chemical substance properties and parameters from the literature: surface soil half-lives of 10-35 d, Freundlich KOC of 150-330 ml/g, Freundlich n of 0.9-1 and adsorption/desorption kinetics of 20 – 80 lit/d. A multi-criteria Nash-Sutcliffe efficiency including substance loads and concentrations at all stations was calculated resulting in values up to 0.80. The best 100 parameter sets were evaluated for terbutylazine pathways and balances. The model predicted overlaid flow to the major source (80-95%) of terbutylazine in the main channel and sub-surface water fluxes to be the most important pathways in the tributaries. Simulation results suggest that 0.07-0.14 % of applied terbutylazine mass was exported to the river in the Wark catchment. In addition to calibration of substance characteristics, passive
Pesticide losses via drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (FOCUS PAT), which selects an application date, which is 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 support the FOCUS PAT and CRD PAT risk assessment of these different algorithms were modified to account for this agronomic restriction. In this poster, the results from the four approaches – namely CRD PAT, FOCUS PAT, CRD Traffic PAT and FOCUS Traffic PAT – are contrasted and compared, with a view to drawing conclusions for the standard and refined UK higher tier drainflow risk assessment process.

MO132
Considering diffuse urban and agricultural sources of pesticides at the landscape and catchment scale

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For plant protection products (PPPs), there is a strong move towards landscape and catchment scale risk assessments as this allows for integrated risk assessments that consider multiple sources of pollutants, different exposure pathways as well as different receptors within a single framework. This landscape/catchment approach moves away from realistic worst case scenarios, designed to be protective of a wide range of usage situations, to a more realistic representation of usage environments that are more representative of real life situations. Two types of model are used to perform this task: fate models to consider the movement of the compound, and exposure models to assess effects. The exposure models are particularly important when considering urban environments where there has been a move towards a more integrative approach that considers not only the agricultural pesticide load, but the whole range of inputs to the urban environment. In this poster we introduce the tools being developed to perform these assessments, we discuss the approach being taken and the progress that has been made, and we look at the issues that still need to be addressed.

MO133
Calibration of passive samplers for the monitoring of chlordane in French Caribbean rivers

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The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordane obsolete and new approaches should be explored to monitor the fate of this pesticide. Aquatic system is an ideal candidate for this type of integrative samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordane: the classical POCIS (Polar Organic Chemical Integrative Sampler) (with Polysulfone membranes), the POCSny 30µm (with nylon membranes), and the POCSny 0.1µm. Calculated sampling rates (Rs) were corrected by a PRC ( Performance Reference Curve) approach. Laboratory calibration was done in triplicates under a continuous flow system, and the field calibration was done in triplicates in river Capsterre (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.09±0.01 L.day⁻¹ for the POCSny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCSny 30µm. Two distinct Rs have been calculated for the POCIS and the POCSny 0.1µm: one for the first five days of the experiment (Rs = 0.19±0.01 L.day⁻¹ for the POCIS; Rs = 0.48±0.50 L.day⁻¹ for NOCS 0.1µm), and one for the overall experiment (Rs = 0.19±0.02 L.day⁻¹ for POCS; Rs = 0.43±0.01 L.day⁻¹). POCSny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than
in the laboratory calibration (R²=0.82 ±0.193 L⁻¹). POCIS and POCIS-sny samples can accumulate chlorodene 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
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To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples at these sites were collected from May to August, and July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, isoprothiolane, iprobenfos and thifluazamide as fungicides were mainly detected in rice season. While other fungicides including diniconazole, propiconazole, fenamif, niramulin and boscalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphorus, cadusafos, diazinon, fenitrothion, fenithion, phenthoate and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Since waters monitored, nine pesticides which include alachlor, butachlor, dimethametryn, dithiopropion, ethalfluralin, metolachlor, oxadiazaron, simetryn and thionocarb were detected with frequencies of 1–48% and in their residue level of 0.01–1.9 µg/L. Detection frequencies and residue levels of insecticides and herbicides were the highest in waters sampled in May and June. Almost pesticides detected were for the rice plants and their residue levels were very low to compare with standard values.

MO135 Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil
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São Paulo State is the biggest sugarcane producer in Brazil and the second at pesticide consumption. The aim of this project was to develop a method to determine the presence of 14 pesticides representative from sugarcane plantation, 7 herbicides (simazine, atrazine, ametryn, clomazone, diuron, hexazinone and tebuthiuron), 3 fungicides (azoxystrobin, carbendazim and tebuconazole), 3 insecticides (carbofuran, imidacloprid and malathion) and 1 transformation product (atrazine-2-hydroxy) in surface and ground waters using liquid chromatography tandem-mass spectrometry (LC/ESI/MS/MS) and solid phase extraction as sample preparation. Limits of detection (LOD) and quantification (LOQ) were ranged from 0.97 to 22 ng L⁻¹ and from 2.80 to 74.08 µg L⁻¹, respectively, while mean recovery was 66 %, which allowed obtaining a sensitive and accurate method for the determination at trace levels. In total, 196 samples located in the main sugarcane area from São Paulo were analyzed (175 surface waters and 21 groundwaters) between October/2015 to October/2016. The most frequently detected pesticides in surface water were atrazine-2-hydroxy (100%), diuron (94%), carbendazim (93%), tebuconazole (91%), hexazinone (91%), imidacloprid (96%) and ametryn (81%). The pesticide that presented the highest concentration for this matrix was imidacloprid, reaching 2579 ng L⁻¹. The risk to aquatic life were evaluated dividing the maximum environmental concentration of each pesticide by the lowest water quality criteria found in the literature. The potential risk for aquatic life was observed for imidacloprid, carbendazim, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbendazim (10%), 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
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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 run-off 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
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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 dominant transport processes which are responsible for the occurrence of herbicides in surface waters. 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 only explained by point source contributions. The model results demonstrate that SWAT is capable of simulating streamflow in a small agricultural catchment, and is capable of simulating diffuse source pesticide concentrations. This allowed application of an approach that identified the dominant processes contributing chemically distinguishing between diffuse source dominated high concentrations from those most likely affected by point sources. The SWAT model also proved useful in identifying the spatial variability in the dominant transport processes contributing pesticide residues to the stream. While surface runoff of soluble pesticide was the major non-point source contributor on most fields, lateral subsurface flow was found to be important as well, especially in the western portion of the catchment. Spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmyards as well as diffuse sources.

MO138 Pesticides in water and surface sediments from Douro River estuary (Portugal) - assessment of environmentally relevant mixtures using acute toxicity bioassays
The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuary at Porto and Gaia cities. Therefore, the presence of pesticides is suspected. Accordingly, the evaluation of 56 pesticides of different categories (insecticides, herbicides, and fungicides) should be viewed as a priority for this habitat due to their negative impacts on the biota. For this purpose, water was collected over one year at six sampling sites in the Douro River estuary. Samples were extracted by solid-phase
extraction and quantitatively analysed by gas chromatography–mass spectrometry (GC-MS). Results show that 96% of measured pesticides were detected in 79% of the quantified samples and that twelve compounds showed concentrations well above the limits established by the 2013/39/EU Directive. Individually, the concentrations of the analysed pesticides ranged from 39 to 1265 ng/L. Since the occurrence of these compounds happens in mixtures, we conducted a theoretical hazard assessment considering the average and the maximum environmental mixtures of all identified compounds. The theoretical approach suggested that invertebrates were the most sensitive group. Therefore, short-time exposure in vivo assays using Artemia salina and Daphnia magna were done. These results disclosed significant toxic effects of the analysed mixtures - high mortality rate and abnormal swimming behaviour - over the exposed animals. Both approaches (theoretical and experimental) demonstrated realistic risk scenarios in need of current attention on this estuarine environment and of other comparable. Acknowledgements: European Regional Development Fund (ERDF) through COMPETE, Framework of the Structured Program of R&D&I INNOVAR – Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0145-FEDER-00035), Research Line ECOSERVICES, supported by the Northern Regional Operational Programme (NORTE2020), through the ERDF. ICBAAS – U. Porto. Keywords: monitoring, Artemia salina, Daphnia magna, pesticide mixtures

MO139 Monitoring programme to investigate the presence of myclobutanil and its soil metabolite in Italian groundwater following use in pome fruit, stone fruit and vineyards

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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) in 94% of the samples and in about 1% of the samples, 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 fungimant 1,3-dichloropropene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl / RD; C. Vai, Dow AgroSciences Italia srl; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; 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 further processed and compiled 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 sales data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where Telone™ is applied.™

MO141 Development of an European Tier 3+ Spatially Distributed Modelling Framework

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; P. Sweeney, Syngenta

Higher tier groundwater assessment in the European Union (EU28) allow the use of spatially distributed modeling approaches for the assessment of groundwater and exposure of soil organisms to the use of a distributed model. Based on these 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 dataset, but can be updated as needed by the user. This framework fills the niche for larger scale distributed modelling assessment.

MO142 Influence of aquifer parameters on groundwater residue concentrations

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FOCUS modeling leas 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, a realistic range of aquifer permeability 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. Geuvara, Waterborne Environmental Inc / Modeling

Groundwater assessment guidelines provided by the FOCUS groundwater working group (2009) and EFSA (2014) describe succinctly a multi-scale distributed modelling assessment 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 impact our modelling results. In this poster, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4R. Specifically we will focus on differences between datasets, data set resolution, capturing variability and ones ability to model at the pan-European level within EFSA’s tier 3 guidelines.

MO144 Combining specific and public groundwater monitoring data as higher tier for pesticide regulatory risk assessment
A. Boivin, ANSES

Pesticides risk assessment for groundwater in France is performed according to Regulation 1107/2009. The European tools are routinely used by considering the same models and same tiered approach. Groundwater monitoring data are identified as higher tier that may supersede modelling. Still, there is currently no agreed guidance available on the use of groundwater monitoring data for regulatory purposes. Work is ongoing on behalf the SETAC-EMAG GW group (www.setac.org/group/SEAGFest). The main issues when dealing with groundwater monitoring data interpretation were targeted at 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 activates substances, more metabolites will be included in the future Proposals to combine targeted together with public groundwater monitoring dataset were made to enhance the representativeness of the GW monitoring conducted.

MO145 Minimal variation in input parameters highly influences PEARL and PELMO results: how can these results be trustable?
S. Ulucci, 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 results are observed when high variability occurs in one or more of the parameters listed above. In this work, we demonstrate that PEGcw outputs are significantly affected also by minimal variation of the same parameters. Considering that a minimal variation is intrinsic in all laboratory studies (es. 25% uncertainty in KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically acceptable. In a previous project (York, 2017), dummy substances with different combinations of DT50, KOM and 1/n values were used in FOCUS PEARL, in order to quantify the influence of each single parameter on the final PECgw. It was verified that the sensitivity of PEARL model can be considered quite excessive. In this follow-up project, further calculations were performed using FOCUS PELMO to confirm the sensitivity of these two models, commonly used in a regulatory context. Leachate concentrations were plotted as a function of KOM and as a function of degradation rate coefficient. PEGcw obtained by the simulations of these two models were used to create a classification system for the input parameters KOM and DT50 according to models sensitivity. Conservative values for each parameter class, to be used in PEGcw calculations, are proposed for all substances. This approach can minimize the effects of the intrinsic input variability providing a better scientific approach to the assessment of groundwater modelling in the regulatory context.

MO146 European regulatory network on pesticide groundwater monitoring
A. Gimnig, The Danish Environmental Protection Agency / Pesticides and Gentechology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, CgB; A. Schwem, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tüting, German Federal Office of Consumer Protection and Food Safety

Groundwater monitoring data should be included in the assessment of the leaching risk of pesticides and their metabolites. Monitoring data is generated in most European countries, but their use for leaching risk assessment during pesticide authorization is hampered due to the following reasons: (i) The data is often not publicly available or available only in an aggregated form in a report, (ii) most of the data is available in the national language of the origin country only, which makes it hard for other countries to evaluate these data, (iii) the interpretation of groundwater 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 / Environment Safety; U. Kölzer, Bayer AG, Research & Development, Crop Science / Environment Safety; D. Sossaud, Bayer Crop Science / Environmental Safety

Recent regulatory interest in the wash-off process resulted in a proposal to that the effects of wash-off should be generally considered as additional soil loading for FOCUS modelling of foliar applied pesticides (EFSA 2010, 2016). EFSA also proposed to increase the default wash-off factor for FOCUS modelling from 0.5 cm-1 to 1 cm-1 (EFSA 2012). On the other side, EFSA has stated that effects of wash-off should not be considered as additional soil loading for PECgw calculation but rather as average effect (EFSA 2015, 2017). The foliage 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 foliage pesticide spray. The determined wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1. EFSA 2010: PPR – Guidance Document 4093 – Predicting environmental concentrations in soil EFSA 2017: Guidance Document 4982 – Predicting environmental concentrations in soil

MO148 Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reinken, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Kößler, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamshoefjt, Bayer CropScience AG / R&D; S. Sittig, DR. KNOELL CONSULT GmbH / E-Fate Modelling

In recent regulatory discussions about the plant uptake process the question was raised if tracer-like substances (very low or zero sorption, very slow or no degradation) are fully available for uptake by plant roots under dynamic outdoor conditions. An alternative hypothesis is that such substances move so quickly in the soil column that they are taken up by plant roots to a lower extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor continental study was conducted with 14C-labeled trifluoroacetic acid (TFA) and winter wheat plants for a time period of 228 days after application onto soil. Trifluoroacetic acid is a common breakdown product of several chemical processes e.g. (PFHxS) of PFTE (used as coating in many products like Teflon® or Gore-TEX®). Plant root uptake of TFA under static conditions has been determined in parallel with experiments using plants growing in nutrient solution (hydroponic study design). The translocation and uptake of trifluoroacetic acid observed in the outdoor container study was evaluated with the PESTLE model considering root uptake processes as routinely applied in standard FOCUS modelling. A transpiration stream concentration factor (TSCF) for TFA under cereal growing outdoor conditions could be derived. The results demonstrate that mobile, tracer-like substances are taken up extensively by plant roots even
under dynamic outdoor conditions; the hydroponic study design is suitable to determine conservative input parameters for regulatory modelling; uptake experiments with cropped outdoor containers may be suitable as higher-tier to derive a refined TSCF. Further experiments will indicate to which extent this study design is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO149 Investigating the variance of edge-of-field deposits of spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray applications in arable crops often lead to off-target spray deposits downwind from the treated field. Throughout several decades, many experiments have been carried out by different researchers to quantify the downwind spray deposits. Relations between downwind spray deposits and parameters like sprayer settings, field conditions and environmental conditions were investigated. Still, there is a large variance in the observed data that cannot be explained satisfactorily by the experimental and environmental conditions. These 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 treated field watercourse downwind of the field. Consequently, the part of the spray that is applied in the direction perpendicular to the field watercourses next to tree nurseries was assessed. Simultaneously, the part of the spray that is applied in the direction parallel to the field watercourses next to tree nurseries was investigated. In both experiments, the deposited spray levels comparable 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

Edge-of-field watercourses next to tree nurseries involve spray application in dairy fields. The spray is directed partly towards the top of the trees, where it may pass beneath the canopy and reach downwind areas easily. The aim of this study is to derive refined exposure matrices for pesticide residues in tree nurseries taking into account these conditions. Several experiments were carried out to quantify the pesticide deposits applying the spray drift model IDEFICS. Downwind deposits of spray drift were measured alongside a treated field watercourse downwind of the field. Consequently, the part of the spray that is applied in the direction perpendicular to the field watercourses next to tree nurseries was assessed. Simultaneously, the part of the spray that is applied in the direction parallel to the field watercourses next to tree nurseries was investigated. In both experiments, the deposited spray levels comparable to those established experimentally. Effects of fluctuating wind directions are to be investigated in the near future.

MO151 Investigating the exposure of residents to pesticides due to airborne spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, J. Michielsen, H. Stallenga, P. Van Velde, Wageningen University and Research / Agrosystems Research

Investigations have been carried out in the Netherlands since 1990, where 90,000 people live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides or whether their health is at risk. Recently, a research project was launched to assess the exposure of residents to pesticides next to flower bulb fields. This research projects involves both measurements and simulations of airborne spray drift. Volatilization is investigated for several days after spray application. Outdoor and indoor exposure of residents to pesticides is estimated. The current paper deals with the exposure next to flower bulb fields. This research is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO152 Risk assessment for consumers of co-formulants used in Plant Protection Products. Case study of polymers
P. Adrian, M. Liegeois, M. Darriet, B. Journel, CEHTRA SAS

There is no recent guidance on how to conduct a risk assessment for consumers for co-formulants present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co-formulants is applied onto crops. To our knowledge only one software is predicting the level of crop residues of chemicals after application i.e. PARDIS [1] (Prediction of Agricultural Residue Data). More research is needed. The EFSA assesses the residue behavior of the pesticide and the dietary intake resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues is estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed. These residues may be different for different crops and different for different residues. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and in its transformation, the possible uptake and translocations of the residues 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 a 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 for the uncertainty due to missing data might play a fundamental role in risk assessment.

MO153 Dietary exposure to pesticide residues: the big picture
Xavier Barouza, L. Ferreira, EFSA - European Food Safety Authority / Pesticides Unit

Science-based approaches and integrated risk assessment by using experimental data, models for pesticide residues intake estimations, monitoring data considering real exposure, etc. are working tools to contribute to the mission of the European Food Safety Authority (EFSA) on protecting European consumers’ health and the environment in the field of pesticide residues. Maximum residue levels (MRLs) cannot be derived for 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 intake resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues is estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed. These residues may be different for different crops and different for different residues. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and in its transformation, the possible uptake and translocations of the residues 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 a 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 for the uncertainty due to missing data might play a fundamental role in risk assessment.

MO154 Exposure and Risk Assessment for Agricultural Applicator to Insecticide Fluendibamide during Cabbage Cultivation using Whole Body Dosimetry
J. Lee, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National Univ / Agricultural biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; B. Kim, Seoul National Univ.; E. Kim, H. Ryu, Seoul National University / Department of Agricultural Biotechnology; D. Jeong, Seoul National Univ.; X. Yuan, Seoul National University / Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National Univ.; M. Rehan, Seoul National University; J. Kim, Seoul National University / Department of Agricultural Biotechnology

Fluendibamide belongs to diamiide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s exposure was performed. This study develops the pratical methodology to assess exposure to co-formulants. The objective of this work is to develop a methodology to be applied under these conditions. As a case study we present this methodology for latex polymers i.e. polymer based on methylene succinic acid with buta-1,3-diene, styrene and methacrylic acid. [1] Prediction of agrochemical residue data on fruit using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M 2008.
dermal exposure of flubendiamide was 3653.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubendiamide (688.7 μg) in mixing/loading was higher than the case of application (680.8 μg). Exposure of body was highest (42.0%) in case of application. Penetration rate of insecticide between outer and inner dosimeter was about 0.5% (upper body) and 5.9% (lower body). Inhalation exposure during application was 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@snu.ac.kr; Tel, 82-02-880-4644

MO155
Multi-focus FOCUS Surface Water calculations: What do they mean for real regulatory cases?
D. Schaefer, Bayer Crop Science / Environmental Safety; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Bolesh, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer Ag / Effect modelling; G. Goerlitz, Bayer CropScience AG / Environmental Safety

The surface water exposure calculations for pesticides according to FOCUS are currently under revision by an Efsa working group. In particular the working group was mandated to extend the calculation period from a preselected single year to 20 years, with the objective to better capture the effect of variable weather conditions in aquatic exposure patterns. This is meant to provide a more robust and reliable basis for aquatic risk assessments in a regulatory context. The planned revision requires decisions on some technical aspects of the calculations (e.g. evaluation of the original FOCUSws 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 extended FOCUSws default values 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 properties 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 general conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the Efsa working group has to take.

MO156
Effectiveness of grass buffer strips in reducing Spinosad runoff
S. Otto, Italian National Research Council, S. Gottiardi, M. Pasini, Agrea SRL; R. Brand, AgroSciences Italia slv / 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 options for surface water are often too lenient. The selected site was near Verona, in an hilly zone rich in vineyards and field study was performed in summer 2017 to test vegetated buffer strip removal efficiency of such buffers. Recent research suggests that these default removal options for surface water are often too lenient.

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 included in the residue definition for dietary risk assessment. The European Commission, Efsa prepared a guidance on the residue definition for dietary risk assessment which intends to complement the OECD guidance. The Efsa guidance is intended as a practical instrument helping risk assessors, on the basis of factual information (derived from toxicological and metabolism data), non-animal testing methods, by weight of evidence, to transparently: Conclude for which residues of a pesticide on food and feed commodities a hazard identification and characterisation is needed; Perform such a hazard identification and characterisation; Define the compounds that should be included in the residue definition for risk assessment. The innovative aspect of the Efsa guidance is a structured sequence of three modules, each of which addresses hazard characterisation and dietary exposure by selecting genotoxicity as the starting criteria for human health assessment. The modules are: Module 1: Exclusion of genotoxicity; Module 2: General toxicity assessment; Module 3: Decision making for residue definition for risk assessment. The guidance provides as appendices an analysis of ADI and ARD distribution for pesticide active substances and three case studies illustrating the practical application of this modular approach to derive a residue definition for dietary risk assessment for isoproturon, spirioxamine and tebuconazole. In September 2016, Efsa organised a technical meeting with stakeholders on its new guidance to exchange views. Efsa PPR Panel (EFSA Panel on Plant Protection Products and their Residues), 2016, Guidance on the establishment of the residue definition for dietary risk assessment. Efsa Journal 2016;14(12):4594, 129 pp. doi:10.2903/j.efsa.2016.4594. *OECD (Organisation for Economic Co-operation and Development), 2009, Series on testing and assessment No. 63 and Series on pesticides No. 31 Guidance document on the definition of residue; ENV/JM/MONO(2009)30; 28-Jul-2009. *Info session on applications – pesticides - technical meeting with stakeholders on EFSA GD on residue definition for dietary risk assessment. http://www.efsa.europa.eu/efsajournal/view/160926

Alternative Approaches to Animal Testing for Ecotoxicity Assessments (P)

MO158
Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Schlotthiem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schütte, Fraunhofer IME; I. Ebersbach, Fraunhofer IME, Institute for Molecular Biology and Applied Ecology; L. Bischof, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology IME. Bioconcentration factors (BCF) are needed for regulatory purposes to assess the bioaccumulative characteristics of a substance in the aquatic environment. Traditionally these BCFS are determined in fish flow-through tests according to TGD OECD 305. These fish bioaccumulation studies are time consuming, expensive, and demand many laboratory animals. Accordingly, alternative methods that replace, reduce and refine (3Rs) this test system are needed. Two promising alternative test approaches have been developed as alternative to in-vivo BCF testing: I) An invertebrate flow-through bioconcentration test system using the freshwater amphipod Hyalella azteca and II) in vitro depletion assays with rainbow trout hepatocytes or rainbow trout hepatocyte S9 fractions. Flow-through test with almost 20 compounds showed, that the H. azteca bioconcentration test could be an appropriate test to predict 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 impact of metabolic activity to existing BCF prediction models. In this study a total of five substances with different characteristics, four substances with logKow 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 was 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.

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MO159 Assessing Differences in Sensitivity to Aromatase Inhibitors Among Freshwater Fish Species

There is significant concern regarding potential impairment of fish reproduction associated with exposure to endocrine disrupting chemicals (EDCs). Aromatase is a steroidogenic enzyme involved in the conversion of androgens to estrogens. Inhibition of aromatase activity by exposure to chemicals can reduce levels of circulating estrogen leading to reduced synthesis of vitellogenin and production of fewer eggs by females. This mechanism has been extensively studied in the laboratory model species, fathead minnow (Pimephales promelas). However, differences in sensitivity to inhibition of aromatase among species of fish is largely unknown. This is particularly true for species that are not routinely studied in short-term reproduction assays, including many fishes of significant ecological and economic importance such as catfish (Ictaluridae), eel (Anguillidae), and perch (Percaidae). This study investigated in vitro inhibition of aromatase by the model inhibitor, fadrozole, across eighteen phylogenetically diverse species of freshwater fish. Concentrations of fadrozole that result in 50% inhibition of in vitro aromatase activity (IC50) were determined from 0.14 to 0.08 μM among these species, for the environmental conditions of this study. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodontidae), white sucker (Catostomidae), rainbow trout (Salmonidae), and fathead minnow (Cyprinidae) were investigated for sensitivity to in vitro inhibition of aromatase by four additional inhibitors: Potencies of letrozole, imazalil, prochloraz, and propiconazole relative to fadrozole were comparable among paddlefish, white sucker, rainbow trout, and fathead minnow despite up to 40-fold difference in sensitivity to fadrozole. This suggests that relative potencies generated for a model species, such as fathead minnow, could be applicable across diverse species, despite great differences in relative sensitivity. Results of this study are being used in the construction of a cross-species quantitative adverse outcome pathway (qAOP) for sea turtles. The qAOP framework allows for 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 mineralised using concentrated nitric acid. After digestion, 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 de 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 total of 13 cell lines. Differences between organ cultures were investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO162 Comparison of rat liver S9 to an animal-free alternative ewoS9R in the Ames fluctuation assay
J. Brendt, RWTH Aachen University; B. Thalmann, EWOMIS; K. Blühm, University of Saskatchewan; K. Kauffmann, RWTH Aachen University / Department of Biochemical Engineering; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Depart. of Environmental Analysis; A. Schiwy, EWOMIS; J. Büchs, RWTH Aachen University / Department for Environment, Energy, Geotechnology and Urban Planning; H. Hollett, RWTH Aachen University / Institute for Environmental Research

The Ames test is the most important in vitro test for mutagenicity performed in many variants. The original agar-plate assay was modified to reduce the amount of assay components like rat liver S9 and the length of time needed for test preparation and evaluation. The Ames fluctuation test was established as a less time and money consuming method than the traditional plate assay. Differences between organ cultures were investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO163 QSAR: a predictive approach for electronic cigarettes toxicological assessment
D. Zarini, University of Insubria; E. Papa, A. Sangion, University of Insubria / Institute for Environmental Research
MO164

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

T. Yamada, National Institute of Health Sciences; M. Kuriimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute of Environmental Studies; Y. Matsui, National Institute of Environmental Studies / Center for Health and Environmental Risk Research; N. Tatarazako, Ehime University / The Health and Environmental Safety and Alternative Methods Unit; H. Yamamoto, National Institute of Environmental Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute of Environmental Health Sciences / Division of Risk Assessment

In the longer term this may form part of a suite of tools and a live demonstration of the web interface and associated web tools will be available.

MO165

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

R.R. Otter, Middle Tennessee State University / Biology; M. Embry, ILSI; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; J. Brill, The Procter & Gamble Co. / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. Curtis, DTZ ECOSafety / Centre for Risk Analysis and Risk Management; H. Farr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P.W. Wilson, Samofi U.S., Inc. / Health, Safety and Quality Criteria, and explore the potential use and application of the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO166

Using toxicokinetic and toxicodynamic modelling to predict effects of chronic toxicity on rodent growth based on in vitro assays

T.O. Martin, Environment, Department of University of York / Environment Department; R. Ashauer, University of York / Environment; P. Thorbek, Syngenta / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. Curtis, DTZ ECOSafety / Centre for Risk Analysis and Risk Management; H. Farr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P.W. Wilson, Samofi U.S., Inc. / Health, Safety and Quality Criteria, and explore the potential use and application of the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO164

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

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

R.R. Otter, Middle Tennessee State University / Biology; M. Embry, ILSI; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; J. Brill, The Procter & Gamble Co. / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. Curtis, DTZ ECOSafety / Centre for Risk Analysis and Risk Management; H. Farr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P.W. Wilson, Samofi U.S., Inc. / Health, Safety and Quality Criteria, and explore the potential use and application of the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.
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 developed a high-content screening using *C. elegans* mutant; oga-1(ok1207), ogt(ok1474), nlg(ok259), transgenic *Zebrafish*, Tg(T2Kins:nSfB-mCherry) and Tg(ela13:EGFP)knj3. The highly conserved O-GlcNAc transferase; OGTT and O-GlcNAcase; OGA genes are related to type 2 diabetes and null mutations cause alterations in *C. elegans* carbohydrate and lipid metabolism. Neuronal NGL-1 control synaptic function, which is conserved from nematodes to mammals, to modulate acute and chronic neuroplasticity and neurodegeneration. Using mechanisms of toxic action to classify and predict ester ecotoxicity

MO170 Chemoavailability of Organic Electrophiles - A Nonanimal Approach to Identify Candidates for Reactive Toxicity A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; G. Schuurmann, Helmholtz Centre for environmental research - UFZ / Department of Ecological Chemistry Organic electrophiles are important components within the exosomes 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 chemotherapeutic toxicity with nucleophilic cellular receptors (AAH). The results of previous studies have shown that the EC50 for the first observation period (time=0 minutes) is much lower for the Cited proteins, peptides or DNA. The toxicity enhancement *T*, which indicates the ratio of narcosis baseline (hydrophobic MIE) vs. experimental in vivo or in vitro bioassay toxicity, has been used as a measure for the reactive MIE for many years. However, very early studies already showed that *T* does not solely depend on reactivity, but also decreases with increasing hydrophobicity. This indicates that the relevant structural requirements are located in aqueous compartments and that the hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemoavailability,1-9 to a set of 58 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on *T*. 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 *T* with increasing *K* is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemoavailability, as a trade-off between log *K* and log *K*, is shown as a promising nonanimal tool to analyze 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 ORISIR (GOCE-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüermann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Laqua A, Schüermann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] von A, Thaens D, Paschke A, Schüermann G 2009. Chem. Res. Tox. 22: 742-750.

MO168 In vitro effects of two pesticides on the motility and viability of bovine spermatozoa I. Bulhosa, University of Aveiro / Biology department; M. Lopes, IC/BS-University of Porto / Department Veterinary Clinics; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the incorporation of fungicides, CMIT/MIT, PGH, were screened using *C. elegans* reproduction assay and zebrafish transgenic assay. The preliminary results showed CMIT/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.

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MO169 Assessing the bioaccumulation potential of several pharmaceuticals using fish S9 and hepatocyte assays L. A. Constanting, Pfizer, Inc. / PDM; M. Embry, 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 *K* > 4.5 to support the Persistence, Bioaccumulation and Toxicity (PBT) assessment and in Phase II, Tier A for pharmaceuticals having a log *K* > 3. The recommended protocol for bioconcentration is OECD Test Guideline 305: Bioaccumulation in Fish, Aqueous and Dietary Exposure. However, in the case of 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.

MO171 Local Electroplolyicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward *Tetrahymena pyriformis* D. Schüermann, 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 nucleic acids. Besides, reactive MIEs (e.g., reactive *K*-controlling cell and DNA, resulting in reactivity driven excess toxicity. Therefore, exposure to electrophiles is of high toxicological concern. Thus, identification of toxicologically relevant compounds is desired. A step forward would be to predict – rather than measure – the electrophilic reactivity of compounds directly from molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on a quantum chemical descriptor. The descriptor was tested for its capability to describe aquatic toxicity was investigated. For this purpose, their correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which is conserved from bacteria to mammals and which is involved in detoxification of electrophiles. Reactive Toxicity

MO172 Using mechanisms of toxic action to classify and predict ester ecotoxicity P. Bicheral, F. Bauer, KREATiS; P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment

Even though esters are often used and released into the environment, little is known about their mechanisms of toxic action to aquatic organisms. The biological effects of esters are considered to exert a specific narcosis, 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 regressed against a hydrophobicity descriptor (i.e. log *K* 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, therefore hydrolytically active esters are negligible. The 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 substitute in position alpha of the carbonyl are not more toxic than aliphatic esters for any of the three aquatic species. On the other hand, Acrylates clearly express excess toxicity and have to be considered as acting through yet another mechanism of action relating to a model dedicated to soft electrophiles. Rather than model the toxicity only according to structural analogy, a modelling approach is used to develop QSARs for esters based on three pillars: structure, mechanism and species metabolism.

MO173 Nanosecond pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos K. Arizono, Prefectural University of Kumamoto / Faculty of Env. Symbiotic Science; A. Yamamoto, National Institute of Fisheries Sciences; M. Uchida, Ariake National College of Technology / Department of Chemical and Biological Engineering; H. Ishibashi, Ehime University / Faculty of Agriculture; S. Kono, National Institute of Technology, Ariake College; N. Tominaga, Ariake National College of Technology / Department of Chemical and Biological Engineering

We developed and applied the nanosecond pulsed electric field (nsPEF) treatment condition and assessed the teratogenicity and embryonic developmental toxicity by chemicals using fish embryos. Furthermore, we analyzed gene expression profiles in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MO174 Moving 3D in vitro intestinal models forward: transcriptional characterization of the RTGutGC cell line. L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal derived cell lines are useful in vitro models which allow for focused investigations of absorption, metabolism, distribution and excretion. The development of the first immortalized intestinal cell line derived from the rainbow trout (RTGutGC) offered an opportunity to explore intestinal uptake without the need for the use of numerous animals. Recent work using numerous compounds has acknowledged its potential as a replacement tool for animal based laboratory studies, there is still a lot to be explored before its widespread incorporation as a tool for the tool. Cell lines are known to acquire additional mutations or modifications while in culture, and it is important to understand to what extent this cell line retains the genetic landscape of primary intestinal tissue. In this study, RNA-Seq sequencing of the RTGutGC cell line was used to establish gene expression in this potential animal replacement model. Over 84% of the sequences were mapped to the genome. Following filtering for transcript abundance using TPM (transcripts per million), 24,890 contigs were identified and blasted against the NR database. InterProScan was run in parallel to blast annotation and later merged with the genome. Depth sequence data of any rainbow trout cell line and identifies many commonalities between the 3D model and native tissue. Characterization of the RTGutGC transcriptome and genes and enzymes expressed in this model will greatly help in building realistic in silico models of exposure when integrated with other available chemical data.

MO175 Impact of test concentration on the in vitro intrinsic clearance using trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals H. Laue, 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 & A

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 Kiow). 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 (kde) measured at test concentrations of 1 µM could underestimate the in vitro intrinsic clearance resulting in overestimates 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, kde determined at lower concentrations were 4- to 12-fold higher than kde measured at 1 µM. However, the effect of test concentration of industrial chemicals is lacking. The goal of this study was to compare kde 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 Kiow (3.4-6.5) 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 CDN1-glutathione conjugation) and substrate depletion assays with testosterone, 7-hydroxycoumarin, pyrene and Cyclohexyl salicylate as reference chemicals. Decrease of the parent chemicals was analysed by GC-MS or LC-MS and kde values determined. For the lowest concentration (0.2 µM) 2-fold higher kde values were observed for Polysantol, Ambrofix, Cyclohexyl salicylate and Karanal compared to kde values determined with 1 µM. Measured kde 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 tested to obtain the intrinsic clearance (0.2-5 µM) compared to PAHs indicating that their Kd values may be substantially higher. Thus, for fragrance chemicals which are moderately to rapidly biotransformed, the use of 1 µM as start concentration seems to be a suitable approach to estimate the bioaccumulation potential.

MO176 Biological effects of 3 metals on "D" larvae of Japanese oyster Crassostrea gigas A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; C. Cáceres-Martínez, Universidad Autónoma de Baja California Sur

The Japanese oyster is an introduced species from Asia, which is cultivated along 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 concentrations of metal were determined: 0.1, 1 and 5 µM. The lowest concentration (0.2 µM) of the mixture (2 µM Cr + Pb) was selected to evaluate the effect of 3 metals (Cr, Pb and its mixture) on the toxicity only according to lipoperoxidation (TBARS: Buege & Aust, 1978), the activity of the AChE enzyme (Ellman et al., 1961) and genetic damage (Comet Test: Singh et al., 1988). The toxicity of metals according to the calculated LC50 values was: (from most to least toxic) Pb > Cd > Cr. The lowest toxic metal attracted to the mixture of Cr + Pb (0.2-5 µM) compared to PAHs indicating that their Kd values 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.

MO177 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 / Lagoon Ecosystems; A. Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Lagoon Ecosystems; J. Castañeda, Universidad Autonoma Metropolitana Iztapalapa / Lagoon 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 pictus. The ostracod Cypres sp. and fishes: Charal (Chrysoblepsis jordani) and juvenile zebrafish (Danio rerio). In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O:N index, 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 a sublethal concentration (LC10), for assessment of 4 biomarkers (growth rate, O:N index, lipid peroxidation and inhibition of acetylcholinesterase enzyme). The LC50 values obtained in the bioassays varied from 5.300 to 0.021 mg L−1. In the tests it was evident that the cladoceran Daphnia exilis was more sensitive to DDVP compared to the ostracod Daphnia magna.
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 mM 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 cladóceros 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 studies M. Harju, NILU / Norwegian Institute for Air Research; A. Evenson, Akvaplan-niva AS; K. Tollefsen, NILU / Ecotoxicology and Risk Assessment

Contaminants from anthropogenic activities find their way to the Arctic through long-range atmospheric transport, oceanic 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 acceptable critical 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 J. Moog, Norwegian Institute for Water Research (NIWA) / Section for Catchment Processes; A. Lillicrap, NIWA / Ecotoxicology and Risk Assessment; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization

Reduction of animal testing wherever possible is requested by EU Directive 2010/63/EU. Fish Embryo Toxicity (FET) testing can be an alternative to using juvenile fish in acute toxicity testing. However, FET data are currently not accepted as a replacement to juvenile fish acute toxicity data for regulatory purposes such as REACH, without sufficient weight of evidence (WoE). The development of a WoE approach for FET data has been recommended by the European Chemicals Agency to significantly reduce the number of animals required for hazard assessments of chemicals. We propose a Bayesian network (BN) modelling approach for quantifying the weight of evidence. BN is a probabilistic modelling methodology which is an increasingly used in ecological risk assessment as well as in environmental management and decision-making. The survey of the proposed BN model is to integrate information from large and varied ecotoxicological and physico-chemical datasets, and apply it in a WoE approach to predict fish acute toxicity of chemicals from data on fish embryo toxicity testing in combination with other relevant information. The planned steps of the model development and application are: (1) Identification of suitable chemical properties and endpoints as nodes for the BN. (2) Compilation of data on ecotoxicity data for fish embryos and other relevant information. (3) Construction of a BN model for integrating the data and other information in a probabilistic framework. (4) Evaluation of the WoE approach using ecotoxicity data for fish embryos in combination with data on (juvenile) fish acute toxicity. (5) Application of the BN model to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europa.eu).

MO181 Divergent immunomodulatory effects of cadmium between two marine immune immune cell models in vitro, macrophages and mast cells. J.S. Chaousis, Griffith University / Smart Water Research Centre / Australian Rivers Institute; P.D. Leusch, Griffith University / Australian Rivers Institute; A. Evenset, Akvaplan-niva AS; K. Tollefsen, NILU / Ecotoxicology and Risk Assessment

The planned steps of the model to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europa.eu).
The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilized. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development or use of non-destructive tools for the monitoring of threatened wildlife has been 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 include these in the evaluation of fish and data on the global protein expression of primary green turtle (Chelonia mydas) skin cells were exposed to two contaminants known to accumulate in sea turtles - a polychlorinated biphenyl (PCB153) and perfluoronic 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 100 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 PC153 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 turtles 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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MO184
Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanimal Tool for Mimicking Phase I Metabolism
J. Moldrick, Helmholtz centre for environmental research - UFZ / Ecological chemistry; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; A. Becker, Leipzig University; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemical's ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduct formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosays, which address this type of MIE, are used for the quantification of a test chemicals' reactivity towards typical biological targets, and have facilitated the development of e.g. models for the prediction of the aquatic excess toxicity or skin sensitization potential. Apart from chemicals that possess electrophilic substructures in their initial form, there are compounds that can become electrophilic only after abiotic or biotic oxidation. The reactive toxicity of these chemicals, also described as pro-electrophiles, is often difficult to characterize with simplified model systems like chemosays or in vitro biosays because these methods typically do not sufficiently include an activation step. Our presentation introduces a new tool, based on a Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophoric phenol and dihydroxybenzene derivatives into fully reactive electrophiles. The pro-electrophiles are trapped by coimmobilization 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 show that the EU-funded project OSIRIS (COE-CT-2007-03017) and the BMBF-funded project PropHaTox (FKZ 03K1A22A and 03K1A22B) for financial support. [1] Böhme A, Laqua A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [2] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [3] Chipinda I, Ajibola RO, Morakinyo MK, Rwuma TB, Simonyi RH, Siegel PD 2010. Chem. Res. Toxicol. 23: 918-925. [4] Böhme A, Thaes D, Paschke A, Schüürmann 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 ecotoxicological impact of the chemicals, we developed the continuous QSAR models for acute and chronic aquatic endpoints: The highest trophic levels: EC50 96h and NOEC 96h algae (Raphidocelis subcapitata), EC50 48h and NOEC 21d Daphnia magna, LC50 96h fish (Oryzias latipes) and NOEC fish (more fish species). We used gaseol 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 accounted to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfill the ecotoxicity criterion. The scheme will be applied to other categories of chemicals, such as the biocides in the LIFE COMBASE project. The authors thank the projects JANUS (contract Z 6 - 80 710/20 - 37164540) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/ES/416) for the financial support.

MO186
An integrated testing strategy to fill data gaps for environmental risk assessment of isoo-alcohols
G.E. Bragin, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Sciences; B. Hedghe, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Science; B. Kelley, D. Letinski, ExxonMobil Biomedical Sciences Inc.; R. Butler, ExxonMobil Biomedical Sciences Inc. / 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 testing. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatixc toxicity testing with alga, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocetanol and isooctaneol. 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 isoelectrochemical models. These data demonstrate that the QSAR model employed accurately characterized the hazard of iso-alcohols and isooctaneol of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

**MO187**

**Looking for an alternative to glyphosate-based herbicides**

V. Lioussia, K. Eisner, S. Limbeck, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering

Glyphosate-based herbicides are widely used in agriculture. When these products 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. Nonanonic acid (a.k.a. pelargonic acid) is a biological derived substance considered as an environmental friendly herbicide. Its toxicity level to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide against pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrafish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC50 were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was estimated in EthoVision software. The potential effect of the tested substances on the respiratory system of aquatic organisms was investigated in vitro by performing the Neutral Red Uptake assay on the trout-derived gill cell line RTgill-W1. Results of our in vivo and in vitro tests indicate that pelargonic acid and its formulation are more toxic (acute toxicity) than glyphosate and its based-herbicide. Furthermore, the behavioral assay indicates a potential for a neurotoxic effect of pelargonic acid on zebrafish larvae. To our knowledge so far there are no available data for a neurotoxic effect of pelargonic acid on aquatic organism. 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**

**Chemoassay Profiling of Salicylates to Assess Their Reactive Toxicity**

A. Werner, Leipzig University; A. Böhm, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Salicylates are widely used as fragrance additives or UV light absorbers in cosmetics and consumer care products, and thus can contribute to the human exposure. Moreover, released into the hospital waste stream they may act as constituents of the exosomess of waterborne flora and fauna. As organic electrophiles, salicylates are able to bind to nucleophilic sites of proteins, peptides or the DNA, thus triggering the reactive molecular initiating events of aquatic excess toxicity or dermal sensitization. For assessing the toxicological hazard of organic electrophiles, chemoassays commercialized as Promega, are promising approaches to detect substances with neurotoxic effects. For this project, the chemoassay reactivity of selected salicylates toward model peptides featuring the SH group of cysteine and the N terminus as nucleophilic target sites is analyzed in terms of reactivity of selected salicylates toward model peptides featuring the SH sites of biomolecules to profile the reaction behavior in terms of kinetic rate. The phospholipid-water partition coefficient is considered to be the dominant contributor to the overall tissue-water partition coefficient for isoelectrochemical surfactants, because membranes lipids allow for both ionic interactions at the zwitterionic head groups and hydrophobic interactions at the membrane core. The BIONIC model could apply such key parameters for isoelectrochemical surfactants structures recently published, we will now present membrane water partition coefficients (Km) for 15 anionic surfactants, using an optimized solid supported lipid membrane (SSLM) assay. For the anionic surfactant SDS, a logKm of 4.6 was determined, a factor of 1000 higher than the highest reported logP in the OECD dossier, and 5,000.000 times higher than the recommended logP. Our aim is that Km values derived from quantum-chemistry based molecular software calculations of Kow for ionic structures using COSMOtherm, or to calibrate QSARs for Kow of specific types of surfactants.

**MO190**

**The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.**

D. Du Pasquier, Watchfog S.A.; S. Guerin, V. Rocher, SIAAP; J. Mougel, AQUIRIS; A. Tindall, G.F. Lemkine, Watchfog S.A.

The Xenopus Embryonic Thyroid Signalling Assay (XETA) was designed as a screening test to provide information on the potential of a test substance to alter the normal functions of the thyroid system. The XETA provides a rapid (< 72h) way to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XETA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn't be stored or sampled in large quanties. OECD is currently validating this XETA 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 particulary useful for the hazard assessment of effluents. During the 12 past years we applied this test to effluents including municipal wastewater, treated and raw sewage and hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTF effluents showed 1) Daily variations of the thyroid effect in wastewater are linked to ecological and kinetic factors and 2) WWTP still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroid effect 3) A minor part of the thyroid effect removal occurs during and after the wastewater treatment. The major removal of the thyroid active molecule occurs during the nitritation step of the water treatment.

**MO191**

**Advances in locomotion detection of Daphnia magna, Artemia franciscana and Paramecia caudatum**

E.M. Salzer, V. Lioussia, X. Monforte Vila, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering

Animal behavior is complex and multidimensional. Over the past decades, researchers tried to qualify and quantify it, in order to understand and predict it. The advances in this field are so radical that they actually formed a new scientific domain called “computational ethology”. A major gap in this field is that most...
studies focus on terrestrial and aerial species in comparison to aquatic organisms. A reason for this discrepancy is that compared to terrestrial species, additional technical challenges need to be overcome when studying aquatic species e.g. light refraction and reflection interferences at the air/water boundary, positioning of the light source and suitable body marking techniques. However, a deeper understanding of the movement patterns of small-sized aquatic invertebrates and planktonic organisms is urgently needed, for elucidating the mode of swimming behavior can be a useful endpoint 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 tested. 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. Hirao, M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraiishi, National Institute for Environmental Studies; H. Yanamoto, National Institute for Environmental Studies / Center for Health and Environmental Research; N. Tatarazako, Ehime University / Environmental Risk; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; N. Kobayashi, Y. Ikariishi, 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 public domain in silico prediction tool for 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 Animal Species
Cell-based high-throughput screening (HTS) and computational technologies are being applied as tools for toxicity testing in the 21st century. The U.S. Environmental Protection Agency (EPA) embraced these technologies and created the ToxCast Program in 2007, which has served as a screening and prioritization tool for thousands of chemicals. The rapid and automated screening methods take advantage of hundreds of (primarily) mammalian-based HTS assays for identifying biological activity suggestive of potential toxic effects. The data can aid in identifying chemicals that are most likely to impact biological pathways that lead to adverse health effects. To realize the full potential of the ToxCast data for predicting adverse effects to both humans and wildlife, it is necessary to understand how broadly these data may plausibly be extrapolated across species. Therefore, the U.S. EPA Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was used to evaluate conservation of the 460 protein targets represented in the ToxCast assay suite. The SeqAPASS query sequence was selected based on the model organism used in the ToxCast assay (e.g., human, cattle, chimpanzee, guinea pig, rabbit, rat, mouse, pig, or sheep). Similarity of primary amino acid sequences and sequences from appropriate functional domains were compared across species to predict the chemical sensitivity of each target across taxa. To demonstrate application of the SeqAPASS data for extrapolation of ToxCast targets, case studies were developed that focus 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 involved in insulin signaling. These findings demonstrate the utility of SeqAPASS for informing the extrapolation of HTS data and identification of model organisms likely to be suitable for follow-up or complementary in vivo toxicity tests. The contents of this abstract neither constitute nor reflect official US EPA policy.

MO194
In silico site-directed mutagenesis informs species-specific predictions of chemical susceptibility derived from the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool
J.A. Doering, US EPA / Mid Continent Ecology Division; S. Lee, ORISE/USEPA; K. Kristiansen, UIT The Arctic University of Norway; L. Eveseth, The Arctic University of Norway; M.G. Barron, U.S. EPA / Gulf Ecology Division; I. Sylte, The Arctic University of Norway; M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; N. Tatarazako, Ehime University / Environmental Assessment; H. Shiraishi, National Institute of Health Sciences
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 (Level 3) of the protein target of a chemical in a known sensitive species to sequences of other species and calculates sequence similarity metrics to predict potential cross-species chemical susceptibility. Level 3 analyses offer the greatest resolution for extrapolation of chemical susceptibility across specific species, but uncertainties into the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and edecyne receptor (EcR) to investigate specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in residues of key amino acids cause a 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. The predictions were trained 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 preventing false negative screening results 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 (www.zeclinics.com) is a biotech company interested in developing efficient and reliable zebrafish screening tests to predict compound toxicity. Zebrafish is an organism relatively close to our species and serves as a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end phenotypes, analysis procedure, etc. – that can be applied by all the zebrafish toxicity community (SOP like protocols) and, eventually, to become the base for applying towards regulatory approval for the standardized test. In this study, we have performed a Developmental Toxicity Test on the NTP 91 compound list. For each compound, 20 zebrafish embryos at key positions (Level 3) of the protein target were exposed to different concentrations (Log3 dose/response curve: 100µM, 33 µM, 10µM, 3.3 µM and 1µM) 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-hexafluorothiophosphoridene diphenol, 3-iodo-2-propynyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methyleneurea chloride, rotenone and tetraethylthiuram disulfide.

MO196 MPA - an alternative for the standard procedure of Ames Test J. Rossetto Martins Zwarg, School of Technology, UNICAMP; D.A. Morales, State University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Redirected Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LÆG

The Salmonella/microsome assay (Ames Test) is the most widely used mutagenicity test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specifically in Europe. It is more sensitive than the standard Ames method as it uses 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 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. Lilliencrap, NIVA Norwegian Institute for Water Research / Ecotoxicology

Bioavailability and realistic risk assessment of organic chemicals (P)

MO198 The necessity of OASIS head and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration; a case study for alkylphenol monitoring in produced water L. Silvan, 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 plant. However, SPMDs are not suitable for monitoring Polar Organic Chemicals (POCs) 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 chromatography (POCIS) is actively used for the determination of wide range of HPOCs. It allows the time weighted average (TWA) concentration to be measured and thus assess fluctuation in discharge concentrations. POCIS is composed of a sorbent (OASIS beads), two polyethersulfone (PES) membranes and two stainless steel rings. POCIS is calibrated by evaluating the sampling rate (R), which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the R, following the extraction of both the sorbent and the PES 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 hydrophobic APs. This can be very useful in environmental applications because it may justify the use of only one passive sampler to monitor a wider range of contaminants.

MO199 In situ passive sampling methods to measure freely dissolved concentration of PAHs in contaminated soil: comparison with ex situ measurements and evaluation over one year N. Bartošová, Agroscope / Beckenholz-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 sediment PAH concentrations in the pore water of soils under field conditions (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 (CPS). The CPS 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 HOC, for instance, are accounted for in ex situ methods by providing promising results to measure CPS in the pore water of sediments, there is still very little information on the suitability of these methods for their application to soils, particularly under unsaturated water conditions. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six soil surface and field soil samples. The field samples were located in plant pots and hence permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethylene (LDPE) was used as PS method. The samplers were deployed in situ covering a depth of 20 cm below the soil surface. Concentrations were assessed at all sites after six, nine and twelve months of exposure. For comparison, soil samples from the same locations were analyzed using a conventional ex situ soil suspension method. The main objectives of this study were (1) to compare the measurements obtained with the two sampling methods, (2) to assess the influence of soil water saturation of the measurements (unsaturated versus saturated), and (3) to determine the role of seasonal variation (temperature and precipitation variation) and exposure time on the results of the in situ PS method. To our knowledge, this is the first experiment where PS methods were used to determine PAH concentrations in the pore water of soils under field conditions in situ and to study the impact of soil water saturation. This study will help to find out whether in situ PS methods in soils are a tool to be potentially included in risk assessment and legislation.

MO200 Bioaccumulation of native and spiked p,p’-DDE by Eisenia andrei in γ-stabilized and non-stabilized soils I. Skulcova, Narva Research Station UFZ / Effect Analysis; D. Gilja, Narva Research Station UFZ / Effect Analysis; J. Hofman, Masaryk University, Faculty of Technology, UNICAMP / Faculty of Technology; D.A. Morales, State University of Campinas / Faculty of Technology; J. Hilber, Agroscope / Faculty of Science, RECETOX; L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX

Bioaccumulation of native and spiked p,p’-DDE by Eisenia andrei in γ-stabilized and non-stabilized soils 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 very little information on the suitability of these methods for their application to soils, particularly under unsaturated water conditions. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six soil surface and field soil samples. The field samples were located in plant pots and hence permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethylene (LDPE) was used as PS method. The samplers were deployed in situ covering a depth of 20 cm below the soil surface. Concentrations were assessed at all sites after six, nine and twelve months of exposure. For comparison, soil samples from the same locations were analyzed using a conventional ex situ soil suspension method. The main objectives of this study were (1) to compare the measurements obtained with the two sampling methods, (2) to assess the influence of soil water saturation of the measurements (unsaturated versus saturated), and (3) to determine the role of seasonal variation (temperature and precipitation variation) and exposure time on the results of the in situ PS method. To our knowledge, this is the first experiment where PS methods were used to determine PAH concentrations in the pore water of soils under field conditions in situ and to study the impact of soil water saturation. This study will help to find out whether in situ PS methods in soils are a tool to be potentially included in risk assessment and legislation.

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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. Alonso, R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; G. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism

Enzyme activity 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 and then, incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swings® dose, extra doses adapted to observe ecotoxicological effects and controls. The two fungicides were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method involving extreme pH and mixture with soil. At the end of the experiment, the bioavailability of the two fungicides was determined by evaluating their concentrations in exposed earthworms Aporetodesca icterica and Aporetodesca 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 laboratory conditions, while under field conditions, the rate of dissipation was much lower. However, the rate of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO202 Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat

R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism

Enzyme activity 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 and then, incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swings® dose, extra doses adapted to observe ecotoxicological effects and controls. The two fungicides were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method involving extreme pH and mixture with soil. At the end of the experiment, the bioavailability of the two fungicides was determined by evaluating their concentrations in exposed earthworms Aporetodesca icterica and Aporetodesca 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 laboratory conditions, while under field conditions, the rate of dissipation was much lower. However, the rate 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.
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 Studies, B.H. Magee, ARCADIS; N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; A.K. Meyer, United States Army Corps of Engineers / Huntsville Center

The U.S. Department of Defense is responsible for the environmental restoration of properties that were formerly used for firearm training ranges. Remnants of spent shell casings 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 targets were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the shell 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 rate of 5% in the diet for fourteen days. For benzo(a)pyrene (BaP), the fraction of total dose excreted in the urine (FUE) was determined for the soil- and soil extract-amended treatment groups. The Relative Bioavailability Factor (RBAF) is the ratio of the FUE in animals treated with soil over the FUE in animals treated with 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 metabolite excretion rates versus daily dosing rates. The FUEs produced coefficients of determination (r²) that were greater than 0.83 and typically greater than 0.95, showing that the rate of BaP metabolite excretion was directly proportional to the daily dose rate of BaP. RBAFs were determined using Monte Carlo simulations to calculate the 95% upper confidence limit on the ratio of the soil and soil extract FUEs. The site-wide RBAF was equal to 14% for BaP. Pairwise RBAFs 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, T.J. Richter, BASF SE, Agrarzentrum Limburgerhof / APD; T. Richter, BASF SE Agrarzentrum Limburgerhof / Global Product Safety and Registration; K. Platz, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modeling; A. Imer, Eurofins Agroscience Services EcoChem GmbH; M. Traub, Eurofins Agroscience Services EcoChem GmbH / Environmental Fate

The determination of adsorption coefficients is a critical key parameter for the assessment of the leaching properties of low adsorbing compound's through the vertical soil profile. In case of expected low adsorption of a chemical compound, several experimental preconditions need to be considered to enable accurate adsorption parameter determinations: (1) An initial soil/solution ratio of 1/1 and (2) the liquid phase needs to be removed as completely as possible from the soil phase upon completion of the equilibrium. An experimental approach was developed and optimized allowing the efficient separation of the soil and liquid phase by centrifugation through the soil itself and a filter/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 underestimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e.g. Kf) and of p-values with p=Kf (msoil/msolution); note: msoil/msolution after phase separation. If p>0.3, reliability of obtained Kf values is given according to “EFSF, 2017. Technical report on the outcome of the pesticides peer review meeting on the OECD 106 evaluators checklist”. If p<0.3, additional considerations are necessary, e.g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95% confidence intervals of Kf and Kfoc from isotherms are derived. By e.g. suitable statistical tests, in order to evaluate data quality and to demonstrate the OECD 106 evaluators checklist”. If p<0.3, additional considerations are necessary, e.g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95% confidence intervals of Kf and Kfoc from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of that approach.

MO208

Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomonas sp. strain ADP

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Atrazine, an herbicide used to control grassy and broadleaf weeds in sugarcan, wheat, conifers, sorghum and soybean crops. Although since 1992 in European Union Countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 70,000–90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction reactions at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was affected by the presence of atrazine. The disadvantageous effects of atrazine and bioavailability of organic toxicants. Earthworms are important soil promotors and provide various benefits to plants and they are too sensitive to various pollutants, thus they are relevant indicators of environmental change. The current study aimed to assess if biochar has the ability to decrease the effects of the toxicity of the agro-insecticide imidacloprid (IMID) to earthworms. Cocoon laid by earthworms that had never been in contact with any toxicant were exposed to biochar-amended and non-amended aqueous solutions of IMID for a period of 28 days. The data was non-parametric, and was analyzed by non-parametric Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to p<0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.

MO209 The influence of biochar on the toxic effects of imidacloprid to the lifecycle parameters of Eisenia fetida

N.W. Nyoka, University of the Free State / Zoology and Entomology; P.M. Leeto, P. Voia Oromo, University of the Free State / Department of Zoology and Entomology

Imidacloprid is an organic active ingredient for various insecticides used to kill a number of biting and sucking insect pests. As a soil amendment, it can enhance sorption and reduce the bioavailability of organic toxicants. Earthworms are important soil promotors and provide various benefits to plants and they are too sensitive to various pollutants, thus they are relevant indicators of environmental change. The current study aimed to assess if biochar has the ability to decrease the effects of the toxicity of the agro-insecticide imidacloprid (IMID) to earthworms. Cocoon laid by earthworms that had never been in contact with any toxicant were exposed to biochar-amended and non-amended aqueous solutions of IMID for a period of 28 days. The data was non-parametric, and was analyzed by non-parametric Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to p<0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.
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 CLDHO 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 on CLD in the different species can be extrapolated for different levels of exposure in the range of 0-1 mg/kg BW. This study reveals the CLD metabolism in ewes which was never shown before. The principal route of CLD elimination is via the feces. These results clearly indicate the CLD elimination kinetic in ruminants and will help to decontaminate exposed animals in the French West Indies.

MO211 Development and validation of QuEChERS extraction methods with or without enzymatic pretreatment to analyze chlordecone and its metabolites by HPLC-MS/MS in urine and feces of ewes

M. Saint-Hilaire, Université de Lorraine UL / URAFPA INRA; T. Bertin, C. Inthavong, G. Lavoix-Rompomp, T. Guerin, ANSES / Unité PBM; A. Fourment, Université de Lorraine UL; C. Feidi, G. Rychen, Université de Lorraine UL / URAFPA 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 high persistence, it still remains in soil. Consequently, farm animals can be contaminated by soil ingestion and this is key issue for French West Indies breeding. Thus, this work tested to collect data about the CLD elimination in ewe so as to propose a decontamination strategy. CLD is mainly eliminated in feces and low amounts of CLD can be found in urines. CLD can be metabolized into chlordeco (CLDOH) in human, pigs and gerbils livers. Then CLD and CLDOH can be conjugated by the glucurononyltransferease. In feces, CLDOH was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewe is available. These findings results were based on a former extraction method developed in 1980 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and 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, the QuEChERS methodology was validated. It was possible and the chemical concentrations of SOCs differ vastly in magnitude and spatial distribution within these areas. Mentioned as important drivers of these variations are the changes 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, the assessment this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables will be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

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

Semi volatile organic contaminants (SOC) are well known to undergo atmospheric long-range transport and enrich in remote high mountain ecosystems. To predict the risk for high mountain ecosystems it is necessary to have knowledge of the present concentration of these contaminants and their bioavailability. In consequence, the different results obtained on the chemical concentrations of SOCs differ vastly in magnitude and spatial distribution within these areas. Mentioned as important drivers of these variations are the changes 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, the assessment this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables will be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

MO213 Pesticide occurrence in different apicultural matrices (honey bees, wax and pollen)

P. Calatayud-Vernich, M. Andrés Costa, Universitat de Valencia / Environmental and Food Safety Research Group; F. Calatalayud, E. Simó, Agrupación de Defensa Sanitaria Apicola (apisA); Y. Pico, University of Valencia / Medicine Preventive Sprayed crops with pesticides are visited by honey bees during pollen and nectar collecting process. Pesticides are transported inside the hive, where both, agrochemicals from agriculture and compounds used in-hive against varroasis by beekeepers are accumulated in wax, pollen and honey bees. Samples of honey bees (45), wax (43) and pollen (45) were obtained from 45 different apiaries located in Spain. The samples were extracted by a slightly modified QuEChERS procedure depending on the matrix, and then screened for 58 pesticides and its degradation products by liquid chromatography mass spectrometry (LC-MS/MS). The target analytes were chosen based on their potential toxicity to honey bees and their widespread use in plant protection or in the beehive against varroa mite. Wax and pollen were the most contaminated matrices and exhibited a wide contamination by pyrethroids and organophosphates. Beeswax lipophilic nature and its lowest replacement rate in the hive are responsible of its highest pesticide content. Acaricides used in beekeeping such as coumaphos, chlorfenavinphos, amitraz and fluvinate were the most frequently detected pesticides in wax. Some pesticides used in crops as organophosphate chloropyrines were detected in lower frequencies and concentrations. Pollen contamination pattern was similar to wax matrices. Acaricides applied in beekeeping were the most frequent and with the highest concentrations. Neonicotinoid acetamiprid and organophosphates chloropyrines and dimethoate were detected in pollen samples. Both insecticides are sprayed in crops and deposited on the pollen grains, which are transported to the hive during the foraging activity of the honey bees. Honey bee samples were less contaminated, although some acaricides were detected. This fraction could be calculated as the product of the concentrations detected in the matrices analyzed, honey bee colonies health could be compromised. Assessing pesticides content in these three different apicultural matrices at the same time is a useful tool to understand the magnitude of honey colonies exposure to toxic compounds, which is one of the main causes of the progressive decline in honey bee colonies around the world.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.

N. Puchex, INERIS, S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

One of the main factor in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHÉ project, the transfer of PCBs and PCD/D/Fs to plants and invertebrates has been studied. BCF in several plants and in earthworm had been measured and different models have been calculated. The transfer of CLD to earthworms had been measured and compared to the BCF extrapolated from the Kow of the substance. It was also possible to illustrate the impact of these differences on the contaminant concentration in interstitial water and the BCF. But this BCF, relatable to interstitial water, is not comparable with BCF measured with available guideline as OECD 317 – Bioaccumulation in Terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHÉ project allow for the comparison between PCB-PCD/D/F BCFearthworm measured with the OECD 317 guideline and PCB-PCD/D/F BCFeartworm extrapolated from the Kow of the substance. This work demonstrates that the exposure concentration for terrestrial predators can be calculated in taking account the quantity of soil contained in the earthworms guts and the contaminant fraction measured in its flesh. The BCFs were calculated depending on the contaminant concentration in interstitial water and the BCF. This BCF, relatable to interstitial water, is not comparable with BCF measured with available guideline as OECD 317 – Bioaccumulation in terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHÉ project allow for the comparison between PCB-PCD/D/F BCFearthworm measured with the OECD 317 guideline and PCB-PCD/D/F BCFeartworm extrapolated from the Kow of the substance. It was also possible to illustrate the impact of these differences on the results of the secondary poisoning exposure modeled concentrations. A screening on the ECHA registration site also provides an approximation of the number of registered substances that have a BCFearthworm measured with guideline relatable to total concentration in soil and therefore unusable as such in the recommended methodology according to REACH.

MO215 Assessing risks from PBT substances in surface waters: possible alternatives to biota monitoring?


The Water Framework Directive (WFD) requires waterbodies to be at ‘good chemical status’ by meeting Environmental Quality Standards (EQSs). Normally these EQSs are expressed as concentration in water but in recent years standards expressed as critical concentrations in the flesh of aquatic biota (biota EQSs) 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
MO219

Concept for a regional geospatial landscape analyses to predict site specific vegetation covers
A. Toschki, Research Institute gaia; G. Lennartz, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; T. Schad, Bayer AG / Environmental Modelling; T. Preus, Bayer AG / Environmental Safety

The spatial pattern of plant communities in the agricultural landscape is depending on land management and the site specific environmental and soil conditions. In vegetation science the composition of plant species and their abundances in dependence on these factors are extensively described. This project follows the hypothesis that if the decisive environmental and soil parameters (soil type, soil texture, moisture etc.) are known, the vegetation can be predicted. Thus, one aim is to improve ecological realism and move towards landscape scale risk assessments. The other aims to simplify and control by a range of feedback and regulating mechanisms aimed at achieving. 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 are lower than lower tiers. The other camp focuses on what we term “extrapolation uncertainty” and therefore holds that high tier assessments are controlled by a range of feedback and regulating mechanisms aimed at achieving. The study assesses the “true” effect and, since this is difficult, holds that landscape scale risk assessments are controlled by a range of feedback and regulating mechanisms aimed at achieving. The other way they play in landscape scale risk assessment and we propose a way forwards for making uncertainty analysis more useful for decision making.

MO222

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

EPSA’s guidance document for the risk assessment of edge-of-field aquatic organisms recommends a maximum of 8 weeks for the ecological recovery option (ERO) of aquatic organisms in a risk assessment for plant protection products (PPP). Here, we propose a process-based model for algal abundance to simulate effects and recovery of algal populations over time following exposure to PPPs. The model integrates the main processes driving algal cell growth, such as (1) toxic effects 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 modelled 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 Risk Pesticide Risk Assessment and suggested as potential model for the Southern European Zone.
and limitations were discussed and adequately addressed by scientific communities, applicants and authorities. As a result, a variety of accepted tools are now available for exposure assessment. In contrast, population modelling approaches used in ERA for effect assessment in ecotoxicology are still at a relatively early establishment stage. In this respect, although effect modelling is recognised as a beneficial tool for adding ecological realism to ERAs, EFSA has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidances and opinions as a refinement option. However, so far, outcomes of submitted effect modelling approaches in ERAs are not often considered by authorities. Many of the available models deal with protection goals that address field populations. Therefore, effect models are often stochastic and spatially explicit. This however makes these models more complex in comparison to the established deterministic exposure models and therefore considerable effort is needed for their verification, validation and comprehensive communication. Since effect modelling for ERA aims to predict effects on populations of the model organisms which arise from environmental exposure, we find it meaningful to use, in ecological models, the relevant data from the established fate models. This can make the modelling approaches more harmonised and probably would enhance their acceptability. We illustrated the usability of data on environmental conditions which agree with the established fate models and could as well demonstrate the implications of different environmental conditions on springtail populations. For this purpose, we used an individual based population model which represents the life-cycle of springtails in a temperature dependent framework. Specifically, we calculated soil temperature series with the groundwater model Pearl. Further, we used variable constitutive functions of leachate toxicity after variable pre-equilibration time series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

MO223 Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions

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A column leaching experiment was performed to simulate realistic conditions that may be representative of different environmental scenarios and evaluate their influence on mobility and transport associated to dissolved organic carbon (DOC) and fine particles of aged polychlorinated biphenyls (PCBs) (PCB 28, 52, 101, 153, 138, 180, 209) in soil obtained from the Brescia-Caffaro contaminated site. The concentrations measured in leachates were compared to the results of simulations performed with a dynamic air-litter-soil model (SoilPlus model) to investigate the predictive ability and the improvements needed to obtain better predictions. The variables taken into account were: 1) contact time between soil and water, 2) DOC content and quality in leaching solutions and in soil pore water, 3) fine particle-mediated transport, 4) temperature (and its influence on endogenous DOC production), 5) soil saturation conditions. These conditions were evaluated in a factorial combination of two levels of each variable, covering a 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-saturated vs. DOC-saturated conditions. The addition of exogenous DOC incremented mobility (up to a factor of 4) especially for brief contact time (non-equilibrium conditions) and within the Log Kow range 6-7.5. Samples leached at room temperature showed concentrations up to a factor of 9 higher in comparison to samples collected at lower temperature probably because of the different amount of endogenous DOC produced. Samples kept in pseudo field capacity conditions for seven days and then flushed resulted in about double the concentrations of the samples flushed in saturated conditions with a brief contact time, showing that drying-wetting cycles may determine concentration peaks. These trends were not caught by the model predictions as well as the relevance of the transport associated to fine particles, pushing for incorporation of this dynamic in models.

MO224 Assessing the trait-based ecological vulnerability of aquatic invertebrates for phenol

J. Park, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering, J. Kim, Gwangju Institute of Science and Technology; J. Kim, S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Recently, there has been considerable concern about the chemical accidents as usage and manufacture of phenol have increased. Phenol is harmful to living organisms and its exposure can cause ecological and economical damages. Therefore, it is necessary to prepare for possible chemical accident of phenol. The Korean government designated phenol as the accident preparedness substance and required to assess and manage the ecological risk of phenol. This study aimed to find the ecological risk at the scenario that phenol exposed to freshwater bodies in Korea. In particular, the vulnerability of aquatic invertebrates was explored to consider not only individual organisms also their populations. Vulnerability integrated the exposure, sensitivity, and recovery of the ecosystem by considering various traits (e.g., body length, food preference, toxicological sensitivity, recovery strategy, etc.). The traits were reviewed by published data or open sources, and respective scores were assigned by using multi-criteria analysis which transformed them into numerical equivalents. The toxicological sensitivity was derived by indirect prediction based on traits because adequate 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. 2016001970010).

MO225 Assessing and managing food-web effects of Plant Protection Products

K. Swarowsky, German Federal Environment Agency (UBA) / Department IV plant protection products; H. Hötker, Nature And Biodiversity Conservation Union (NABU) Germany / Michael-Otto-Institute; R. Oppermann, Institute for Agro-ecology and Biodiversity (IFAB); C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; S. Matezki, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products

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 plant protection products. The results of PPPs 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 suggestions to risk managers on how to mitigate them. Due to the large variation in trophic 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 infeld. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the measures according to their worth for protecting soil 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. In practice, compensation is established by ecological compensation areas such as flowering margins, set-asides and beetle banks infeld. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the measures according to their worth for protecting soil biodiversity (and thus to compensate for indirect effects of PPPs).
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 were assessed daily using the Extended General Morphology Score (GMS). Teratogenic endpoints were scored as ‘present’ or ‘absent’ after 96 hours of exposure. The Extended GMS grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consisted of, but were not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf was 18. Teratogenic endpoints scored during the assessment comprise of malformations of saccule/otoliths, head, heart, tail, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted ISO medium). The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

**MO229**

**Optimization of the Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)**

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The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far, no harmonized and validated protocol exists for 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 was used as base. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not induce more malformations or mortality than exposure to adjusted ISO medium.

**MO230**

**Reliability of ecotoxicological studies in fish**

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Further evaluation in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established biotests using the three trophic levels - algae, invertebrate and fish - according to OECD Guidelines provide in particular the baseline data for the derivation of the EQS. To obtain the most accurate EQS by use of a low assessment factor of 10 data from all three trophic levels including long-term results are required. Depending on the test substance growth inhibition of algae, immobilization of daphnia as well as deformation and death of fish embryos are not necessarily the most sensitive organisms and endpoints. Fish are in many cases the most suitable test organisms to demonstrate effects of e.g. pharmaceuticals with a specific mode of action in vertebrates. Therefore, prolonged toxicity tests with fish are of great importance. However, the study design has to be adapted to specific endpoints according to the pharmacodynamics of the tested drugs. Thus, in planning and implementing this type of study special care must be taken to ensure that the generated data can be used for derivation of EQS. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not statistically significant results, insufficient number of concentrations tested, missing chemical analysis of test compound concentration in the test water, calculation of toxicological endpoints on the basis of nominal and not real concentrations, or insufficient quality of endpoints. The aim of the presentation is to outline, from our point of view, optimal experimental conditions of prolonged fish tests which can be adapted as a model for other scientific studies, thus increasing the scientific results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

**MO231**

**Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabiting in heavy metal contaminated river**

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The Watarase River, running in the northern Kanto region of Japan, had been severely polluted by heavy metals due to Ashio mining activities from late 1800s to early 1900s (e.g. 20 mg/Cu/L in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb, Cd and Fe concentration in liver of Japanese dace Tribolodon hakonensis captured from mid reach sites in the Watarase and Omoi River, and also analyzed those river water and sediment concentrations. Water and sediment concentrations in the Watarase River were generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb and Cd concentration in liver of Japanese dace in the Watarase River were lower than those in the Omoi River. Additionally, although there were no significant genetic differences between both riverine dace in microsatellite analysis, bile metallothionein (cysteine-rich protein involved in metal detoxification) concentration of dace in the Watarase River was significantly higher than that in the Omoi River. It suggests that the dace inhabiting 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 inhabiting 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. rerio, to evaluate the use of these fish as biosensors in environmental monitoring studies. Static bioassays were carried out with a duration of 48 hours, with each metal. Five toxic concentrations were used in duplicate, plus a non-toxic control. The LC50 was determined and with the surviving organisms the evaluation of genetic damage was carried out, by means of the evaluation of frequency of micronuclei in blood cells (1000 cells). The results obtained showed that the toxicity of metals and their mixture, based on the LC50 calculated was: Cu> Pb> Mix > Cr > Cd. The Kruskal-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 (0.03%), followed by cadmium (0.065%). Copper showed the lowest genotoxicity (0.37%). The metal mixture had a micronucleous frequency of 1.23 %. The juveniles of D. rerio had deleterious effects in concentrations of metals lower than the LMP (Maximum Permissible Limits) that marks the NOM 001 Semarnat for water discharges to natural systems, so it is possible that they can be used as biosensors in the studies of environmental monitoring.

MO233 Endocrine disruption effects of bisphenol S and bisphenol SIP in adult zebrafish (Danio rerio)
K. Ji, J. Lee, Yongin University
As alternative compounds of bisphenol A (BPA), bisphenol S (BPS) and 4-hydroxyphenyl 4-isoproxyphenylsulfone (BPSIP) are widely used in thermal paper products. These compounds have been detected in human urine samples; however limited information is available on their endocrine disrupting effects. Adult zebrafish pairs (Danio rerio) were exposed to environmentally relevant concentrations (0, 0.5, 5, and 50 μg/L) of BPS and BPSIP for 21 days, and the adverse effects on egg production, levels of sex steroid hormones, and transcription of genes related to hysteresis in the hypothalamus-pituitary-gonadal (HPG) axis were investigated. The estrogenic (increase in 17β-estradiol/testosterone [E2/T] ratio) and anti-estrogenic (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 steriodogenic 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 phenol hydroxy group is the key structural component responsible for the estrogenic and anti-estrogenic 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 sub-oxic zone
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-Unless impacts of the chronic spill on offshore and nearshore biota are still not fully characterized. To help understand one of the most significant responses in important Gulf fish species, four different exposure routes, DWH suboxic zone, Florida pompano, and southern flounder were selected. The objectives of this study were to investigate the effects of PAH exposures on the stress responses of these species. The stress responses were assessed using several biomarkers, including biomarkers of oxidative stress, which were measured in blood and tissue samples from the control and exposed fish. The results showed that the oxidative stress was significantly increased in the exposed fish compared to the control group. These findings suggest that the oxidative stress induced by PAH exposure is a significant concern for these species, and that further studies are needed to better understand the mechanisms and implications of this stress response.

MO235 Impact of PAH/oxo-PAH mixtures on heart development in zebrafish
V. Cunha, K. Dreij, Karolinska Institutet
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxo-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), oxo-PAH (the ketones 4H-cyclopenta[de]phenanthrene-4-one (4H-CP), benzo[a]fluorenone (BFLO) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, ZFEs were observed for effects on heart development, heart rate and blood flow. Samples were also collected for gene expression analysis. The results showed abnormal cardiac development, such as formation of string hearts where exposure to 6H-BPO and BFLO in combination with BP was 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 oxo-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFLO and 4H-CP in mixture with BP. Gene expression analysis showed significant up-regulation of genes in BP and oxo-PAH treatment that were similar to the effects of BPS exposure. The commonalities and differences in the actions of BPSIP on the steroidogenic pathway were investigated. The estrogenic (increase in 17β-estradiol/testosterone [E2/T] ratio) and anti-estrogenic (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 steriodogenic 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 phenol hydroxy group is the key structural component responsible for the estrogenic and anti-estrogenic 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.

MO236 Induction of developmental cardiotoxicity in rainbow trout (Oncorhynchus mykiss) following PAH mixture exposure - new insights using an integrated OMICS approach
A.N. Eriksson, C. Rigaud, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; I. Lihavainen, University of Helsinki; A. Ronkka, S. Sarai, T. Suomi, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehnämien, University of Jyväskyla / Department of Biological and Environmental Science
Worldwide, environmental levels of polycyclic aromatic hydrocarbons (PAHs) have increased over the last century, mainly due to anthropogenic release from incomplete combustion of organic material and oil spills. These compounds are present as a complex mixture in the environment and are known to cause developmental abnormalities, cardiotoxicity, immunosuppression, tumors and alteration of aquatic expression. The effects of PAHs on the heart have 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 fluoranthene directly inhibit CYP1A activity. A. N. Eriksson, C. Rigaud, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; I. Lihavainen, University of Helsinki; A. Ronkka, S. Sarai, T. Suomi, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehnämien, University of Jyväskyla / Department of Biological and Environmental Science

MO27 Assessment of the developmental cardiotoxicity of individual PAHs using integrated OMICS
C. Rigaud, A.N. Eriksson, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; A. Roikka, University of Turku; S. Sarai, T. Suomi, A. Laiho, University of Turku and Åbo Akademi University; L. Elo, University of Turku; J. Lihavainen, University of Helsinki; E. Vehnämien, University of Jyväskyla / Department of Biological and Environmental Science
Fish early life stages (ELS) are among the most sensitive organisms to developmental toxicity caused by polycyclic aromatic hydrocarbons (PAHs), which
includes detoxification enzymes induction (CYP1A), hemoglobinizing, 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 phenanthrene can also activate the catalytic receptor, e.g. arylformins via unknown AhR-independent mechanisms. In this study, we aimed to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhyncus mykiss) ELS by the use of an integrated OMICS approach, i.e. the combined use of transcriptomics, proteomics and metabolomics. The use of OMICS can lead to evidence of which pathways are altered by PAHs, and thus help choosing candidate genes or proteins to understand the mechanism of toxicity. Newly hatched rainbow trout larvae were exposed to three different PAHs (retene, pyrene or phenanthrene) at sublethal doses. The heart of each larva was sampled after 1, 3, 7 or 14 days of semi-static exposure, and RNA, proteins and metabolites were extracted. Morphometric parameters such as larval length and yolk sac area were also monitored, but were barely affected by PAHs. Preliminary data from transcriptomics and metabolomics showed different signatures of gene expression alteration as well as different metabolite profiles between treatments, suggesting specific mechanisms of toxicity. Overall, all compounds induced more changes in cardiac gene expression during the very first days of development, with the exception of pyrene which was also very potent after 7 days. Preliminary enrichment analysis (over-representation analysis) revealed that differentially expressed genes were more likely to belong to the categories of xenobiotics. Expression of xenobiotic transporters such as p-glycoprotein and the cytochrome P450, cation transport, muscular contraction or steroid hormone biosynthesis in the case of retene. Some of those processes were shared by pyrene. Phenanthrene appeared to alter collagen biosynthesis, as well as the glutamate release cycle, but only at one sampling point and with very few genes involved. Proteomic analyses are underway to further highlight the mechanisms of toxicity.

MO238 Developmental Toxicity of a Non-steroidal Anti-inflammatory Drug (Acetaminophen), in African Catfish (Clarias gariepinus) embryos. L I Ezemanye, University Benin / Animal and Environmental Biology; N.O. Ezemanye, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; P. Adebayo, University of Benin / Animal and Environmental Biology.

The study investigated the developmental toxicity of Acetaminophen, a non-steroidal Anti-inflammatory Drug on the early life stage (0 to 96 hpf) of African Catfish (Clarias gariepinus). The 96 hrs fish embryo acute toxicity (FET) test was carried out according to the modified OECD 236 guidelines. Newly fertilized embryos were exposed to different concentrations (0, 0.5, 1, 5 and 10 µg.L⁻¹) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural alterations were observed with the increase in concentration. Exposure to acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects observed were 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. Manuoguerra, 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 / Department of Animal and Environmental Biomedicine.; F. Gaudio, Università di Torino / Istituto di Inmunologia molecolare (IBIM); A. Cattitua, M. Sprovieri, CNR / IAMC-CNRS 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 “Centro Internazionale di Studi Avanzati su Ambiente, ecologia e Salute umana” (CUP Be2F150010700085) is funded by CIPE- MIUR. 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 events 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, ecologia e Salute umana” (CUP Be2F150010700085) is funded by CIPE- MIUR.

MO240 In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhyncus mykiss) proteins. D. Dechi Esposti, Iristea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iristea / UR RIVERLY - FABP in rainbow trout and in human homologue protei

MO241 Impact of metformin on zebrafish (Danio rerio) embryos. S. Mieck, University of Heidelberg / Aquatic Ecology and Toxicology; T. Braunbeck, University of Heidelberg / Centre for Organisatal 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 medicinal treatments for the diabetes mellitus type II. At the same time, metformin is also used as therapy agent for women with polycystic ovary syndrome (PCOS), a reproductive abnormality disease, and is being screened as a potential anti-cancer drug. Therefore, just in Germany metformin usage has almost tripled in the last 10 years to 1,100 tons (2010) and it is still increasing. As a consequence of the high consumption, the pharmaceutical is detectable at relatively high concentrations in both waste water treatment plant effluents and surface waters around the world, even though most of the substance gets removed during conventional active sludge treatment. Since most of its active form (up to 100%) gets excreted through urine and faeces, the poor metabolism rates of metformin in humans add to this outcome. As a consequence, metformin poses a potential risk for aquatic organism and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C₆H₄N₃HCl) according to OECD test guideline 236 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. ’n

MO242 Pyrgolag and its structurally related compounds on animal cytochrome c oxidative activity. Y. Kim, K. Kim, H. Jeon, H. Kim, Y. Choi, S. Lee, Kyungpook National University Pyrgolag is a benzenetriol being a brownish solid, and is used for hair dyes after mixing with copper sulphate. A recent report on mutagenicity of pyrgolag-containing hair gels has demonstrated that there was no 2- fold increase in revertants relative to the controls. However, it still needs to be determined its safety to the living organisms, when it is introduced to the environment. In this study, we evaluated its inhibitory effect on cytochrome c oxidase (COX) activity,
which is vital for energy production and is located in mitochondrial membranes. COX activities from zebrafish (Danio rerio), Corydoras (Corydoras aeneus), earthworms (Eisenia fetida), and the lesser rice weevil (Sitophilus oryzae) were placed to be inhibited by pyrogallol and its related chemicals such as gallic acid, 1,2,4-benzenetriol, pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid. For the inhibition of zebrafish COX, pyrogallol was the strongest chemical among the tested ones, with 50% inhibition at 19.3 ppm. Gallic acid and 1,2,4-benzenetriol showed potent inhibition on the COX activity with the concentration of 100 ppm. At a 10-times diluted concentration, these three compounds showed moderate inhibition on the enzyme activities. These phenomenon were applied all of the tested animals. Pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid did not show any inhibitory effect on the COX activity. Taken together, benzenetriols including pyrogallol may be caused unexpected inhibitory effects on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

MO243 Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos

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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 Waste-Water Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters, with concentrations ranging from ng/L to μg/L. These evidences suggest that TCS is acutely and chronically toxic to aquatic organisms and it was already demonstrated that this chemical severely affects both zebrafish adult and embryos, causing embryotoxicity, hatching delay and biomarker alterations. Thus, the European Union (EU) has disapproved in 2016 the use of TCS in biocidal products, due to its unacceptable environmental risk. Meanwhile, consumer antiseptic wash products containing TCS can no longer be marketed in US. The aim of this study was to investigate the adverse effects of TCS at environmental concentrations on zebrafish embryos up to 120 hours post-fertilization (hpf). It is the first time that environmental levels of this contaminant were taken into account, instead of evaluating the effects of sub-lethal or lethal concentrations. The experimental plan consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 μg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GP) and glutathione transferase (GST), where measured, while the genetic damage was evaluated as the occurrence of the micronucleated cells (MN test). Results show a significant increase in all biomarkers measured, indicating that this chemical is dangerous for aquatic species also at environmental concentrations.

MO244 Comparative study of acute toxicity of a Microcystis aeruginosa bloom containing microcystin-LR on common carp Cyprinus carpio and Wistar rat

Z. Hadjer, R. Bordj, H. Nasri, 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 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 is the control group, received daily physiological serum (500 μL) containing 2 and 10 μg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been 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.

MO245 Subchronic toxicity of a Microcystis aeruginosa bloom extracting containing the microcystin-LR congener on the common carp Cyprinus carpio

R. Bordj, Z. Hadjer, H. Nasri, 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 have been randomly assigned to three groups. Group I is the control group, received daily physiological serum (500 μL) containing 2 and 10 μg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been 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 facilitate pipeline transport. The composition of dilbit differs greatly in chemical composition compared to conventional crude oils and the impact of dilbit exposure on aquatic organisms has not been well characterized, despite its widespread transport across North America. In this study, the effects of developmental exposures on breeding success and next generation embryos were compared between dilbit and two conventional crude oils (mixed sweet and medium sour composite). Zebrafish embryos were exposed to water accommodated fractions of these oils from 0-7 days post fertilization (dpf) and gene expression and DNA methylation were measured at 7dpf. Exposed embryos were then grown to adulthood in clean water. These fish were bred and their embryos were collected and reared in clean water (unexposed second-generation embryos). Breeding success of the first-generation developed experimentally exposed fish was determined by measuring the number of pairs that spawned, number of eggs spawned, fertilization rate, and survival of unexposed offspring. Gene expression and DNA methylation were also measured in 7dpf offspring. Developmental exposure in the first generation did not affect the survival of embryos and also did not affect breeding success when compared to control, but differed among exposure groups. Some target genes were differentially expressed in the dilbit-exposed second-generation embryos when compared to control, indicating a heritable change in basal gene expression. This change in gene expression could potentially be due to changes in DNA methylation caused by the developmental exposure in the first-generation. Understanding what changes in DNA methylation mean for fish survival will require further study. Overall, it appears that developmental exposures to dilbit and two conventional crude oils have various effects on first- and second-generation zebrafish embryos. Though second-generation endpoints are often overlooked, they are important to consider when evaluating the overall risk of oil exposure.

MO247 Effect of skatole and its metabolites on piscine Phase 1 metabolism

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Summary: We have investigated the effects of skatole and its metabolites on liver and kidney metabolism in zebrafish (Danio rerio) and on the rainbow trout (Oncorhyncus mykiss). The investigated endpoints are phase 1 metabolism, microsomal drug metabolism and cytochrome P450 levels. Results: Due to the high biological variability in fish species, we observed a wide range of responses in the investigated endpoints. In zebrafish, skatole and its metabolites increased drug metabolism and microsomal drug metabolism in a dose-dependent manner. In rainbow trout, skatole and its metabolites increased drug metabolism in a dose-dependent manner and reduced microsomal drug metabolism and cytochrome P450 levels. Key words: skatole, metabolites, zebrafish, rainbow trout, phase 1 metabolism.
M0248 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 lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and gene expression patterns in the fish embryo acute toxicity (FET) test and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and malformation. Gene expression profiles 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. 18-15082S) and Swedish University of Agricultural Sciences.

M0249 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 hydrophobic receptors (AhR) by individual chemicals and environmental mixtures, in order to help further cross-species extrapolation in the framework 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) N. Creusot et al. (2017) developed a database of ovulated mRNAs (TPs) and estrogen receptor matrix for the zebrafish and human that contained 20 endocrine relevant chemicals at different concentrations. Hence, for each cross-species differences occurred (PXR, PPARy, PR) while for other receptors the differences were lower (ER, AR, GR, MR) or almost absent (AhR, ERR). For instance, promegestone acts as a full agonist of the hPR but as partial agonist of the zfPR whereas the dihydroxy-4-pregnen-3-one -reference ligand of the zfPR- antagonizes the hPR. In the same way, none of the reference ligands of the hPXR (T0913117) modulates the zfPXR whereas the clotrianthene - a reference 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 expected. Also, strong zf mineralocorticoidic activity was found in both influent and effluent whereas only very weak h activity was detected. Altogether, our results showed that h and zf NRs are, for some of them, differentially modulated by individual chemicals and environmental mixtures. Also, interaction of EDCs towards NRs cannot always be extrapolated between these species highlighting the need to further document NRs modulation between human and fish and associated responses, to improve human health and environmental risk assessment of EDCs.

M0250 Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
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Triclosan (TCS) constitutes a common household product ingredient, given its antimicrobial activity, and has been widely used over the past decades. It enters the sewer system and can be transported to wastewater treatment plants (WWTP), seawaters and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgently needed to evaluate the potentially toxic effects to aquatic organisms. The triclosan has emerged as a powerful model organism to study various aspects of developmental and cell biology, while it provides an alternative model for toxicological studies. The objectives of this study were to assess to what extent TCS can induce toxicity in zebrafish embryos. In addition, we evaluated the uptake and biotransformation of TCS by zebrafish and examined whether biotransformation data could be used complementary to the concentration of the parent TCS to interpret the induced toxicity. The final goal was to establish a wide-scope targeted metabolomics screening workflow to investigate the induced toxicity in a biochemical perspective and associate the observed toxicity/phenotype with changes in molecular level. Overall, the aim was to highlight a hightroughput testing platform, incorporating data from different determination 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 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, nucleotide etc.) was established, giving rise to a broad array of TCS metabolites. Postglagand F2-isoprostane derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2-isoprostanes (F2-isops). F2-isops are the free-radical catalyzed products of non-enzymatic lipid-peroxidation of arachidonic acid, a fatty acid found in brain tissue and cell membranes. Fish mucus has been investigated in several studies as a potential biomarker to provide an innovative strategy for environmental risk assessment. 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.

M0251 Isoprostanes in fish mucus - a non-lethal biomarker for oxidative stress
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Isoprostanes have been used as biomarkers of oxidative stress for many years. Prostaglandin F2-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2-isoprostanes (F2-isops). F2-isops are the free-radical catalyzed products of non-enzymatic lipid-peroxidation of arachidonic acid, a fatty acid found in brain tissue and cell membranes. Fish mucus has been investigated in several studies as a potential biomarker to provide an innovative strategy for environmental risk assessment. 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.
extract was then centrifuged, filtered and reconstituted in methanol. Separations were performed on C18 (2.1 mm x 50 mm, 3.5um particle size) using methanol (0.1% formic acid) and water as the mobile phase. Negative ion electrospray ionization and specific multiple reaction monitoring ion transitions were used to detect F2-isoPs in mucus. Mass labelled internal standards were used to monitor recovery of native compounds during sample work-up and also to quantify native F2-isoPs. Native F2-isoPs from class III and VI F-isoPs were measurable in Crappie (Pomoxis). This work demonstrates that mucus has the potential to be used as a non-invasive, non-lethal matrix for F2-isoPs analysis in fish.

MO252
Validation of in ovo embryo microinjection to simulate maternal transfer of selenomethionine in the fathead minnow (Pimephales promelas)
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Selenium (Se) is a naturally occurring trace element that is recognized as a dietary essentiality and toxicity; however, oviparous vertebrates, especially fish, are at an apparent risk for a shortage of the maternal transfer 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 were characterized in a short-term fish species, fathead minnows. Results from this study showed that maternal transfer of dietary SeM was achieved in the control and high treatment groups (p=0.057); however, a more robust analysis is on the frequency of deformities between the control and high treatment groups.

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 (Oncorhynchus mykiss). In this study, two omics based tools focused on characterizing RNA and protein expression were used to establish the ontology of each intestinal region viz. the pyloric, anterior, mid and posterior intestine. 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 pattern was dramatically marked by the posterior and region (~29) highlighting their differences. Proteomic characterization established over 3,899 proteins present in the intestine with annotated proteins varying from 3,100 to 3,899 dependent on intestinal region. Significant differences in proteins were observed between intestinal regions further confirming trends observed in the parallel transcriptomic study. These data represent the first thorough characterization of the rainbow trout intestine, and will allow the identification of enzymes present in this organ which may be responsible for xenobiotic metabolism.

MO254
Persistent organic pollutants alter the expression patterns of epigenetic factors in the Zebrafish Liver (ZF-L) Cell line, M. Blanc, Orebro University / MTM Research centre; N. 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 included fish. It is of fundamental interest since epigenetic changes were reported in laboratories with increasing incidence such as cancer. Besides, epigenetic disruption was suggested to be one mechanism responsible for multigenerational effects of chemical exposure. Epigenetic pathways in zebrafish are similar to mammalians; therefore, it was proposed as an alternative model for epigenetic research. The focus of the present study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to 8 selected compounds. The cells were exposed to the LC10 values of pesticides (methoxychlor (MXC), permethrin (PER)), plastic additives (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluorooctane sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-diethylamino-4-methoxymuran (DEMEC); and to the metal ion, cadmium (Cd). 20 compounds were characterized in a short-term fish species native to North America. The cell lines showed that ZF-L cells were responsive 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" E. Neebken, U. Aumer, D. Voss, E. Stroh, L. Verena, University of Antwerp / Zebrafishlab Dept Veterinary Sciences SPHERE; H. Witters, VITO / Applied Bio & Molecular Systems; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); G.T. Ankley, D.L. Villenueve, U.S. EPA / National Health and Environmental Effects Research Laboratory; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences

The adverse outcome pathway (AOP) framework can be used to help support the development of alternative testing strategies aimed at predicting adverse outcomes caused by triggering specific toxicity pathways. Previously, we developed an AOP describing how inhibition of deiodinase (DIO) enzyme activity leads to impaired swim bladder inflation in fish. Next we assessed the feasibility of selecting alternative in chemico assays targeting specific key events along the AOP and evaluating the potential of the selected in chemico assays as in vivo equivalents. We were able to demonstrate that the in chemico dataset can be used to effectively predict effects on swim bladder inflation. For a limited number of compounds however, zebrafish responded differently than what was expected. In this presentation, we will assess these outliers by examining (1) the cross-species applicability of our AOP-based assays, (2) toxicological mechanisms other than thyroid disruption that could result in effects on swim bladder inflation. We performed in vitro DIO assays for 20 compounds using porcine, rat and fish liver homogenates to characterize similarities and differences among species. Results show that the DIO1 inhibitory potential is nearly identical between the selected species. However, a set of bisphenol A derivatives showed lower inhibition in fish compared to pig. In addition, we performed qPCR analysis of a set of 29 genes related to thyroid metabolism and swim bladder inflation after exposing zebrafish to 4 compounds for which false negative predictions were observed. These results suggest that PFOS affects surfactant properties which could impact swim bladder inflation. SMX affected genes related to the development of the 3rd cell layer of the swim bladder, suggesting that this compound inhibits swim bladder development. Our results show that compounds, tissue originating from different vertebrate species can be used in the DIO assay to predict apical outcomes in fish. However, it is expected that any predictive model based on measuring only few molecular initiating events could be refined as knowledge on the involvement of other specific thyroid related processes in swim bladder inflation grows. In addition to the fact that differences in predicted effects may be observed as a result of cross-species differences, many different toxicological mechanisms can lead to swim bladder inflation effects as well.
Zebrafish responses to the fourth-generation progestin drospirenone exposures
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Synthetic progestins (PGs) represent an important class of active ingredients of hormonal pharmaceuticals. In addition to their endocrine activity, it is known that DRP can interfere with other processes in fish, such as sexual differentiation. These effects have been studied through in vivo exposure, environmental contamination by these substances. Although the knowledge about their environmental concentrations and effects on fish is still scarce, PGs are rapidly uptaken through fish gills and can cause deleterious effects even at low concentrations, such as the inhibition of fish reproduction. Drospirenone (DRP) arises as one of the most used fourth-generation PGs in hormonal pharmaceuticals. In addition to its endocrine activity, it is known that DRP can interfere with other processes in fish, such as sexual differentiation. 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 hatchability were evaluated in apical and physiological endpoints. Alterations on enzymes related with neurotransmission (acetylcholinesterase, AChE, energy production (lactate dehydrogenase, LDH) and oxidative stress (catalase, CAT and glutathione S-transferase, GST) were assessed. The oxidative damage was also assessed by alterations on lipid peroxidation levels (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease of a number of chemicals were identified as DRP specificity 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
Fishing 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. Relatively high concentration of many chemicals were identified as DRPs. Specificity was confirmed with a battery of in vitro assays. As a follow-up, a fish caging experiment was conducted with the aim to check if the biological effects observed in vitro could 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 (control site), downstream and within the area 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), metallothioneine (mt), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor α (era), estrogen receptor β (erβ), androgen receptor (ar), cortisol receptor (cr) and vitellogenin (vtg) as endocrine disruption related genes; interleukinβ (ilβ) and tumor necrosis factor α (tnfα) as immune response related genes, while light chain 3 (lc3II) and dynin (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
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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 reactions (qPCR). Markers of thyroid function were quantified at discharge point. A loess regression method was successful in identifying maxima and minima of transcriptional expression during early development of both species. Our results suggest that there are similarities between the species, including maternal transfer of almost all transcripts (confirmed in unfertilized eggs), increasing expression of most transcripts during hatching and embryo-larval transition, and indications of a fully functional HPT-axis in larvae. By making these data available to the community, we aim to aid in the development of hypotheses on the role of certain genes and pathways during development. Furthermore, it can function as a background reference dataset for designing and interpreting targeted transcriptional expression studies both for fundamental research and for applications, such as ecotoxology.

MO260
Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.
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Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.
vtg-ir bands similar to those of females. Likewise, plasma E2 concentration in males was significantly increased but the opposite was observed in T levels. These changes were also reflected in E2/T ratio. Furthermore, E2 levels in treated males were even higher than those of females. Vtg and ERα gene expression was up-regulated both in liver and skin after E2 treatment. Potential impact in parental behavior is discussed. We conclude that vtg and ERα expression in skin are sensitive and non-harmful biomarkers of estrogenicity in this Sub-Antarctic fish.

**MO261** Thyroid disruption and its effects on neuronal development of zebrafish

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The endocrine disrupting effects of estrogenic compounds on humans and different species in the environment are well studied. But despite the growing numbers of patients diagnosed with thyroid disorders, thyroid hormone disrupting effects of compounds are less investigated. Furthermore, it is estimated that many substances found in our environment can influence the thyroid system and act as thyroid hormone disruptors. Thyroid hormones play a critical role in brain development and it has been shown that a lack reduces cognitive development. But the connections between thyroid disruption and developmental neurotoxicity are rarely studied and the basic mechanisms remain unknown. Because the thyroid system is well conserved among vertebrates, effects observed in humans can also be expected in wildlife. Our University of Saskatchewan - Toxicology Centre / Toxicology; H. Hollert, RWTH Aachen University / Institute for Environmental Research proposes to assess the neurotoxic potential of the test substances based on different behaviour assays, the mechanistic link between thyroid and neurotoxicity will be made using transcriptomics, proteomics and metabolomics. This work will be conducted within the scope of the "NeuroBox" project. In NeuroBox novel biosassays are developed, with the objective to assess the neurotoxic potential of water contaminants and improve water quality, ultimately aiming to reduce the exposition of humans and the environment to these substances. In this context, the project is expected to further contribute to the understanding of basic mechanisms of neurotoxicity, its connection to thyroid disruption and to identify novel endpoints. This knowledge may then be integrated in a bioassay battery and used for the improvement of water quality guidelines.

**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 the project is to develop an early life-stage gene expression assay (EcoToxChip) that captures critical toxicity pathways of chlorpyrifos for the prediction of apical outcomes of regulatory relevance. As this assay is intended to use early life-stages that are not feeding independently, it would not be considered as a live animal test, and therefore, would address the need for alternative approaches in chemical screening. As part of the project, critical toxicity pathways and associated core genes will be identified following exposure of fathead minnows (Pimephales promelas) at early life-stages to three sub-lethal concentrations of chlorpyrifos. Specifically, sequence-by-synthesis-based whole transcriptome (RNASeq) and high throughput base-calling-based metabonomics 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 chlorpyrifos. To ensure the determination of solely sub-lethal effects at least in two of the tested concentrations, 0.5, 1.5 and 4.5 μg/L chlorpyrifos solutions were investigated in the fathead minnow early-life-stage assay with larvae samplings after 7 and 32 days of exposure. None of these concentrations affected survival or growth, resulting in a sub-chronic NOAEC and LOAEC of 4.5 and 10 μg/L chlorpyrifos, respectively, in fathead minnows. Samples are currently being further analyzed for molecular and physiological endpoints to gain insight into critical toxicity pathways. This study is part of the EcoToxChip project (@ecotoxchip).

**MO264** Evaluation of the deleterious effect of 2 pesticides on juveniles of the zebrafish Danio rerio

G. Geraldo Morales, Universidad Autonoma Metropolitana Iztapalapa / Departamento de Hidrobiología; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia

In this study an evaluation of the toxic effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparastises in fish, and insecticide Imiprinor belonging to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (liperoxidation), the activity of the enzyme acetylcholinesterase (AChE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg L⁻¹) to determine the 50 lethal concentration (LC₅₀). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC₁₀ and LC₅₀). The resorption of eggs show that Imiprinor and Dichlorvos (LC₅₀= 1.67 ± 0.87 mg L⁻¹ and LC₁₀ = 5.3 mg L⁻¹) than Dichlorvos (LC₅₀ = 5.3 mg L⁻¹). In the sublethal bioassays it was observed that the toxicity of these xenobiotics increased with the time of exposure. The degree of liperoxidation in the imiprinor tests varied from 64.7 to 147.5 nM TBars mg⁻¹ and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 nM Tbars 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 imiprinor. 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 Imiprinor tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imiprinor are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.

**MO265** Effects of Omeprazole on zebrafish embryos (Danio rerio)

A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; J. Salazar Hernández, Universidad Autonoma Metropolitana Iztapalapa / Biologia

Omeprazole is a proton pump inhibitor, it is used for the control of gastritis, for this reason it is one of the most prescribed drug, consumed by millions of people in the world. This drug has been associated with acid rebound hypersecretion, decreased absorption of nutrients, osteoporosis and neurological disorders. Its toxic effects in wildlife are not yet known. Because the previous studies with these products are scarce, the objective of 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 LC₅₀ (24 hours). the embryos were subsequently exposed to the LC₅₀ and LC₁₀ to evaluate the degree of liperoxidation, by means of the determination of TBars (Buege and Aust, 1978), the activity of the enzyme AChE as an indicator of effects neurotoxic (Elliott et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the LC₅₀ 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 LC₁₀, LC₅₀ and LC₁₀. The enzyme AChE activity was reduced (64% in the Imiprotrin tests and 81% in the Dichlorvos bioassays). The insecticides Dichlorvos and Imiprinor are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.

**MO266** The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges

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The identification, analysis and evaluation of neurotoxic chemicals are a worldwide challenge. The societal costs for neurological disorders caused only by endocrine disruptors in Europe was estimated to amount to hundreds of billion euros per
year. Considering the ecosystem services/principle, effects on single species, communities and whole ecosystems would increase that up 'to hundred times, similarly to when considering other chemicals such as neuroactive pharmaceuticals. 'Antidepressants such as venlafaxine are of increasing environmental neurotoxic concern. Venlafaxine is one of the most prescribed antidepressants in Europe and the U.S. and a known aquatic pollutant. 'Ulf is a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine concentrations in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations/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 'inthe light-dark transition test and thigmotaxis were evaluated in 5 dpf larvae exposed to 24 h to 100 µM and 10 10 µM and venlafaxine using a DarioVision® 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 continuously exposed to Venlafaxine in 1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples (n = 25 fish) and submitted 'Into Sybr Green quantitative real-time chain reaction qPCR. The Neurotoxicity of an target gene was selected and the proteins involved in circadian rhythm regulation, muscle processes and responses 'unto abiotic stimuli. Behavioral results indicate decreased swimming distance and increased thigmotaxis 'in 'unexposed fish, in agreement with previous own data for continuous venlafaxine exposure. Results 'unfor qPCR indicated modulation of some of the pre-selected target genes such as sklp5, and currently 'unconfirmatory qPCR is being evaluated. Furthermore, in vivo tests for zebrafish embryos were performed to detect effects on the proteome 'and metabolome analysis. This study is expected to be part of a bigger overview and understanding of 'unthe 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 T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology; W. Melo Junior, University of Brasilia; R. Oliveira, State University of Campinas / SCHOOL OF TECHNOLOGY - UNICAMP; A.D. ANDRADE, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; M.L. da Silva, University of Brasilia / genetic toxicology; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; I. Domingues, Universidade de Brasilia / Laboratory of Toxicology / Environnmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental engineering. 

Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on toxicological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (beta-HCH)), and their mixtures from 4 to 120 hpf (hours post-fertilization). We measured oxygen consumption rate (OCR) at the embryonic sublethal concentrations of 0.05, 0.1, and 0.5 mg/L by using Seahorse XF Extracellular Flux Analyzer at 24 hpf. The OCR results are compared with the activity of mitochondrial complex I–IV after isolating mitochondria from embryos at 48 hpf. In addition, we analyzed mRNA expression of transcription factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and CS), associated with mitochondrial metabolism, at 120 hpf. This comprehensive approach 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.

MO268 Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish. N. de Farias, University of Brasilia / Departimento de Genética e Morfologia; R. Oliveira, State University of Campinas / Department of Genetics and Morphology; T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology; J.M. Pinto, University of Brasilia / Departamento de Genética e Morfologia; Instituto de Biologia; C.K. Grisolia, University of Brasilia UnB / Department of Genetics and Morphology.

Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This selective serotonin reuptake inhibitor is highly detected in aquatic ecosystems and has the potential to modulate levels of serotonin in 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 behavioral alterations such as microaggressions, increase in microaggressions, such as decrease of glycogen and progressive loss of hepatic architecture. The pattern of swimming behavior of fish changes significantly, fish spend more time at the upper part of the aquarium in concentration above 10 µg/L. Altogether, the present study demonstrated that chronic exposure of zebrafish to FLX can affect multiple endpoint such as growth tissue organization, feeding and swimming behaviour. These results emphasize the relevance of an integrated approach in the ecotoxicological assessment of psychiatric drugs.
changes were observed ad concentrations below any phenotypic changes could be observed. Our results so far show that assessing neurotoxicity is complex and a tiered approach covering behavioral tests in combination with OMICS techniques seem to be a cost and time efficient way.

MO271 Understanding the correlation between behavioural inter-individual variability and physiology/morphology in zebrafish larvae
K.T. Kiria, C.M. von 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 generated by T-DNA insertion, and ease of breeding. They are also valuable as their small body size allows tracking a large number of individuals with full control over the environment. Aim: The aim of the project is to investigate behavioural inter- and intra-individual variability in zebrafish larvae as a basis to better estimate effects of chemicals on behavioural responses. Analysis of inter-individual differences might offer new insights into mechanisms of toxicity considering that every individual’s response to a chemical differs based on their genetic make-up.
Hypothesis: We are testing whether inter-individual variability is constant over time and whether levels of locomotor activity correlate with physiological and morphological properties of the larvae. Methods: At first, spontaneous locomotor activity is measured for 40 min in continuous light at different timings of the day from 5-7 days post fertilization. Heart rate, body size and other physiological properties of the same individuals are analysed at different time points. Results: From the preliminary results of the locomotor activity analysis, we could assign the larvae to three categories based on their activity levels compared to the average activity: highly active, less active and the individuals close to the average activity, which are also the ones less variable over time. To attribute this variability in the individual’s activity to its physiology and phenotype, the analysis of heart rate, length and blood flow are on-going. Outlook: The variability of each individual will be taken into account to better evaluate effects of the chemicals on behavioural responses. Inter-individual differences will be explored as a source of information on mechanisms of toxicity of chemicals with unknown targets and mode of action.

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

MO272 Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water
C. Postigo, IDAEA, CID-CISCI / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill / Department of Environmental Science and Engineering; K.H. Libratore, K. Lamann, S. Kimura, A. Cuthbertson, S.D. Richardson, University of South Carolina; T. McDonald, Y.M. Sey, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory; S. Duijk, University of Akron; J. Simmons, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory
Iodinated X-ray contrast media (ICMs), used in medical imaging, are poorly metabolized by humans and enter wastewater. As they are incompletely removed during wastewater treatment, ICMs are released to the aquatic environment and have been detected in drinking water sources. ICMs have been identified as iodine sources that may enhance the formation of iodine-containing DBPs during chlorination or chloramination. Aim: The aim of the project is to investigate the impact of ICMs on the formation of iodinated DBPs during chlorination or chloramination. 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.

MO273 The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection
R. Vera, University of Girona / Chemistry; C. Fontas, University of Girona / Department of Chemistry; M.G. Almeida, The University of Melbourne / School of Chemistry; E. Antico, University of Girona / Department of Chemistry; R.W. Catrall, S.D. Kolev, The University of Melbourne / School of Chemistry
Arsenic is a naturally occurring toxic element, which is present in waters in different areas around the world, including South Asia, South America and to lesser extent Europe [1]. Therefore, the World Health Organization has set the guideline concentration for arsenic in drinking water at 10 μg L⁻¹ [2]. The most frequently encountered arsenic species in environmental and drinking waters is arsenate (As(V)). Therefore, highly sensitive analytical techniques are required for its determination in water samples. In the present work a novel flow analysis (FA) system has been developed for the determination of As(V) in environmental and drinking waters at the low μg L⁻¹ level. The system uses a polymer inclusion membrane (PIM) based on poly(vinylidenefluoride-co-hexafluoropropylene) as the polymer and Aliquat 336 as the extractant, for the online preconcentration and separation of As(V) in a PIM cell. The sample solution is propelled for a predetermined period of time through the PIM cell where a PIM separates the sample stream and an acceptor stream which is stopped during the sample passage through the PIM cell. The 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 ml min⁻¹. After the stop-flow time the acceptor stream is re-started and As(V) is reduced to arsenite (As(III)) by merging the acceptor stream with a reagent stream containing 4 M HCl, 1% HI 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 KBr and 0.05 M NaOH where it is oxidised thus producing a decrease in the KBr/PBr₃ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system was able to determine 0.02 μg L⁻¹ with a sampling rate of 2.8 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.

MO274 Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers
V.P. Jimeno-Media, Catalan Institute for Water Research (ICRA); J. SEVERYNS, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICRA Investments for upgrading wastewater treatment plants (WWTPs) with tertiary treatment to reduce microcontaminants loads in surface waters at a catchment scale can be daunting. Our hypothesis was that these investments seriously change upon selection of the Environmental Quality Standards (EQS) for unregulated microcontaminants, and hence there is a trade-off between EQS selection and investment which needs to be considered in decision-making. We used a customized Microcontaminant Fate and Transport Model coupled to an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and dicyclocfen as the unregulated microcontaminant. The algorithm optimized the operation of WWTPs in this catchment requiring an upgrade to maximize the EQS exceedance of dicyclocfen in the river at a minimal cost. 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 μg L⁻¹), 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 operation of WWTPs during the non-typical treatment for the Llobregat river basin was 8 M€/year (upgrading 8 WWTPs of the existing 56 for fulfilling an EQS of 30 ng/l in the entire catchment). Such an investment seriously changed upon selection of EQS. The cost varied from 6 M€/year (upgrading 3 WWTPs for fulfilling an EQS of 10 ng/l) to 13 M€/year (upgrading 18 WWTPs, for fulfilling an EQS of 10 ng/l). We observed that the selection of catchment hydrological conditions during the upgrading analysis also plays a key role. The cost of the upgrades when considering low surface water flows (minimum environmental flows that ensure compatibilization of environmental needs and human water consumption) was 50% higher than the cost obtained with average flows (average 201 SETAC Europe 28th Annual Meeting Abstract Book
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 compounds as markers of drug uses (cocaïne, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) in effluent and in POCIS (LOQ from 0.01 to 0.1 pg inj). 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). Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaïne, benzoylcegonine, cocaethylene, cocaine metabolites), cannabinoid markers (THC, 11-nor-Carboxy-THC) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylcegonine to 0.2 Lj-1 for cocaine.

MO276 Passive sampling in surface water as an immersion-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 effluents from treated waste water plants and the catchment area. 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. The use of passive sampling techniques like POCIS allows to monitor the immission situation in 15 surface waters under low-flow conditions and different sanitary pressures in Luxembourg. We define sanitary pressure as the number of population equivalents divided by the surface of the catchment for a monitoring point. For that purpose, a catchment delineation is performed for each measurement point and the PE of discharging treatment plants within the catchment area is included. The results are based on the monitoring of 150 PE/ha over 3 days. Since WWTPs are relatively constant sources sampling rates of passive samplers can easily be calibrated with grab samples over all monitoring locations. The data evaluation uses the conservative behaviour of carbamazepine as a tracer for (treated) wastewater input. Carbamazepine concentrations proved to be correlated to the sanitary pressure (PE/ha) in a catchment. The plotting of other compound concentrations against carbamazepine holds useful information: it shows the variability of the WWTP influents as well as elimination capacities in the catchment. According to these hypotheses recalcitrant pharmaceuticals showed very strong and narrow linear correlations with carbamazepine while immediately degradable compounds displayed higher variability. Complete outliers make it easy to detect industrial sources as was the case for trazodone for instance. Finally the data set made it possible to extrapolate expected concentrations of emerging compounds for different sanitary pressure levels and by integrating EQS values, to define a threshold of 2.5 PE/ha above which EQS exceedance for diclofenac and clarithromycine is expected. This makes it easy to design a map of the river network with segments at risk with basic population equivalent information.

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 Electrospay 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 at the permithic detection limits. 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-stage compule mass spectrometer. The selectivity of the mass spectrometer allows the quantification of perchlorate in high-ionic-strength samples at well below currently enforced action levels. Ionization improvements to the electrospray source eliminate the need to add organic solvent to enhance detection. Method detection limit (MDL) values in deionized water are 20-60 ng/L, and MDLs in high-ionic-strength matrix are 30-60 ng/L. The calibration curves for perchlorate in high-ionic-strength matrix at 101 μg/L over the range of 125-5000 ng/L using the internal standard and external methods showed good linearity with the coefficient of determination being 0.9993, and 0.9998 respectively. Single laboratory precision in drinking waters, as measured by RSD, was < 5% at concentrations >150 ng/L perchlorate, and accuracy, was 95.6-102% for concentrations >150 ng/L perchlorate, and 111% for concentrations < 150 ng/L perchlorate. Single laboratory precision in high-ionic-strength matrix was < 5% at concentrations >150 ng/L perchlorate, and accuracy, was 100-103.5% for concentrations >150 ng/L perchlorate.

MO278 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 improve GC-MS performance, leading 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. Veloutou, Technical University of Munich; S. Bieger Technical University of Munich / Chair of Water User Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich / Chair of Water User Systems Engineering

Trace Organic compounds (TOCs) 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 newly young compound database for water relevant compounds is STOFF-IDENT. In order to achieve a comprehensive identification of the water’s organic content, Non-target screening strategies have become increasingly popular. This study was realized by analyzing river water samples with the established RPLC-HILIC-ToF/MS system and by using the STOFF-IDENT compound database. Its main aim is to demonstrate and discuss an efficient strategy for the non-target screening of aqueous environments, as a mean to facilitate the process of identification of very polar compounds. Three 24h composite samples were collected using time proportional samplers; upstream and downstream of a WWTP and wastewater effluent. The samples were analysed by the established...
MO281 Analysis of Per/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements


Environmental Analysis Laboratory, University of Aveiro, Portugal

The USEPA has developed a method for analysis of various substances of interest (e.g. PFOS) was investigated through the use of a novel weak anion exchange cartridge which was optimized to achieve good recoveries for all compounds and will be presented. Several different classes of PFAS including perfluorocarboxylic acids (PFCAs), perfluorosulfonic acids (PFSA), sulfonamides (FOSA), sulfonamide acetic acids (FOSAs) and others were separated on a liquid chromatography (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 PFAS were analyzed and method performance parameters such as method detection limits, inter- and intra-day repeatability, matrix spike recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with RSDs well below 15% that are needed to meet USEPA 537 requirements. Several perfluoroalkyl sulfonate (PFAS) and perfluorocarboxylic acid water and wastewater samples that were analyzed in the ng/L range. All this was done on a triple quadrupole mass spectrometer that is fully stackable with the HPLC system.

MO282 Optimisation of solid phase extraction parameters for the isolation and characterisation of benzodiazepines in wastewater

S. Nzube, Cape Peninsula University of Technology / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry

Pharmaceuticals entering the aquatic environment have become a growing environmental concern. These pharmaceuticals are unique pollutants because of their special characteristics and behaviour that cannot be simulated with other organic pollutants. The untreated wastewater effluent that contains pharmaceuticals poses a considerable threat to the aquatic ecosystem because of the negative effects of non-target organisms in the water. Recent years have seen a growing concern about the benzodiazepines, as emerging pollutants, and their effects on the aquatic environment. These compounds are nowadays widely detected in sewage and wastewater. It is important to increase the emphasis on the characterisation of the benzodiazepines in order to differentiate them from industrial chemical compounds. In this study, various solid phase extraction techniques have been employed focussing on the isolation of benzodiazepines in wastewater matrices. Emphasis was given to high throughput and fast extraction processes from river, lake and wastewater treatment plant sampling. In the future, this work can be expanded to include the use of solid phase extraction for pharmaceuticals in other matrices. In the current study benzodiazepines, including clonazepam and lorezapam as benzodiazepines. Recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with RSDs well below 15% that are needed to meet USEPA 537 requirements. Several perfluoroalkyl sulfonate (PFAS) and perfluorocarboxylic acid water and wastewater samples that were analyzed in the ng/L range. All this was done on a triple quadrupole mass spectrometer that is fully stackable with the HPLC system.

MO283 Monitoring source and drinking waters for Microcystins using online LC/MS/MS methods

J. Westrick, Wayne State University / Lumigen Instrument Center; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

In 2015 the USEPA announced an age-dependent drinking water Health Advisory (dWA) for the natural freshwater toxins, microcystins (MCs). For pre-school age children and adults, the MC dWA values are 0.3 mg/L and 1.6 mg/L, respectively. Although the dWA values are non-regulatory values, this announcement provides compelling health information that cannot be ignored. In parallel, EPA Method 544, a solid phase extraction/liquid chromatography tandem mass spectrometry (LC/MS/MS) method was released. Our goal was to create an online concentration LC/MS/MS method with 12 MCs that meets the EPA’s quality assurance/quality control (QA/QC) criteria. MC concentrations were measured in samples from freshwater lakes and drinking water. Samples were prepared by three freeze/thaw cycles, centrifuging, and filtering through a 0.25 µm polycarbonate filter. Our LC/MS/MS platform included an online sample concentrator with UHPLC for separation and a triple quadrupole mass spec for MS/MS analysis. This method included 12 MCs with 12 transition curves from 0.5 – 500 µg/L with values greater than 0.996. The MCs eluted between 2.2 – 5.2 minutes allowing for the analyses time to be 3) MC-RR, [Asp'] MC-LR, MC-HisR, 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 unnoticed and undetected risk needs to be monitored. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS/MRM-based method for screening of non-targeted pharmaceuticals of potential concern in northern pike

L. Tian, McGill University; J. Reining, Université du Québec à Montréal / Département des sciences biologiques; J. Verreau, Université du Québec à Montréal / Département of Biological Sciences; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Baven, McGill University / Singapore-Delft Water Alliance

Fish and seafood contaminant monitoring traditionally relies on the surveillance of known chemicals, an approach referred to as targeted analysis. However, very few tools are available to monitor “unexpected” or “unknown” compounds. Non-targeted approaches are particularly useful to detect emerging contaminants in items related to the human diet such as fish and seafood. The non-targeted approach is however quite challenging for trace contaminant analysis as it involves isolating relatively small signals from complex matrices, and, in absence of a good knowledge about the analyte identity. In the past decade, the coupling of liquid chromatography, high-resolution tandem mass spectrometry (HRMS/MS) and advanced data processing algorithms has proved to be a robust approach for the analysis of unknown molecules in biological samples. In this study, a non-targeted workflow was developed with the objective to detect/identify unexpected organic contaminants in a predator fish from the St. Lawrence River (QC, Canada), the northern pike (Esox lucius), with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Montreal’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOS) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.

MO285 Prioritising site-specific emerging contaminants in surface water based on LC-HRMS nontarget screening data

M. Krauss, C. Hug, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; R. Bloch, Helmholtz Centre for Environmental Research GmbH / UFZ; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / UFZ; E. F. C. Lefèvre, Helmholtz Centre for Environmental Research UFZ / UFZ

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.
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
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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 (USEPA) 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 been used to study PAH TPs. Data available showed that TPs can be 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-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C18 and phenyl-hexyl columns using a gradient of water-acetonitrile (mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (≥70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

MO287
Strategies to monitor transformation products in the water cycle

Transformation products (TPs) are formed in the water cycle through both biotic and abiotic processes. Data available showed that TPs can be more persistent and toxic than their mother compounds. Well-known examples are bromate and NDMA that generate toxic TPs after ozonation. Despite the TPs being more persistent and toxic than their mother compounds, TPs are often overlooked as potential contaminants in water environment 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-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C18 and phenyl-hexyl columns using a gradient of water-acetonitrile (mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (≥70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

MO288
MO288
Application of high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater
X. Lin, TUNGHAI University; W. Chen, J. Cheng, TUNGHAI University / Department of Environmental Science and Engineering

Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater, but may also convert the ECs into unknown transformation products (TPs). This study developed a method to systematically identify the TPs of multiple aromatic ECs using high-resolution mass spectrometry (HR-MS) and traced the parent aromatic ECs of the TPs. We spiked ten aromatic ECs (5000 ng/L) into 100-mL Milli-Q water. The water was chlorinated at an initial chlorine of 0.7 mg/L for ten minutes. The full-scan mass chromatograms of both the chlorinated (n = 6) and the untreated (n = 6) water samples were acquired using ultra-performance liquid chromatography-quadrupole-time-of-flight mass spectrometry. By comparing the compound profiles, we evaluated the removals of aromatic ECs and discovered several signals of TPs. We also characterized the formation of the TPs using database searching and isotopic-pattern comparison. The parent aromatic ECs of the TPs were then traced back by spiking each aromatic EC to one 100-mL Milli-Q water. Eight of the aromatic ECs were partly removed by chlorination, where triclosan showed the highest removal (99.4%), followed by bisphenol A (72.5%). Nine of the features that were present in the chlorinated and absent in the untreated water samples were indicated as TPs. The results of database searching and isotope-pattern comparison showed that the molecular formulae of all of the nine TPs contain at least one chlorine. Each chlorinated TP was then successfully traced to one aromatic EC. The nine TPs were transformed from five aromatic ECs, including all of the four parabens and triclosan, by replacing one or two hydrogens with chlorine atoms. The HR-MS method successfully identified nine chlorinated TPs. The results of this study demonstrated that parabens and triclosan could be transformed into more persistent, bioaccumulative, and toxic chlorinated compounds. The proposed method will be applied to the systemic identification of TPs in real water samples containing multiple ECs.

MO289
Unravelling the potential of a partial nitritation/anammox biomass towards micropollpulants biodegradation
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In the past few years, anammox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of micropollpulants 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 carbazapem). Batch experiments were performed under different conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitirifying bacteria), iii) aerobic conditions with althiourie (an inhibitor of ammonia oxidizing bacteria), iv) anoxic (optimal for anammox bacteria), v) aerobic with acetate (optimal for heterotrophic bacteria) and vi) anoxic with acetate (optimal for heterotrophic denitrifying bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and 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, carbazapem 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 micropollpulants.

MO290
Removal of pharmaceuticals in a biofilm reactor: effects of manipulating carbon feeding on system performance
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Pharmaceuticals are frequently detected in the effluent of municipal wastewater treatment plants as conventional activated sludge systems are unable to completely remove these compounds. Biofilm reactors are a promising biotechnology to remove pharmaceuticals from treated wastewater. However, it is currently unclear whether depleting the reactors from degradable carbon (enhancing the need of the microorganisms to go after difficult to degrade carbon) or increasing the load of organic carbon (assuming co-metabolism) will maximize the removal of pharmaceuticals. Therefore, in this study, we built up a saturated sand filter based biofilm reactor to investigate the effects of intermittent acetate feeding on the removal of indigenous pharmaceuticals from treated wastewater. Presently, the sand biofilter was operated at 12 h of hydraulic retention time (HRT). In order to prevent adaption of the species composition of the biofilm to the presence of acetate, the system was intermittently fed with influent without carbon addition or with carbon addition. Ten acetate concentration levels were tested in this study, 0, 10, 20, 30, 60, 90, 120, 150, 200 and 300 mg C/L. For each feeding condition (without or with the different carbon concentration), the system was continuously monitored for the removal of the investigated pharmaceuticals.
operated for 1.5 HRTs, after which four samples were taken over 6 hours. The results showed that with the different acetate additions, the effluent oxygen concentration decreased, reaching the lowest value of 0.98 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased always to initial conditions (4.7 mg/L) in each starving phase between the feeding phases with acetate. The acetate addition resulted in three different compound dependent removal patterns of the pharmaceuticals. Briefly, unchanged and inohexyl and isohexyl removal were attributed to co-metabolism (enhanced acetate). Metoprolol, iomeprol, diclofenac, propranolol and sulfamethizole removal were removed 1) at lower acetate concentrations by co-metabolistic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed indicating removal of acetate, which could be interpreted 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 Cook gö, D. Okutman, I. Istanbul Technical University / Environmental Engineering

The consumption of pharmaceuticals increase annually due to a variety of reasons involving affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropollutants regularly, focusing on the maxima and the degradation rates of those pollutants have been moved to the OECD list. Hence, there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 10L aerobic 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 acetate solution (100 mg/L). To assess the acute inhibitory effect of micropollutants respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75µg/L of each; Naproxen, Dichlofenac, Ketoprofen, Mafenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aquasim2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10µg/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75µg/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 completely accumulated in sludge phase (< 0.2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD (kX12) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50µg/L. When the concentration of PMx increased from 10 to 50µg/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75µg/L PMx resulted in differentiation in organic matter structure which caused a change in the maximum hydrolysis rate (kX12) and consequently the oxygen uptake rate (OUR) could be improved for readily hydrolysable COD (S0). The results of this study will help to clarify toxic effects of micropollutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEIP 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. Kostanjevski, Rudjer Boskovic Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. Matotic, Faculty for Food Technology and Biotechnology; M. Ahel, S. Terzic, Rudjer Boskovic 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 filtration, are often necessary to reduce the emissions to acceptable levels. In this study, bimetallic iron oxide and EDDP, respectively. Silver nanoparticles beads have been successfully prepared and its efficiency inadsorbent for the removal of metallic carcinogens from water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two main transformation products characterized by masses of 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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Removal of opioid analgesics was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. Transformation products (TPs), disinfection byproducts (DBPs), and unknown compounds are being identified via high resolution-time-of-flight GC/TOF/MS/MS and UPLC-Q/TOF/MS/MS. Some compounds were not removed even after UV treatment. Controlled laboratory chlorination/bromination on three samples from Full-Scale Advanced Wastewater Treatment Plant (Orange County GWRS) in order to make indirec potable reuse of wastewater safer. Uplimolecular 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, tricosan, 17α-ethinylestradiol, 17β-estradiol, estrone and chlorpyrifos. Gas chromatography mass spectrometry (GC/MS/MS) was used to quantify perethran, galaxolide (PBDE), polychlorinated diphenyl ether (PBDE), pentachloroethyl chloride (CCl5CH2Cl), pentachloroethyl ether (PBDE-99, benzofuran and N-nitrosodimethyl-amine (NDMA). Transformation products (TPs), disinfection-by-products (DBPs), and unknown compounds are being identified via high resolution-time-of-flight GC/TOF/MS/MS and UPLC-Q/TOF/MS/MS. Some compounds were not removed even after UV treatment. Controlled laboratory chlorination/bromination on three samples 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, tricosan, 17α-ethinylestradiol, 17β-estradiol, estrone and chlorpyrifos.

MO294 Development of a novel ozonation system for the removal of priority pollutants from wastewater
C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; B. Silwana, Durham university; M. Makombe, Cape Peninsula University of Technology / Chemistry; E. Iwohwa, University of The Western Cape / SensorLab Department of Chemistry; V.S. Somers, CPUT / Chemistry 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 scarce in view of large proportions of the land being used for 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 impregnated with chitosan to form bimetallic iron-silicon nanoparticles (CSF/Fe-AgNPs) to remove heavy metals from wastewaters. In this study, chitosan iron-silver nanoparticles beads have been successfully prepared and its efficiency in the removal of Cd(II) under ambient temperatures has been evaluated. The removal...
rate of total Cd(II) from actual wastewater was 89.25%. Furthermore, the monolayer adsorption capacity of Cd(II) based on the Langmuir model was measured to be 90 mg/g. Results were satisfactory when employing the adsorbent for removal of Cd(II) from wastewater samples. Keywords: Adsorption, Bioavailability, Monitoring, Wastewater.

MO296 WATER JPI Project FRAME: A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse

Indirect Potable Reuse (IPR) provides options to maintain sufficient water quantities for 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 Sustainable Europe)”. Principal objectives of FRAME are: (i) to evaluate treatment processes with combined analytical, toxicological and microbiological approaches; (ii) to evaluate advanced treatment options in a multiple barrier approach to improve removal of CECs and inactivation of pathogens; iii) to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECs; (iii) 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) and other biogeochemical processes. Multi-residue analysis methods were developed for sensitive analysis of 176 CECs, including 12 PFAS. The majority of quantification limits are in the range of 0.5 ng/L to 50 ng/L. Sorption of charged CECs onto Fe-oxides and other minerals was simulated with the goal to create a sorption model for complex soil compositions. Treatment process models using kinetic modelling of CEC and pathogens fates for different approaches. Principal results are: benzenehexachloride (BHC), dichloro-diphenyl-trichloroethane (DDT), dibutylphthalate (DBP), diethylenehexylphthalate (DEHP), disobutylphthalate (DBP), di-n-octylphthalate (DNP), dioctonynylphthalate (DINP), and diisodecylphthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

MO297 Evaluation of Rainwater collected from Concrete underground tank and other storage tanks in Owerri Imo State, Nigeria
A. Okeke, University / Chemistry
ABSTRACT Due to the lack of public pipe borne water supply in Owerri municipality and its Environs in Imo State, South-Eastern Nigeria, many individuals have developed different techniques for rainwater storage-harvesting for drinking and water domestic. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physiochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the probable occurrence 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 physiochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes. Keynote: Harvested Rainwater, microbiological analysis, physiochemical analysis, storage facilities, trace metals

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health
C. Allen, L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; 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, paints and medical devices. Due to their high production volume and continuous release, phthalates are emerging contaminants ubiquitous in the environment. Research has shown that the widespread exposure to these chemicals has been associated with numerous adverse health effects including impaired reproductive health in males, decreased neurological development in children, cancer and obesity. As a result, some phthalates including DBP, BBP, and DHEP 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/MS analysis, tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in influent to assess phthalate exposure. A meta-analysis on health risk data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. Results will inform on the feasibility of using sewage biomarkers for future compliance monitoring. Metabolites from the following phthalates are considered for biomarker identification: benzylbutylphthalate (BBP), dibutylphthalate (DBP), di(n-butylphthalate) (DNP), diisononylphthalate (DINP), and diisodecylphthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres: Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

Phthalates and their metabolites in the environment
L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; A. Staines, Dublin City University / School of Biotechnology and DCU Water Institute; R.U. Halden, Arizona State University / Center for Environmental Health Engineering; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates, or phthalate esters, are 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 ones of higher molar mass have low volatility and are slightly soluble in water. They are a group of synthetic organic chemicals that are used as additives, or plasticisers, 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 Faceau 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), Diisononylphthalate (DNP), Diisononylphthalate (DIDP), Di(n-butylphthalate) (DNP), Di-n-octylphthalate (DNP), Diisononylphthalate (DNP), Di(n-octylphthalate) (DNP), and Dimethylphthalate (DMP). A selection of phthalate monooesters have also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, while phthalates including DBP, BBP, and DHEP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers have similar deleterious health effects. This research is timely as the
extent of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300 Poly- and perfluoralkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluoralkyl acid

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This study proposes to identify the origin of 30 poly- and perfluoralkyl substances (PFASs) in the wastewater of 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, PFOHs, C₆-C₈ PFCA and 6-2 PTSA. High levels of 8.2 and 10.2 PTSA (> 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 dPAP (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-C₈ 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 perfluoralkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the matrices. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₈ 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 micropolutants such as pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds in domestic wastewaters. In order to quantify and understand the fate of these compounds within the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e. incoming wastewater, treated effluent, wastewater after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzenzotriazole, ciprofloxacin and fluoroacol. QACs and chlorhexidine reported. The study provides not only new scientific understanding but also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO302 Herbicides and fungicides in wastewaters 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 fungicides and herbicides in 5 major rivers and 13 smaller streams within regions of intense agriculture in southern Ontario, Canada. The Polar Organic Chemical Integrative Sampler (POCIS) was selected as a principal monitoring technique, although grab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling rates for each target compound were determined in the laboratory with synthetic water over 14 days at 15°C. The sampling rates were adjusted for the influence of environmental factors (e.g. temperature, flow) by measuring the loss of Performance Reference Compounds (PRCs) spiked into POCIS deployed in the field. Extracts from POCIS and grab samples were analyzed by liquid chromatography with tandem mass spectrometry (LC-QTRAP). In total 580 compounds were detected in wastewater samples. The results showed that there was no correlation between the watersheds that had the highest levels of fungicides vs the highest levels of herbicides. This may reflect differences in crops grown across the region, or differences in the timing of application of the pesticides. Overall, this study indicated that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

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 186 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 record of the river were distributed over 22 sampling sites in 2012 and 31 in 2013 distributed along the river. 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 georeferenced and integrated into a geographical information systems (GIS). Ecotoxicological data about drug distribution have been obtained from the measurement data as well as from the literature by calculating risk quotient (RQ). In 2012, 3,4-methylenedioxymethamphetamine (MDMA) and 4-methoxyphenylcyclohexylcaine (4–MeO-PCP) were detected in one sampling point at a concentration of 22.8 and 37.6 ng/L, respectively. In 2013, 4-MeO-PCP was detected in a different sampling point of 2012 at a concentration of 7.55 ng/L and ephedrine methyl ester (ECME) was detected at a concentration of 15.03 ng/L. Butofenate (BUF), methadone (MET) and p-methoxymethamphetamine (PMA) were found out in 3 or 4 sampling points at concentrations < 70 ng/L in 2012. Ephedrine (EHP) and codeine (COD) were detected in 3 sampling points at average concentrations of 11.6 ng/L for EPH and 91.3 ng/L for COD in 2013. The compound detected more frequently along the river was benzoylcegonine (BECC), a metabolite of benzocgonine, with an average concentration of 25.4 (2.91–76.8) ng/L in 2012. In 2013, MDMA was detected in 5 sampling points (mean of 4.6 ng/L, ranged from 2.34 to 7.21 ng/L) and BECG and MET were detected in a total of 8 and 7 sampling points, respectively, each one at a mean concentration of 14.02 (1.83–12.7) ng/L for BEECG and 11.4 (2.19–40.1) ng/L for MET. GIS provided the spatial incidence of drugs of abuse along the Turia River Basin. The occurrence of drugs of abuse may be correlated to the highest population densities contacting to the descriptive model of territorial presence. Compounds used as drugs of abuse and prescribed as pharmaceuticals (MET, COD and EPH) were mostly detected in Valencia city and its metropolitan area where most hospitals are located. Although risk assessment showed low ecotoxicological hazard, further studies are also needed in order to assess long term toxicity.

MO308

Occurrence, fate and environmental risk assessment of benzophene-type UV filters in a tropical urban watershed
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A variety of benzophene 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 runoff and 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-dihydroxybenzophene (BP-1), 2,2′,4,4′-tetrahydroxybenzophene (BP-2), 2-hydroxy-4-methoxybenzophene (BP-3), 2,2′-dihydroxy-4,4′-dimethoxybenzophene (BP-6), 2,2′-dihydroxy-4-methoxy-benzophene (BP-8), 4-hydroxybenzophene (4OH-BP) and 4,4′-dihydroxybenzophene (4DHBB)) were investigated in a tropical urban watershed consisting of five major tributaries that discharges 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 benzophene 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 evaluating the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.
Toxicology and Risk Assessment TAYER / Rey Juan Carlos University
Historically, coastal and transition waters have preferentially been used for human settlement, leading to a continuous input of wastewater effluents into these habitats. Water quality monitoring of these systems, with the goal of improving their protection under the water framework directive is highly needed. The number of studies characterizing the presence of psychoactive pharmaceuticals (PAS) in coastal waters and marine biota (Spaun et al., 2016). 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 cilastropin (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 cilastropin (92.50 ng/L). Only 3 PAS (alprazolam, cilastropin and venlafaxine) were present in the collected biota samples ( razor clam, clam and octopus) in concentrations up to 14 ng/g d.w. (cilastropin), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazardous quotas (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, cilastropin, and sertraline. The venlafaxine concentrations by glyphosate in the AMPF (Fe) were taken in the Marne River (a tributary of the Seine River) at 2 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100µL of bile was taken at 96 h to evaluate the concentrations over time which organisms are usually exposed but also their bioaccumulation potential. In this context, the objective of this work was to investigate the occurrence of different classes of psychoactive substances and metabolites in mussel tissues, and to assess the bioaccumulation potential of these compounds in these organisms. To this end, an analytical method based on a “quick, easy, cheap, effective, rugged, and safe” (QuEChERS) extraction and subsequent determination by means of liquid chromatography–electropray–tandem mass spectrometry (LC–ESI–MS/MS) was developed and validated for analysis of over 40 psychoactive compounds and metabolites, including various illicit drugs (opioids, amphetamine-type stimulants, cocaine, cannabinoids, and hallucinogens) and therapeutic drugs (antidepressants, sedative/hypnotics and stimulants) in mussels. This relatively fast and simple methodology allowed the quantification of most of the target analytes at the low ng/mL level. Poor analyte absolute recoveries, which could be attributed to ionization suppression effects by matrix components, were obtained especially for cannabinoids. However, analyte losses and matrix effects are satisfactorily compensated by the use of deuterated analogues as surrogate analytes. Further, 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.

**MO314**

**Pyrocaustic compounds in mussels: analytical method development and occurrence assessment**

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It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is essential to analyse the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

New Horizons in Particular Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)

**MO315**

**MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives**

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Imaging-Micro-Fourier Transform Infrared Spectroscopy (Imaging-µFTIR) applying a Focal Plane Array (FPA) is the most promising analytical tool for direct and rapid analysis of microplastics (MP) deposited on IR windows or collected on suitable membrane filters. The amount of data produced during an imaging analysis (many GB), combined with the lack of specific features addressed to MP identification and environmental education, commercial FTIR acquisition equipment. Since the IR map extremely time consuming and partially operator dependent. Although a novel automatic analysis pipeline has already been developed by Primpke et al. (2017), the spectral identification is still performed using a commercial FTIR software, limiting the use of the pipeline to the FTIR software’s owners. Here we present a dedicated software (MPHunter) for MP analysis which can export, convert and manage datasets from the two FPA-µFTIR Imaging suppliers. The software, which can manage several million single spectra and many

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SETAC Europe 28th Annual Meeting Abstract Book
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 hampers the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20 µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently being validated by the JPI Ocean’s, POSEIDON. 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 mission. This task can be accomplished with well-defined sampling procedures and sampling locations. Next task is the sample preparation procedure to remove organic and inorganic parts in such a manner, that the microplastic particles will not be destroyed. A further important point is the subsequent loss free transport to an analytical lab and the use of blind samples from the sampling location through all steps until the lab. Starting from this point our poster describes the following practical steps to identify plastic particles by the microscopic particles in environment samples. All operations and analyses are performed in dust-free rooms in flow boxes and all equipment is plastic-free. First procedure is a three-step vacuum filtration to divide the particles in four fractions, above 500 µm, from 500 to 50 µm, from 50 to 10 µm and below 10 µm. After filtration the particles of the different fractions are on silicon filters made from wafers which are IR transparent. Now optical particle identification programs determine all particles in shape and fractions are on silicon filters made from wafers. The reference spectra can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The correlation results can be further refined to define particle boundaries. Potential MP can then be marked, measured (main axes, area) and saved. MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpke et al. (2017) and use it as the searching engine.

MO318
Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics
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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. An evaluation of pyrograms from a collection of pristine plastic samples was performed. The 19 pristine samples were used to train our software, MPHunter, which uses a semi-automated approach to classify the pristine plastic samples. The semi-automated approach was validated by a blind sample analysis using a collection of microplastic samples from different sources. The results showed that the software was able to accurately classify the plastic samples into their respective polymer types and weathering conditions.

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 and additive composition. In a recent 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 polylethylene and polystyrene microplastic samples subjected to different types of simulated environmental weathering (UV, additive leaching, abrasion, biodegradation) in the laboratory. An unsupervised analysis approach was first used to classify pristine and environmental MP samples. Multivariate tools were then applied to classify the samples based on the global pyGC-MS derived composition of the polymers, and to compare pristine materials with samples from the environment. The technique shows promise where manual techniques fail or have difficulty due to the lack of visual resolution of chromatographic peaks with important diagnostic mass spectral features.
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 environmental change in mind, blue bottle caps from several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). For this purpose, several sequential sessions of the machining processes were carried out in order to avoid changes in the physical properties of the plastics that would result from temperature increase due to due to prolonged friction. After the machining, the obtained 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 spinning in order to avoid differences in the distribution of sizes. To prepare standards, the 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-slope Arctic Ocean

H. Lee, S. Kim, Incheon National University / Department of Marine Science; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science

The Arctic is one of the pristine areas that are sensitive to global environmental changes and have a relatively low environmental pollution. However, Arctic is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces/m² in sea ice and 1.34 pieces/m² in the Arctic polar water). Previous research on the Arctic has concentrated on the waters associated with the Atlantic Ocean (for example, the Barent Sea), while the Arctic Sea (e.g., the Chukchi Sea, East Siberian sea, etc.) linked to the Bering strait has never been studied. This area can be particularly important because it links Asian marginal seas and the Pacific Ocean, which is regarded as a global hot spot of microplastics contamination. The goal of this work is the development of a systematic protocol for sampling, sampling pre-treatment and analysis of MP in terrestrial samples, which ends up in a fast, quantitative method. Up to now, various studies about the analysis of MP at beaches, in marine sediment and along rivers are available. In these studies, as sample pretreatment density separation techniques were used to reduce the inorganic matrix. In some cases, a chemical oxidation step to minimize the organic matrix is additionally carried out. FTIR or Raman spectroscopy were used to analyse the sample with enriched concentrations of MPs. Using these techniques, only small proportions of inserted samples were analysed. Similar investigations techniques were used for terrestrial samples. The few existing studies investigated sewage sludge, compost fertilizer or areas of intensive utilization of plastics foils in agriculture or from relationships to the microplastics contamination between sea-salt and seawater. The TED-GC-MS in various worst-case or rather polluted hot-spots (i.e. lake-compot, soil along frequently used roads). A special emphasis is given to easy and fast working steps and techniques for representative sample amounts. A quantitative assessment of highly occurring MP from littering (standard thermoplastics) as well as tire abrasion (synthetic elastomers) is intended.

MO322 Microplastics in Expanded Global Table Salt Product Samples and its implication

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Microplastic pollution is becoming a global issue in marine environment pollution. Among the various environmental media, some recent studies have identified microplastic contamination that remains in salt (sea salt, lake salt, rock salt). As salt is an essential human/animal food-item, microplastic contamination in salt is an issue of concern. In this study, sea salt samples were collected by manta nets (surface water in August 2017-2018) in the Arctic region near the Russian icebreaker (R/V ARAON) to identify the presence, distribution, fate and effect of microplastics used in all the extraction experiments were the same. It was thoroughly mixed previously to spinning in order to avoid differences in the distribution of sizes. To prepare standards, the 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.

MO323 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 transport 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 in the presence of soil particles (3.8%) while almost no growth was observed when using soil particles as inoculum. Accelerated UV weathering and higher biomass concentration was found to increase the biodegradability by activated sludge. Interestingly, increased response in terms of oxygen consumption was observed with acetate as co-substrate, indicating improved rubber degradability in the presence of a readily degradable carbon source. PLGA exhibited limited biodegradability and, following extended incubation, it was suggested that rubber microparticles may not have decreased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, readily biodegradability tests proved suitable to obtain information on degradation of car tire rubber. This study provides first evidence of their degradability, especially for weathered rubber in the presence of a co-substrate, which should be considered for future biodegradability assessment. Non-inhibitory effects 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 duration tests, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

MO325 Evaluation sorption properties of tire materials using poly-parameter linear free-energy relationships (ppLER)
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Tire materials are common representatives of microplastics in the environment. They are introduced on the one hand as tire wear, an abrasion product, which reaches the environment via road runoff.1 On the other hand recycled and shredded tire crumb rubber (TCR) is applied as filler material for example on turf fields. It was recently shown that tire materials are a substantial share (~66%) on waste that is introduced into the environment as microplastic particles.2 Tires generally consist of a mixture of polymers (~40-60%), mostly styrene butadiene rubber (SBR). These elastomers are compounded with carbon black or silica as reinforcing agent (20-35%), oils (15-20%) as softeners and extenders as well as vulcanization chemicals (e.g., zinc oxide and sulphur (1-2%)). Although tire materials are known to pose the risk of leaching toxic substances, they are one of the most popular construction materials and are widely distributed for example in the application of artificial reefs and for recycling. Additionally, rubber is found in the organic pollutants from water.4 The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (ppLERs) 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 sorbent as well as the sorbate.5 They have been successfully used to describe and predict sorption of organic compounds to various sorbents.6 This work hence intends to investigate sorption properties of tire rubber crumb using poly-parameter linear-free energy relationships.1 B. Liebmann, Mikroplastik in der Umrwelt, 2015.2 B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183.3 C. Lavino, 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. Hoy, F. Cross, Mar. Fish. Rev. 1975, 37, 18.6 L. Alamo-Nole, O. Perales-Perez, F. R. Roman, Desalin. Water Treat. 2012, 49, 296.7 M. Abraham, A. Ibrahim, A. Zissimos, J Chromatogr A. 2004, 1037, 29.8 S. Eno, P. Grathwohl, S. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

MO326 Particle toxicity in the daggerblade grass shrimp (Palaeomonetes patulus) - micronized tire wear particles and microparticles
L. J. Haile, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kumpmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment
Microrubber (MR) from car tires constitutes a significant contribution to particulate contamination of the aquatic environment. MR is produced from driving, in the interface between tires and asphalt, and may eventually be led out to the surface waters, possibly together with leached granulated rubber particles used in artificial turf. Although rubber particles have been detected in the aquatic environment the potential environmental impacts of this contamination are largely unknown. Hyalella azteca is an ecologically relevant freshwater amphipod that is also a well-established model organism in ecotoxicology. This study aims to investigate the acute and chronic effects of micronized tire rubber particles and leachate on the freshwater amphipod 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 (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emerging contaminant of concern that is similar but distinct to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

MO328 Acute and chronic effects of Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine micronized tire rubber to previous data on worn car tire particles
L. J. Haile, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kumpmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment
Acute and chronic effects of Hyalella azteca and a comparison of pristine, micronized tire wear particle to previous data on worn car tire particles 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 gut ranged from 43.0±13.8 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 51.2±2.1 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 wear prepared TWP are less acutely toxic than that of other synthetic particles, especially fibers.
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 plastics and novel nanoscale forms on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters over time. As such, these tools will allow us to address important knowledge gaps, in particular (1) the biokinetics, biotransfer and disposition of their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminant transfer in the marine environment under low exposure. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MOC30
Adsorption kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media

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Release of plastics debris in the environment has been catching more and more concern due to their ability to agglomerate in aquatic environment. It has recently been observed, that plastics break down to produce nanoparticles by photochemical degradation in marine waters. However, there is a lack of suitable analytical tools, and the environmental fate and transport mechanisms of nanoparticles have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous media, whereas (1) the biokinetics, biotransfer and disposition of their aggregation behavior is clearly due to the complexity of environmental matrix and the extremely low concentration of nanoparticles, which push towards beyond the classical detection limits of analytical instruments dedicated to their physical characterization. The aim of our work, is to develop unprecedented methods to measure ultra-trace concentration of engineered nanoparticles in environmental and laboratory samples in aquatic environment. In our study, we investigated aggregation kinetics of plastic nanoparticles in culture media for fresh water (Dauta) and marine (F/2) phytoplankton. Polystyrene nanospheres (20 and 100 nm) and crushed nanoscale plastics particles were added in culture medium, whereas fate and toxicity of nanoplastics depends 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 vector for contaminant transfer in the marine environment under low exposure. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MOC33
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 Hg (100 pm, precisely measured) using microcosms. The first couple of biofilms was obtained using different times of colonisation e.g. 85 and 127 days whereas the second couple (bottom/surface biofilms) was obtained owed to different colonisation depth in the Vercors River (CH). Prior Hg exposure, biofilm biomass and microbial composition (chlorophyll content and diurnal evasional fluxes from biofilms was measured at different step times (t < 24 h) to model non-extractable Hg uptake kinetics using a non-linear pseudo first order one-compartment model. In each biofilm, non-extractable Hg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the younger biofilm was measured to be 10 times higher than that of the older biofilm. That same ratio was also obtained between the bottom and the surface biofilms. Except for the older biofilm, Hg accumulation reached a plateau at ~6 Hg exposure. A decrease in the EPS thiol concentration was observed in the bottom biofilm upon Hg exposure, suggesting a change in Hg bioavailability in the microorganism environment living in that biofilm. Our study demonstrated that biofilm microbial and EPS composition as well as thickness influence Hg uptake by microorganisms living in biofilms.
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 C-13 labeled Hg as organic compound (1,1,1-trichloro-1,2,2-trifluoroethane) 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 unamended area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these monitoring activities, the background level of total reducible mercury in the environment as well as trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment and in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IAA) and WHO implemented a UN Environment - Global Environmental Facility (GEF) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analysis as part of the monitoring of mercury in the environment as well as trends in levels of mercury and mercury compounds. In 2013, the Minamata Convention on Mercury was adopted by governments recognizing mercury as a pollutant of global concern for both human health and the environment. After reaching the 50th ratification the convention entered into force on 16 August 2017. According to the Article 22, the Conference of the Parties should establish of arrangements for providing itself with comparable monitoring and assessment capacity to allow for the efficient implementation of the Convention. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS-Mercury)”. A new initiative called “Mercury Pho2” has been launched at an international conference in November 2019 in Japan, which aims to substantially improve existing mercury monitoring capabilities through the application of new methods and technologies. This new insights will be of help for future estimates of Hg mass balance in one of the most contaminated areas in the Adriatic Sea. Keywords: atmospheric mercury; mercury fluxes; fish-farm; Grado Lagoon

MO335

Atmospheric mercury assessment: a contribution to global monitoring and effectiveness evaluation within the Minamata Convention

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MO336

Assessment of Hg impacts on mountain river ecosystems

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MO337

Mercury Photo-reduction and Total Photoreducible Mercury Dynamics in the Lakes of Kejimkujik National Park, Nova Scotia

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Photo-reduction and photo-oxidation are fundamental mechanisms controlling mercury volatilization and accumulation in freshwaters. In all surface waters dissolved gaseous mercury (DGM) is produced as a net result of the reduction of reducible mercury, which is believed to be primarily divalent mercury (Hg(II)) bound to specific carboporphous ligands, and the oxidation of elemental mercury (Hg(0)). These two processes control the amount of DGM available for evasion across the water-air interface; however, determination of the fundamental rate constants and mechanisms of these reactions in freshwaters are still areas that require more research. In particular, the total amount of photoreducible mercury is emerging as a key variable that requires more exploration. Here, we review the processes that control Hg(0). We discuss the advances over the last decade and the challenges that as well as temporal dynamics in total reducible mercury derived from two recent projects that examined water samples from a series of freshwater lakes in Kejimkujik National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photooxidation rates would be significantly different in lakes of different trophic status. Another hypothesis was that the amount of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rate constants and batch experiments were used to derive net reduction rates (and gross reduction rates by difference). These results showed that net photo-oxidation rates for freshwaters were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

MO338

Influence of Avian Biovectors on Mercury Speciation in a Wetland

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Mercury is the most biologically available form of mercury and the form which biomagnifies in food webs (Gocheff 2003). Biovectors, including avian and terrestrial biowector forms – including mercury – may indirectly affect metal speciation (Choy et al. 2010). The site for this study, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (Larus argentatus) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this biovector, a study was conducted. Mercury speciation in a reference bog with similar geological and hydrological characteristics. The filtered samples were analyzed for total mercury, methyl mercury, and water chemistry parameters (pH, conductivity, anions, cations, and dissolved organic and inorganic carbon). Results show significantly higher nutrients (nitrate, phosphate, and sulfate), total mercury, and methyl mercury concentration when compared to the reference bog that is minimally impacted by avian biovectors. This elevated availability of methyl mercury could potentially pose a threat to the local ecosystem and wildlife population due to methyl mercury’s toxicity to living organisms (Akearok et al. 2010, Singh et al. 2011). Citations: Akearok J et al. 2010. Science of the Total Environment 438: 11-30. SETAC Europe 28th Annual Meeting Abstract Book
Organohalogen compounds (OCs) and mercury (Hg) have diverse deleterious health effects and are persistent in the environment. They tend to bioaccumulate and biomagnify along the food chain. Diet is the major source for the incorporation of these pollutants into humans, especially through consumption of fish. This research focused on the presence of OCs, total mercury (THg) and methylmercury (MeHg) in lean fish from the Western Mediterranean Sea. Determinant factors of these concentrations such as trophic level and weight of fish have been studied. The estimated weekly intake (EWI) from the Spanish population of these pollutants has been assessed. Samples were collected between March 2015 and August 2016. Most of them were from Balearic Islands (Majorca n=67, Menorca n=17, and Ibiza n=18) and the rest of the samples were from Tunisia (n=2) and Egypt (n=1). Additional fish samples were collected from the Atlantic Ocean, in front of Senegal (n=4) and Mauritania (n=10) coasts for comparison. The OCs levels found in fish were similar or lower than in other previous studies. In contrast, 15% of the most frequently fish species consumed by the Spanish population had Hg concentrations above the maximum level set forth by the European Union MRL for human consumption. The concentrations of OCs and Hg between trophic levels halit in been compared. Except for HeCB, the values were higher in the upper trophic level with statistically significant differences for ΣDDTs and ΣPCBs (p < 0.05). The relationship between fish weight and pollutant concentrations were also studied. A positive relation between Hg concentrations and weight was found (R² = 0.58; p-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 presented higher levels for ΣDDTs, ΣPCBs and Hg (p < 0.05). The estimated weekly intake of OCs were well below the reported Tolerable Intakes. However, for Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the WHO threshold of 0.7 µg/kg bw. This showed the equivalent to 11 µg/kg for MeHg, involving provisional tolerable weekly intakes of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intake in adults and children (7-12 years of age), respectively.


Fish consumption is linked to the prevention of some human diseases, especially reducing the risk of cardiovascular disorders and cancers, and also reducing the occurrence of some pathological conditions such as gestational diabetes, hypertension, depression and cognitive disorders. Additionally, fish is an excellent source of quality protein, vitamins and n-3 fatty acids. At the same time, fish consumption is considered a major pathway of mercury (Hg) exposure in human. More than 90% of this Hg present in fish tissue is found essentially in its organic form (methylmercury (MeHg)), which is the most toxic form of Hg. Due to the potential adverse human health effects, international agencies have established Reference doses (Rd) as recommendations to Hg intake. Some studies have been assessing 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 consumed about 80 kg of fish per year being the region with the highest consumption of fish products in Portugal. This study is the result of a review of all published articles indexed in Web of Science that presented Hg concentration in the muscle for fish species captured in the Azorean Exclusive Economic Zone, and additional new data from fish obtained by recreational fish. The selection of species was based on the fish landing reports (1994-2015) of Azores Fisheries Statistics (SBS-PESCA). At the same time, the Azorean fish market as fish for ceviche, quesadillas or soup, economical fillet, battered or breaded fish from sea bass, catfish, tilapia, red snapper and other popular species. In the fish market, the risk due to non-commercial fish meat. However, the magnitude of this practice was not known, therefore the objective of this study was to quantify the substitution of fish meat with shark meat in Mexico City’s fish market (Central de Abasto) to evaluate the risk due to non-intentional shark meat ingestion. Samples were bought in the fish market as fish for ceviche, quesadillas or soup, economical fillet, battered or breaded fish from sea bass, catfish, tilapia, red snapper and other popular species. Chondrichthytes universal oligonucleotides in PCR were used to analyze the samples. 777 samples were applied to obtain information regarding fish consumption habits, portion sizes and other characteristics of the population of the Mexico City metropolitan area. Shark mercury content was taken from the previous study. Hg average daily dose, lifetime average daily dose and total dose were calculated for two concentrations: 0.3 mg Hg/Kg (Risk factor) and 2.7 mg Hg/Kg. Health risk was calculated using USEPA equations. Of the 52 “fish samples” analyzed 61.53% were identified as sharks of the following species: Leopard (Galeocerdo cuvier), Common sawshark (Pristiophorus ciratus), Goblin (Mitsukurina owstoni), nurse (Ginglymostoma cirratum), steak (Rhincodon typus), scalloped hammerhead (Sphyrna lewini), dagger nose (Isogomphodon oxyrhynchus), silky (Carcharhinus falciformis). With regards to the health risk, when considering the lowest Hg concentration, children may eat only one 188 g portion/month, while fertile women and older people, two 190 g portions/month and men up to five 260 g portions/month. When considering the average Hg concentration, the number of portions/month is drastically reduced to less than one portion/month. At the same time, the portion size described before are respected, the calculated risk for babies was 0.83 but significantly reduced later in life if the lowest Hg concentration is considered. However, when calculating the risk with the average Hg concentration the risk quotient was always above 1 and up to 7.2 for babies. In conclusion there is a health risk when eating fish that cannot be identified, so people must buy whole fish to secure their identity and authorities should implement a monitoring program to penalize the sale of shark meat as fish meat.
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 Cananéa 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 which gives the possibility to use tools 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 ($\delta^{15}N$) in the trophic web composed by benthic invertebrates, benthivores fish (Stellifer rastrifer, Parachromis 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 $\delta^{15}N$ were carried out by Elemental Analysis - Isotope Ratio Mass Spectrometry (EA-IRMS), and mercury analyses were carried out by Optical Emission Spectrometry, Inductively Coupled Plasma with Vapor Generator Accessory (OES-ICP-VA), in the muscular tissue of the organisms. The results of $\delta^{15}N$ varied from 6.4 to 13.8 % in Paranaguá and from 7.1 to 14.3 % in Cananéa, with continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (0.02 to 5.8 mg kg$^{-1}$) than in Cananéa (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 $\delta^{15}N$, 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 excepted since both seascapes can accommodate from anthropic activities than Cananéa, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

**MO344 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada**

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Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets with seafood. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available to humans. Thus, several studies have demonstrated the importance of seafood as a source of Hg and MeHg in the human diet. However, not all seafood is equally dangerous. 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.

**MO345 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish**

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Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish.

**MO346 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)**

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Saltmarshes are important components 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 different trophic levels can accumulate from anthropic activities than Cananéa, 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 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. Anaclético, 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 with seafood. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available for absorption by human intestinal epithelium after the digestion process. On the other hand, several studies have highlighted the health benefits attributed to green tea consumption and their potential effects on reduction of bioaccessibility of contaminants. In this context, the aim of the present study was to assess the effect of green tea in Hg and MeHg bioaccessibility in raw and cooked marine fish species. Results demonstrated that total Hg/MeHg concentration in seafood does not reflect the bioaccessible fraction. Hg bioaccessibility in raw samples ranged between 60% (yellowfin tuna and black scabbardfish) and 37 % (European conger), with most species presenting a bioaccessibility below 50%. Moreover, after grilling, Hg/MeHg bioaccessibility significantly decreased in all species, ranged between 31% (yellowfin tuna) and 8% (Atlantic wreckfish). The bioaccessibility of Hg and MeHg was also affected by the presence of green tea, decreasing the amount of these contaminants. In raw samples with tea, Hg bioaccessibility decreased between 47% (black scabbardfish) and 26% (swordfish); and between 18% (yellowfin tuna) and 7% (swordfish) after grilling. Green tea significantly decreased Hg/MeHg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, atlantic wrekfish and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioaccessibility, since they are relatively unstable. This work clearly reveals that green tea is able to reduce Hg and MeHg bioaccessibility, leading to lower the risks associated with seafood consumption. Nevertheless, a better understanding of green tea bioaccessibility is needed, and how its protective effect affects other contaminants. Such information is certainly useful to help consumers to wisely select their food, and to enable food safety authorities to integrate this information in risk assessment and communication activities.
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 sorbs 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 Gjonnekull fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations, with varying loads of MeHg. Bulk concentrations 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. Activated carbon treatment was similar to AC with an aragonite diffusion gel and a spheroid-thin resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/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 causes an initial 55% reduction of MeHg but after 1, 3 and 6 months the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water MeHg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.

**MO351**

**Bayesian Human Health Risk Assessment of Almadén Mining Area**

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Almadén, with the largest and richest known mercury deposit is located in the southwestern of Ciudad Real (Spain) with a population of 5,657 inhabitants (2016). This area can be considered one of the most affected by mercury in the world, both by its natural origin and by anthropogenic pollution since there are indications that the cinnabar mines of this region have been mined without interruption since before the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almadén environment represents a significant health impact. Different environmental scenarios were considered. Using the MINAMITA model, the concentrations in the final 2017–18 map were 0.61 mg/kg in the air, 0.6 mg/l in the water, 0.6 mg/kg in the soil, 0.6 mg/kg in the vegetables and 0.6 mg/kg in the fish. Based on this model we have calculated that the intake of mercury by the population is 0.1 mg/kg. This intake is below the tolerable daily intake (TDI) of 0.09 mg/kg. The sum of all dietary intakes is therefore below the tolerable daily intake (TDI) of 0.09 mg/kg. The sum of all dietary intakes is therefore below the tolerable daily intake (TDI) of 0.09 mg/kg.
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 determination of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg(II) concentration in generated elemental and oxidised Hg reference gas standards are required, as well as tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used for the on-line measurement of Hg under field conditions and a comparison of Hg species inter-conversion.

MO354
PBTK/TD assessment of mercury (Hg(II)) accumulation in freshwater tilapia species
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Waterborne and dietborne exposures of freshwater fish to inorganic mercury (Hg(0)) 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 excretory. The dose, physiological and biochemical 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 – 0.003 μg g⁻¹ ww(Hg(II)), indicating that Hg(II) is accumulated in muscle and below levels at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) in was in gill (0.0115% C.I. 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
H. C. Varela, University of Aveiro; A. M. Soares, F. Morgado, University of Aveiro / department of Biology & CESAM; S. Abreu, University of Aveiro / Dep. Biology & CESAM
Fish consumption is recognized as an important component in the human diet, due to the high-quality protein content and n-3 fatty acids, however, it is also considered the main route of mercury (Hg) exposure from ingestion of contaminated seafood. Hg is released into the environment by natural and anthropogenic sources and recognized as a pollutant of high importance, due its high degree of toxicity, persistence and bioaccumulative properties. Since exposure to mercury poses human health at risk, the Food and Agriculture Organization (FAO)/World Health Organization (WHO), Joint Expert Committee on Food Additives (JECFA) and also by the United States Environmental Protection Agency (USEPA) have been established reference doses (RfD) or “Provisional Tolerable Weekly Intake” (PTWI), in order to minimize that risks. JECFA established a PTWI for MeHg of 1.6 μg kg⁻¹ bw⁻¹ week⁻¹, whereas USEPA pointed a lower value of MeHg intake, setting the RfD at 0.14 μg kg⁻¹ bw⁻¹ day⁻¹ (equivalent to 0.74 μg kg⁻¹ bw⁻¹ week⁻¹ ). Recently (2012), PTWI suggested by JECFA for MeHg was revised by the European Food Safety Authority (EFSA) to 1.3 μg MeHg kg⁻¹ bw⁻¹ week⁻¹. This study, presents a brief review of the Hg concentration present in the muscle of commercially valuable fish species caught near the mid-Atlantic ridge (Azores Archipelago) where fish consumption e relatively high (…) and compares these Hg concentrations with the maximum levels of Hg for certain contaminants in foodstuffs 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 227 g; only fish with MeHg concentrations below 0.34 μg g⁻¹ could be selected to be consumed so that the PTWI established by JECFA would not be exceeded, despite the concentration of 0.5 μg g⁻¹ (for most of the fish species) or the concentration of 1.0 μg g⁻¹ ("exception list") is allowed for fish consumption.

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

MO356
Ring-test of different implementations of the General Unified Threshold Model of Survival (GUTS)
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The additional information and insight gained through the application of toxicokinetic-toxicodynamic modelling can strengthen the environmental risk assessment of chemicals in consumer products or plant protection products. For the endpoint survival the most suitable and powerful tool is currently the General Unified Threshold Model of Survival (GUTS), which consists of two complimentary models: GUTS-SD (stochastic death) and GUTS-IT (individual tolerance). In order to ease the use of GUTS and increase trust and acceptability we recently carried out a ring-test of eleven different implementations of GUTS. The frequency of erroneous results due to programming errors and less appropriate settings for numerical solvers or parameter search and convergence algorithms indicated that user training and experience is key. However after correction of user errors all software implementations resulted in comparable and similar results. Estimated parameter values generally agreed well and the implementations returned similar results in scenario tests, but some discrepancies were noted. We suggest that new users and new GUTS implementations should be trained using this ring-test and refer to these results as benchmark. Any new user should run the ring test exercises and improve their modelling techniques until they achieve comparable results. Standardisation of typical use cases could also help to reduce sources of error as well as corresponding, user-friendly, robust GUTS software. This software could reduce sources of error by restricting user-choice to only those options suitable and relevant for the regulatory risk assessment under consideration.

MO357
Feeding impairment in fish explained by a TK-TD model
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In current environmental risk assessment (ERA), plant protection products (PPPs) are tested on a diversity of standard test species suitable and relevant for the regulatory risk assessment under consideration. Recent developments in mechanistic effect modelling provide the possibility to extrapolate risk assessments from standard test species to nested ecological scenarios or exposure situations, which will improve the quality of ERA as well as saving time and resources. Toxicokinetic-toxicodynamic (TKTD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory may have the potential to provide a general modelling framework for sublethal effects. Mechanistic effect models based on DEB theory have been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus,
predicting effects on feeding and assimilation is a crucial characteristic for a TKTD model to predict sublethal effects in the context of ERA. We present here the results of the i-ERA project (integrated ERA) on the responses to low food conditions / feeding impairment in four fish species (rainbow trout, fathead minnow, zebrafish and medaka). We tested the DEB model for predicting organism level responses of juveniles (rainbow trout) and adults (all others) under low food conditions. We find that for two of these conditions, fish do not change their metabolism compared to the standard DEB model. This indicates that the model can be used in ERA for the four fish species analyzed here to predict effects of compounds that act on feeding inhibition without any adaptation. The differences in the organism-level response to low food conditions / feeding impairment between the four species can be explained by differences in their model parameters. The standard DEB model can be extended to include variable adaptation and low food conditions. We suggest their metabolic 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 reproduce toxicity in the field or the mesocosm experiments, we extended our modelling approach to the more dynamic exposure scenario, TK-TD modelling was used as an additional approach to address the potential effects of short-term exposure as predicted for some FOCUS surface water scenarios. The *Lemna* TK-TD model developed by Schmitt et al. (2015) was used to simulate laboratory tests assuming exponential growth as observed in the experimental controls. Growth under field conditions was modelled as dependent on temperature. This differs from the laboratory experiments where constant temperatures were used. The substance-specific TK-TD parameters were calibrated using the results of a growth inhibition test with 7 days of exposure followed by 7 days of recovery in fresh medium without test item. The so calibrated model was verified by comparing its predictions with results of three other tests with different exposure patterns, some of which were designed with this purpose in mind. Modelling challenges were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure patterns on the growth of *Lemna*. We simulated laboratory refined exposure tests with PEC profiles of the 7 days worst-case time window of the FOCUS step 3 scenarios as well as field populations using the full FOCUS profiles as inputs. For the exposure profiles characterized by short-term pulses, margins of safety were above 10 to reach a 50% inhibition of the growth rate over 7 days, the endpoint used in Tier 1. For the simulated field tests, maximum deviation of biomass under control and exposure conditions was used as assessment endpoint. If up to 25% deviation of biomass of an exposed population from a control population is considered a negligible effect, the Margins of Safety was above 20 all analysed scenarios. The experimental results showed that for different exposure scenarios, the same species tested showed 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 an additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

**MO359**

**TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish**

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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 variable-exposure and organism response over time. Here, changes in SSD (and the corresponding HC) are calculated for a scenario with combinations of two species using the toxicokinetic/toxicodynamic (TK/TD) model for survival GUTS. The GUTS model was parameterized based on standard acute tests for each fish species and both stochastic death (GUTS-SD) and individual tolerance (GUTS-IT) assumptions were tested. Then, the 58-day LC₅₀ for constant exposure and for two different pulse exposure scenarios (single and double pulses) were derived. The LC₅₀ values were subsequently used as input for the SSD calculations. The SSDs were derived by fitting probability distributions to the LC₅₀ data, and the corresponding HC₅₀ were determined. The analysis was performed separately for two compounds. Results with both toxicants revealed that the sensitivity ranking for the fish species and consequently the HC₅₀ values were not the same among the tested exposure scenarios. Predictions with either GUTS-SD or GUTS-IT models also had an impact on the SSDs and did not yield the same results for the same exposure profile. Additionally, longer exposure durations did not always result in lower HC₅₀. These findings infer that SSD strongly depends on the exposure scenario, and reveal the interference of substance toxicokinetics and organism responses to toxicity in determining the sensitivity ranking of the species. Therefore, it is essential for a reliable environmental risk assessment not only to consider realistic exposure scenarios, but also the TK/TD processes related to the substance and the organism. With a set of standard data, the GUTS model can help to achieve this goal for untested exposure patterns.

**MO360**

**RIFCON EasyGUTS: Ready-to-use and freely available software for TK/TD modelling of survival**

D. Nickisch, O. Jakobi, A. Medianec, Rifcon GmbH

GUTS (General Unified Threshold model of Survival) is one of the most commonly used models used for toxicokinetic and toxicodynamic evaluations of aquatic experiments in the context of the European registration of plant protection products at lower tiers in the ecotoxicological risk assessment. One user friendly implementation of this model is the Windows based program EasyGUTS. This implementation and its functionalities were recently tested and verified using published data. Results obtained with EasyGUTS are in good agreement with results obtained from various other publications and model implementations. However, one limitation of the program during this verification process was that it was only possible to select the log-normal distribution for the individual tolerance model rather than giving the possibility to also use other functions like a log-logistic distribution. This was the case since the GUTS R package to which EasyGUTS is linked, is restricted to only this possibility. Since a TK/TD draft guideline is expected earliest next year and no preference for a distribution is given in recent publications, in line with the EFSA 'Scientific Opinion on Good Modeling Practice'. Moreover, EasyGUTS as a functional tool was tested in internal and external modelling workshops. Our experience is that the usability of the software and the robustness of the calibration algorithm was fitting well, so that even all users could reproduce results and decisions. Since EasyGUTS is finally verified and harmonised with the R GUTS package, it is ready to use under free license agreement and can be downloaded from the RIFCON homepage beginning of 2018. This poster presents the functional features 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. Bruns, 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 TK/TD 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 datasets. Particularly in chronic experiments, test organisms are continuously exposed over long time periods (week to months), which makes these experiments costly, time consuming and which limits the number of non-standard species to be investigated, as these species - in the absence of appropriate husbandry and test methods and due to complex biologies - are particularly challenging to test reproducibly in chronic set-up’s. Here we will present an approach using the GUTS model (TK/TD model for survival) informed by specifically designed peak-exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatment levels of an insecticide, in combination with several observation time points for 5 aquatic insect species and 3 crustaceans. The outcome of these experiments will inform the GUTS/IT 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 cumulatice distribution. Apparent toxicity observations, such as the LC50s, have been reported to depend on ambient temperature and their participation in aquatic ecosystems 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 ranges can be described by the Arrhenius function. Part of this study is to examine if the Arrhenius function is also able to predict TKTD model rates, such as GUTS, for different temperatures. We use GUTS to extrapolate toxic effects across temperatures and investigate the impact of temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlorpyriphos.

MO365 The use of population models in copper risk assessment: a case study with Acipenser transmontanus
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaene, Ghent University / GhEnToxLab; P. Van Sprang, ARCHE; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Current metal risk assessment consists of assessing single-species data on metal toxicity and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effects on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (Acipenser transmontanus) population model to predict population level effects of copper toxicity. The white sturgeon is a fish species particularly sensitive to copper during early developmental life stages. An individual-based model (IBM) was implemented using the software platform 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 as alternative tools in ecological risk assessment. In this contextual lethal (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 homogenous). Population EC, values were derived with the IBM by extrapolating observed (conventional) LC, values from literature. Here we fit 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 used in this area. The DEB model was applied for A. transmontanus species. Responses were analyzed by combining the TKTD model with DEB models. High copper concentrations were found to be toxic to A. transmontanus, as the population was not able to remain stable under these conditions. Additionally, the TKTD model was compared with the DEB model for different copper concentrations. The TKTD model was found to be more accurate in predicting the effects of copper on A. transmontanus populations. This is because the TKTD model takes into account the toxicokinetics of copper, which is not considered in the DEB model. Furthermore, the TKTD model allows for the prediction of population-level effects, which is not possible with the DEB model. In conclusion, the TKTD model is a more accurate tool for predicting the effects of copper on A. transmontanus populations. However, more research is needed to further validate the TKTD model and to improve its accuracy.
sensitivity distribution (SSD), and results from model ecosystems and field studies whose task is to extrapolate single-species data to ecosystem-level responses. Although AF and SSD methods are described by strict guidelines making them commonly applied, they do not consider the effects of ecological interactions between species on the assessed risk level, which is potentially not-negligible since population dynamics in polluted environment are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing ecological risk of chemicals considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to 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. Chua, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advising WorleyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health

Population viability analysis is useful tool for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) pesticides 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-RBM links concentrations of OPs to % Acetylcholinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into matrix metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The primary results from this model development will help to reevaluate the maximal acceptable dose of specific contaminants to salmon populations, underlining 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-ERMA / URAFP INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFP INRA; M. Delanoy, URAFP-ERMA / URAFP INRA; A. El Hajj, T. Oster, C. Malplate, Université de Lorraine UL / URAFP ERMA; N. Tran, Université de Lorraine UL / ECOLE de chimurgie, Faculté de Medecine de 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 correct assessment of effects in adult rats 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 chlordane (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primary neurons isolated from different postnatal CNS areas. We then assessed neuronal functions using specific markers for neuronal death, neurite development and synapse formation. In parallel, we produced cerebrospinal fluid (CSF) from pigs exposed to CLD via contaminated food. This CSF containing CLD and its by-products that are able to cross the blood brain barrier could then be used on the same cultures to compare its effect with that obtained with the following direct treatment with the molecule. We were able to identify a direct neurotoxic effect (10 µM) on specific purified neuronal cultures together with more subtle damages at lower concentrations including neurite arborization defects (0.1 to 1µM depending on the respective neuronal cultures). Additional effects on pure glia cell cultures at higher concentrations (100 µM) suggest a reactive gliosis in the whole animal. These observations were confirmed by CSF treatment using CLD-contaminated CSF but not with CSF from control pigs. In addition, the dose with no observable effects is at least 10 times lower using primary postnatal neuronal cultures compared to embryonic cultures. Our experimental model is therefore much more sensitive and may reflect more precisely the consequences of chronic CLD exposure. Our strategy could help to re-evaluate the CNS effects of this remnant pollutant present in West Indies soils.

MO370 A new classification method for mechanisms of toxic action F. Bauer, KREATIS; P.C. Thomas, CEHTA SAS / Ecotoxicology and Risk Assessment

A knowledge of the mechanism of action (MechOA) of substances is a crucial first step in risk assessment approaches, especially when using in silico models to predict (eco)toxicity. Mechanisms of Action are similar to Molecular initiating Events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechOAAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechOAAs. Consequently, a new method to predict MechOAAs with high accuracy and with simple rules was developed using a Mechanism of Action classification with 6 general MechOAAs including 23 detailed MechOAAs. The MechOAAs are given mainly for mammals and fish but information on other species was also included. We used a training set of 301 molecules, and validation set of 491 molecules. Our method was built as a linear decision tree composed of 62 decision rules. This method achieved 92.0% correct classifications for the training set and 92.3% for the validation set. 6% of the predicted classifications were slightly different from the literature MechOAAs for the training set (3.4% for the validation set) and 1% of the training set was misclassified (4.3% in the validation set). Finally, only 1% was out of the applicability domain for the training set while no molecules from the validation set were unclassified. This model is both simpler and performs better than the previous methods that were 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 continuously 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, algaeicides and fungicides are added to the materials. Nevertheless, active ingredients leach from the treated facades, if contacted with wind-driven rain. Especially in suburban residential areas a large fraction drains directly to soil, e.g., flowerbeds, gravel strips or the lawns surrounding the houses. Consequently, the soil in areas with biocide-treated buildings is exposed to rain runoff water highly polluted with biocides. In the present study, the degradation rates of eleven biocides in soil were determined in laboratory microcosms. Degradation half-lives ranged from rapidly degrading (T1/2 < 10 d) to compounds with higher persistence (T1/2 > 120 d). For two selected biocides (terbutryn and octylisothiazolinone) a set of transformation products were quantified in the microcosms as well. This showed that the mass balance for terbutryn could be closed with nine analysed transformation products for the entire incubation period (120 d), revealing that relative persistent metabolites are formed. In contrary, the mass balance including transformation products of octylisothiazoline was not closed, as two transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Alivibrio fischeri than the
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. Botro, Dr. Robert-Murjahn-Institut; U. Schoknecht, BAM Federal Institute for Materials Research and Testing; K. Bester, Aarhus University / Environmental Science

Biocides are common additives in façade coatings to protect the materials against biological deterioration. In case of classical formulations, these preservatives are used for this purpose. Nevertheless, these biocides leach to the environment when the façade is getting in contact with driving-rain. Long-term exposure tests in natural weather showed large gaps in the mass balances, indicating towards other loss mechanisms. The present study focused on phototransformation as a major pathway for active ingredient loss. In laboratory experiments in UV-weather chambers the formation and fate of photoproducts were compared with those of the respective parent compounds. Nevertheless, for most biocides the degradation rates of the parent substance are much lower than those of the photoproducts. Hence, though many of the used biocides are degrading relatively rapidly in soil, they will persist longer in façade coatings.

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. Antho, S. Harlt, DR. KNOELL CONSULT GmbH

Rodenticides as biocidal products are regulated according to Regulation (EU) No 528/2012 (BPR). In both frames - evaluation of active substances as well as authorisation of biocidal products – a risk assessment needs to be carried out for biocidal active substances and their transformation products. The latter is based, inter alia, on 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 site in the eastern 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.

MO374 New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage - K. Michaelis, German Environment Agency (UBA); M. Schwander, German Environment Agency Umweltbundesamt; M. Galler, M. Schweitzer, SCC GmbH

Preservatives for products during storage are also known as in-can preservatives and are regulated according to Regulation (EU) No 528/2012 (BPR). These preservatives are biocidal products which are used in many different end-products (e.g. detergents, paints, glues etc.) to prolong their service life. The environmental emission of these end-products is evaluated in an Emission Scenario Document (ESD), whereas the existing ESD for in-can preservatives does not contain calculations for the variety of all end-products. Consequently, the German Environment Agency (UBA) initiated a research and development project for the further development of the evaluation method of in-can preservatives. The draft for the revised ESD has been prepared by SCC GmbH on behalf of the German UBA. Due to the variety of different applications of in-can preservatives, a differentiation in 6 sub-categories was defined. Additionally, for a complete environmental emission estimation different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the uses of the end-product (application and service life) within a subcategory have to be considered. To reduce the workload and to enhance the emission estimation it was decided to define emission scenarios which describe a realistic worst-case situation for the environment refer to application amount, emission days and release fractions. On the basis of expert knowledge, draft competent authority reports of in-can preservatives and a survey between stakeholders, industry and other EU member states worst-case scenarios were identified and discussed at EU level. Finally, the revised ESD suggest one or a few worst-case scenarios for each subcategory. Using a prioritisation concept for biocides a worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.

MO375 Monitoring of Biocides in German Sewage Treatment Plant Effluents - First Results - C. Meier, German Environment Agency (UBA) / Biocides; K. Pohl, German Environment Agency (UBA) / Section Biocides; M. Alting, I. Noeh, German Environment Agency UBA / Biocides; A. Thoma, F. Sacher, DVGW Water Technology Center; M. Kaiser, S. Fuchs, Karlsruhe Institute of Technology KIT / IWG

Due to a widespread use, biocidal active substances and their transformation products are expected to be found in the environment. Projections show that there will be an increase of biocide entries in the environment, mainly in urban areas due to an increased use of e.g. disinfectants and especially masonry preservatives. Biocidal substances enter the environment through numerous entry pathways. One main entry path is through sewage treatment plants (STP). Therefore, the German Environment Agency (UBA) initiated a project where the effluent of 29 public STPs from all over Germany will be investigated over a period of one year, starting in November 2017. Additionally, selected samples from influents as well as from sewage sludge emissions will be in the focus. Using a prioritisation concept for biocides a list, ranking substances that enter the environment through the STP-pathway, was generated. The list was judged by experts and finally, for this project 23 biocidal active substances or transformation products were chosen for analysis. First results show that several substances can be detected at measurable concentrations in the effluents. This ongoing project will provide better knowledge about the fate and behaviour of biocides entering the environment through sewage STPs. It will give us a time dependent picture of the environmental pollution by biocides in Germany through urban STPs and will also show possible fields of action for regulatory purposes.

MO376 The 'risk envelope approach' applied to environmental risk assessments for disinfectants - a strategy to reduce workload for biocidal product families - A. Vanden Bosch, ARCHE; L. Jansen, Arche consulting; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; E. Van Ael, A. Ghekiere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche Consulting; M. Verstraeten, Arche Consulting

Under the Biocidal Products Regulation, applicants can apply for authorisation of biocidal product families (BPFs), which consist of products with similar uses, the same active substances, similar compositions within specified variations and similar levels of risk and efficacy. Especially when consortia are formed and products from multiple companies are grouped into a single dossier, building a dossier to demonstrate safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the BPFs, in the interest of the applicants as well as the competent authorities. BPFs are typically subdivided into subfamilies called 'meta SPCs'. The subgrouping in meta SPCs considers a.o. the composition, formulation type, product type (PT), risk mitigation measures (RMMs), classification and labelling (C&L) and shelf-life of the respective product. This harmonisation ensures the identical 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 use groups and ranked according to these key parameters. As such, one or more worst case or ‘critical’ use can be identified. If it can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental and risk assessment for a BPF of 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

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The LIFE-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, hazard classifications, environmental fate and derived metabolites includes aquatic toxicity data for fish, invertebrates, algae and WTP microorganisms. The EU Regulation (EC) No 1272/2008 on classification and labeling was considered to group these compounds in four toxicity categories taking into account the values of NOEC or LEC50: 1 (≤ 1 mg/L), 2 (>1 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 20% 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% of biocides belong to this category for the microorganisms group. Metabolites are mainly less toxic than the parent biocides, however many of them present the same toxicity and very few (< 7%) are more toxic. The ongoing work indicates that biocides and a considerable percentage of their metabolites present a high toxicity for the aquatic species. It also identifies data gaps related to the ecotoxicological potential for metabolites.

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MO380 Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015

M. Schiefer, NIVA Norway; INIA / Centre for Coastal and Marine Research; L.A. Tveiten, Norwegian Institute for Water Research NIVA / Marine Biology; B.A. Beyrich, S. Øknevd, Norwegian Institute for Water Research NIVA / marine pollution; D. Hjerrmand, Norwegian Institute for Water Research NIVA / Oceanography; J. Beyer, N.W. Green, NIVA Norwegian Institute for Water Research / marine pollution

Imposex is a TBT-induced alteration of male sexual 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 international regulations on industrial chemicals when these 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 (TPTT). TBT and VDSI (threshold 1.43 µg/kg w.w.) were low in N. lapillus at eight stations in 2015. At most stations, VDSI was 0 or close to 0 and below the OSPARs Background Assessment Criteria (BAC=0.3). The highest level (VDSI=0.828) was found at the shipping channel Karmsundet, which were above BAC but below the OSPARs Ecotoxicological Assessment Criteria (EAC=2). There were significant downward long-term (whole period 1991-2015) and short-term (recent 10 years 2006-2015) trends for both imposex/VDSI and TBT based on time trend analysis. These results show that the Norwegian legislation banning use of TBT on boats less than 25 m in 1990, on larger ships internationally from 2003, and the total ban in 2008 have been effective
in reducing imposex in *N. lapillus* and have re-established some of the populations. Low levels or significant downward long-term and short-term trends for TBT in common periwinkle (*Littorina littorea*) and blue mussel (*Mytilus spp.*) substantiate this.

**MO381**

**Risk assessment issues for algaecides under BPR**

C. Durou, M. Darriet, J. Rivera, CEHTRA SAS

A prospective and comprehensive environmental risk assessment (ERA) must be performed on the active substance for the market authorisation of biocidal products. The technical guidelines are made publicly available by ECHA. The data required for the ERA include the determination of a set of properties (physical-chemical, fate properties, short- and long-term ecotoxicity), an effective in-use dose or concentration, frequency of application of the biocidal product etc... In coming years, a prospective risk assessment has to be prepared in order to address the risk associated with the use of biocidal containing these active substances and also any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocide activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk scenarios. Realistic worst cases are necessary assessing the leading behavior. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algaecide applied in swimming pools. The poster will concentrate on follow-up key aspects: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for 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

Timed chemical risk assessment framework adopted in Europe for evaluating the surface and groundwater risk from veterinary medicines used to treat livestock follows a tiered approach. The initial exposure assessment is a simplistic approach, with the FOCUS suite of models (FOrum for Co-ordination of pesticide fate models and their USE) often subsequently required for higher tier surface and groundwater refinement. Standard FOCUS scenarios defined within the guidance are intended to represent realistic worst cases to enhance assessing the leading behavior. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algaecide applied in swimming pools. The poster will concentrate on follow-up key aspects: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for 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.

**MO383**

**Are currently-adopted European guidelines on veterinary medicine product and feed additive risk assessment sufficiently cautionary?**

A. Di Giudice, Universita degli Studi di Milano-Bicocca / Department of Earth and Environmental Sciences; B. Kolar, National Laboratory of Health, Environment and Food; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences

Veterinary medicine products (VMPs) are used in livestock production to preserve animal health or to promote growth in certain categories of animal; feed additives (FAs) are products aimed at improving the quality of feed and the quality of food from animal origin, or to improve the animals’ performance and health. These substances may not be put on the market unless authorisation has been given following a scientific evaluation demonstrating that they have no harmful effects, on human and animal health 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) immission 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 which is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZ are measured, and in total 23 substances actually distributed in several zones higher thresholds of N immission standard are allowed. Both ERAs procedures could therefore underestimate the PECsoil with a potential environmental toxicity for non-target terrestrial organisms. This study is aimed to evaluate if PECsoil, calculated using standard models currently used in the authorization procedures of VMPs and FAs, are sufficiently adequate to protect soil and water quality. In order to evaluate the contribution of animals to environmental occurrences of veterinary medicines in Dutch waters to feed possible policy measures. For this, we gathered information from detected compounds in both groundwater and surface water, as these sources are related to drinking water production. From the bulk of the compounds on the market no measurement data are known (84%). Of the 260 compounds used in veterinary medicines only, 23 are measured, and in total 23 substances actually distributed. These detected involved 15 antibiotics, four anti-parasitic resources, three anthropic and one painkiller. Our quick-scan confirms that a good insight into the presence of veterinary medicines in the water cycle is still lacking. Not only measurement data is limited, it became clear that data on local and regional surface waters is missing or fragmented. We propose inclusion of monitoring data in national and international databases, so this 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 veterinary use only. We noted that some 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.

**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 from veterinary medicines to environmental occurrences of veterinary medicines in Dutch waters to feed possible policy measures. For this, we gathered information from detected compounds in both groundwater and surface water, as these sources are related to drinking water production. From the bulk of the compounds on the market no measurement data are known (84%). Of the 260 compounds used in veterinary medicines only, 23 are measured, and in total 23 substances actually distributed. These detected involved 15 antibiotics, four anti-parasitic resources, three anthropic and one painkiller. Our quick-scan confirms that a good insight into the presence of veterinary medicines in the water cycle is still lacking. Not only measurement data is limited, it became clear that data on local and regional surface waters is missing or fragmented. We propose inclusion of monitoring data in national and international databases, so this 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 veterinary use only. We noted that some 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 chemicals to environmental compartments. Environmental emissions for biocidal products are estimated according to Emission Scenario Documents (e.g. OECD). In some ESDs, the emission is calculated based on the use/consumption of the product as specified on the label (e.g. PT18), with a number of default assumptions applied. However, other ESDs include the facility to take account of tonnage information as well as average consumption values in product specific calculation models (e.g. PT2). Both approaches have strengths and weaknesses. However, the importance of establishing realistic and reliable methods of estimating environmental emissions cannot be understated, especially in light of the intention to develop guidance on aggregate assessment. Accordingly, this poster will illustrate on two approaches for estimating emissions: regional tonnage (top down) or consumption (bottom up). Opportunities and limitations of the applicability of the data and their implications for use in EU environmental exposure assessments will be evaluated.

**MO386**
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387
Recommendation on Steam Cracker allocation for the sake of comparability of petrochemicals products datasets used in LCA studies

G. Castelan, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different 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 uncontrolled effects and a better interpretation by LCA experts, particularly in perspective of comparability, in LCA studies of these downstream products. Basing on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensual 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main “products” fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same 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

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Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecoinvent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecoinvent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance; 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations, CML 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 question of relevant default basic uncertainty values is significant lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecoinvent might contain inconsistencies and leads to error in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, performing automatic conversions in the submission software or simplifying the provision of uncertainty data using simpler probability distributions.

MO389
Life cycle assessment of battery systems with harmonized life cycle inventories considering different storage applications

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 application scenarios in Europe. On the basis of the presented 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. Bahramifar, 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 Fe₃O₄-based (Fe₃O₄@SiO₂-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are compared at different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of these adsorbents, it also leads to a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to consider 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 the test comparing the impacts between MGO-NH-SH and Fe₃O₄@SiO₂-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change, water use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis was employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethanol and DCC can reduce the impacts significantly.

MO391
Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of showering

S. Shahmohammadi, Radboud University / Environmental Science; Z. Steinmann, 225 SETAC Europe 28th Annual Meeting Abstract Book
Radboud University Nijmegen; H. King, University of Nijmegen; H. Hendrickx, 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 through 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 behaviour as a basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle of showering. The results of showering were modelled in 4 countries namely Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country behaviour, climatic and infrastructural differences as well as intra-country variation in consumer behaviour are crucial for determining the variability in the life cycle environmental impacts. Inter-country variability - the ratio between the highest median footprint and the lowest median footprint over the four countries- in the 4 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.5, 2.2, 1.4 and 5.8 respectively. Intra-country variability - the ratio between the 95th percentile and the 5th percentile of the distribution- was typically higher than inter-country variability and ranged between factors of 5 and a factor of 20 depending on the process and indicator considered. Sensitivity analysis showed that consumers’ reasoned choices - particularly heater type and shower flow rate- and their habitual behaviours - particularly shower duration-, are the dominant sources of variabilities. Reductions in the water and energy related impacts of showering through changing of reasoned choices are achievable by one-off decisions such as buying an efficient water heater. However, reducing the impacts through changing of consumers’ habits could be challenging and needs more systematic approaches as consumers tend to keep their old habits.

MO394 Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments K. Schlüch, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; M. Krock, Federal Institute for Geosciences and Natural Resources; M. Kraas, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; D. Rückamp, Federal Institute for Geosciences and Natural Resources; K. Hunz-Rinke, Fraunhofer IME / Department of Ecotoxicology

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 makes it an important NM source. 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 CeO2-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 cultivated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere induce AgNMs. AgNMs were applied into 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 overall 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 K. Schlüch, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; M. Hoppe, Federal Institute for Geosciences and Natural Resources; M. Kraas, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; J. Schubert, Leibniz Institute for Polymer Materials; M. Chana, Institute for Building Materials (IBB); K. Hunz-Rinke, Fraunhofer IME / Department of Ecotoxicology

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) (Kaiser et al., 2011). Slightly soluble Ag2S is considered as none toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schluch 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
In our previous study, the dissolution of silver nanoparticles (AgNPs) was investigated. AgNPs were added to clean soil at concentrations ranging between 0.009 and 0.057 g soil/g animal/day. The results showed that the uptake rate constants were similar for both ZnCl$_2$ and ZnO NPs. However, the toxicity of AgNPs was higher than that of ZnCl$_2$ and ZnO NPs, with an inhibition of 70% at 700 μg Ag/g soil. The toxicity of AgNPs was also dependent on soil type and properties, such as pH and organic matter content.

In the elimination phase, the total available energy reserves and internal Zn concentrations were measured. The results suggested that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of the form and concentration, which is important for maintaining homeostasis.

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 its impact on the immune system, we studied the uptake and elimination of AgNPs in enchytraeids. The results showed that the uptake rate constants were similar for both ZnCl$_2$ and ZnO NPs. However, the toxicity of AgNPs was higher than that of ZnCl$_2$ and ZnO NPs, with an inhibition of 70% at 700 μg Ag/g soil. The toxicity of AgNPs was also dependent on soil type and properties, such as pH and organic matter content.

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hemocytes, 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 phase. Land application is currently the main method for agricultural land, as a resource of nutrients and organic matter, is encouraged under the “Resource Efficiency Roadmap of Europe” [1]. However, the presence of contaminants in biosolids such as engineered nanoparticles can cause concerns. Total Ag concentrations in biosolids can be up to 195 mg Ag/kg dry soil in biosolids according to Johnson et al. [2] which is close to observed EC50 concentrations of AgNP for cells (AgNPs) [3]. Moreover, AgNPs are mostly transformed to Ag sulphide nanoparticles (Ag-SNPs) due to the reducing conditions present in the wastewater treatment plant (WWT). [4] Recent studies suggest the possibility of AgNP residuals because of the partial sulfidation of AgNPs [5]. Land spread of biosolids might lead to the transfer of AgNPs and Ag-SNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs on soil microorganisms (Enchytraeus albidus) which are important for a number of ecological reasons that is important for a number of ecological reasons (tomato, potato, cucumber) during the transformation process. These processes include plant production, nutrient cycling of organic matter, storage of water and carbon, and richness of pathogens in agricultural crops. Poor water is the interstitial water water found between sediment and soil. Soil acts as a biological habitat and gene reserve for a variety of species which are involved in all the soil ecosystem health. Therefore, contaminants released into soil can affect the organisms which dwell in them directly affecting soil richness. As nanomaterials are being released into the environment they are able to form complex structures with organic material and soil particles. In order to address the fate and behaviour of CdTe QDs three different functional groups (COOH, PEG, NH2) were used for soil ecotoxicity studies. The earthworm Eisenia andrei, pot worm Enchytraeus albidus and soil nematode Caenorhabditis elegans were used following OECD and ISO protocols to determine compatibility of nanomaterials. The nanomaterial distribution in soil was determined by using a flow through system combined with microwave digestion and ICP-MS where nanomaterials were poured onto soil as well as homogeneously mixed and eluted using ultrapure water. It was found that a predominant amount of metals were found within the eluted interstitial water and that NH- functional groups had a higher binding affinity to the soil. There was no mortality seen for both earthworms and pot worms exposed up to 500 mg/L over 21 and 28 days respectively. Significant stimulation in reproduction was seen at 5 mg/L for NH; and 5 and 30 mg/L in the COOH for earthworms. Pot worms showed an insignificant bimodal response but a significant decrease in reproduction was seen at 5 mg/L in the NH; group only. The nematodes showed a significant decrease in reproduction and fecundity. Bioaccumulation is – the best way to study all functional groups. A dose dependent nanomaterial uptake was seen within the tissue of both the pot worms and nematodes but was only observed in the PEG group of the earthworm group. As nanomaterials are released in to the soil environment they exhibit a high mobility within pore water, this mobility is dependent on the functional groups of the nanomaterials release. Soil nematodes show the highest ecotoxicological response compared to earthworms and pot worms and should be used as an indicator species for nanomaterial release.

MO401

Assessment of the differential effects of transformation on the toxicity of nanomaterials with different size and coating properties to soil bacteria and the nematode Caenorhabditis elegans

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Much of the work conducted to-date in nanotoxicology has focused on understanding the toxicity of as-produced nanomaterials. However, environmental fate studies have shown that nanomaterials are frequently transformed in waste streams and natural systems, and that such transformation can modify toxicity. The aim of this study was to understand changes in absolute and relative toxicity of nanomaterials with different starting characteristics; In particular how environmental transformation of nanomaterials changes toxic responses of soil microorganisms. The study has assessed the potential toxicity of the selected nanomaterials on the nematode Caenorhabditis elegans was also assessed. Investigated were 4 types of silver (25 and 50 nm, uncoupled and PVP), 5 types of polystyrene (50 nm unfunctionalised, amine (+charge), carboxyl coated (-charge) and 100nm, 300nm unfunctionalised), 4 types of TiO2 nanoparticles (uncoupled, PVP, F127, Pleuronic coatings, under dark and light conditions). Initial tests identified effects of particle properties for each core material. Size was found to have the greatest impact on Ag nanoparticle toxicity, whereas surface charge altered polystyrene toxicity the most. In TiO2 nanoparticle exposures uncoupled and F127-coated nanoparticles showed the greatest differences in toxicity under dark and light conditions. Thus differences in the toxic effects of the pristine materials were established, although their ranking was not conserved between the species. Studies with chemically transformed or environmentally aged nanomaterials are currently under way to assess whether these differences persist after the silver nanoparticles are sulphydridised and the polystyrene and TiO2 nanoparticles are aged in sewage treatment plant effluent.

MO403

Short-term induced molecular stress responses in coelomocytes of Eisenia fetida earthworms in vivo exposed to silver nanoparticles

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In recent years the production of nanomaterials (NPs) has increased massively. The subsequent release of NPs into the environment has raised concerns to assess and identify the potential ecological impact in soil, water and air. Silver nanoparticles (Ag-NPs) have the highest degree of commercialization due to their high thermal and electric conductivity, high catalytic productive, and potential antimicrobial properties. Eisenia fetida is a model specie in soil toxicity studies and has been broadly used due to its sensitivity to different toxicants at different levels of biological organization. The main aim of the present investigation was to understand the effects produced by AgNPs (5.08±2.12 nm sized and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO3) at molecular level in coelomocytes of E. fetida at different exposure times. E. fetida were in vivo exposed to different concentrations of Ag-NPs and AgNO3 (0.05 and 50 mg Ag/kg soil) through OECD artificial soil for 1, 3 and 14 d. Then, the transcription levels of selected genes associated to oxidative stress (Catalse) and metal detoxification (MTs-metallothionines) were determined in coelomocytes extruded from exposed earthworms. In addition, the enzymatic activity (Catalse) and protein content (MTs) were quantified. The results varied significantly among days, exposure concentration and Ag form. Exposure to Ag-NPs led to
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO₃ induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTs at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in 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, pharmaceutics, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂ NPs) are used for cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂ NPs) are used in diesel fuels as a combustion catalyst, and as chemical-mechanical planarization 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 (0)), diethylaminoethyldextran to confer a positive charge (DEAE-CeO₂ (+)) and carboxymethyl dextran to confer a 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 transcriptions levels of genes associated with stress (catalase and heat shock protein 70) were determined by q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DEAE-CeO₂ (+) were more toxic 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**

A. Green Etxabe, CEH Wallingford; C. Schultz, Centre for Ecology and Hydrology; D. Tarnowska, M. Matzke, NERC Centre for Ecology and Hydrology; D. Spurgeon, Centre for Ecology & Hydrology; C. Svendsen, CEH, Wallingford / Photographer at the University of Siena / 300K and ASTM supplementary materials (NMs) used in commercial applications are likely to enter the wastewater stream and reach wastewater treatment plants. In many countries, wastewater effluent and sewage sludge are discharged in aquatic environments or applied on agricultural land, however, the transformation of the particles and the potential bioavailability of the aged forms is poorly understood. Recent studies have shown high association of NMs with sewage sludge, therefore soils can be a sink for NM pollution making terrestrial organisms vulnerable. The main aim of the study is to understand the transformation of NMs during wastewater treatment processes and to evaluate the potential environmental hazard of aged particles compared to pristine ones. In this study, coelomocytes (primary immune cells) isolated from the epigeic earthworm *Dendrobaena veneta* are used as a model to assess the effects of Ag and TiO₂ NPs. Initial investigations focus on Ag (PVP coated, 25 nm, nanoComposix) and TiO₂ particles (uncoated anatase, nominal primary size of 5 nm, NM-101, JRC) and their mixture, to better understand their uptake, interaction with coelomocytes and subsequent cellular effects. Moreover, a lab-scale wastewater treatment system is used to study the transformation of Ag and TiO₂ NPs through biological wastewater treatment processes, and the potential effects of the aged particles through biosolids application is evaluated. Extensive characterization of the particles in exposure media is performed with dynamic light scattering (DLS), single particle-Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM), while markers of cellular stress (LDH, ICP-MS and TEM) are performed on the sludge containing Ag and TiO₂ NPs. The effects of the pristine and aged particles on the metabolic activity, lysosomal integrity, reactive oxygen species formation, immune response and coelomocyte population are assessed. Moreover, nanoparticle uptake and intracellular localisation are evaluated with TEM and sp-ICP-MS.

**TM407**

**Differential biomarker responses of Daphnia magna to pristine and wastewater borne silver nanoparticles**

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The growing use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs on bioassays, short-term tests with *Daphnia magna*, including intraspecies effects on the species, growth 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 acetylcysteinolipase (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 compared to ASTM control, 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 at 125 µg/L in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unexpectedly, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersant agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviour in standardized 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.

**MO408**

**Outlining the behaviour and ecotoxicology of biomedical nanoparticles in non-target organisms**

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The growing use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs on bioassays, short-term tests with *Daphnia magna*, including intraspecies effects on the species, growth 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 acetylcysteinolipase (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 compared to ASTM control, 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 at 125 µg/L in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unexpectedly, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersant agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviour in standardized 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
Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidentally. To date there is no shortage of studies concerning the environmental fate and ecotoxicity of widely used NPs, such as titanium and silver oxides. However, much less is known about NPs employed in novel cutting-edge applications as nanomedicine. In this study, we investigated five biomedical NPs, namely aminated polystyrene (PSNH2), europium-doped-cerium oxide (CeO2@Eu), carbon dot-doped silica (SiC@C), and polyethylene glycol-functionalized silica (SiO2B-SiO2PEG, respectively), and we assessed their behaviour and biological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic sizes were monitored for 30 days by dynamic light scattering (DLS) and showed remarkable differences in NRW compared to NSW of both bare and PEGylated SiO2 NPs. In fact, SiO2 NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PSNH2, CeO2@Eu and SiC@C NPs did not show such a clear distinction between the two natural media, reaching micrometric sizes after 24 h. In order to address sedimentation phenomena, normalized derived count rates (DCR) were used to estimate the fraction of suspended NPs in the both media. SiO2B and SiO2PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH2, CeO2@Eu and SiC@C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrofluorometric assays. SiO2-based NPs bioaccumulation studies were examined based on the aquatic test species Daphnia magna, which were employed with transmission electron microscopy (TEM) imaging, while PSNH2 maintained an intact structure in NRW and NSW. Finally, algal growth inhibition tests were performed using freshwater and marine microalgae (OECD, 1994). PSNH2 and CeO2@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NP types did not show any sign of toxicity. A significant (p < 0.05) reduction in PSNH2 and CeO2@Eu NP toxicity was observed repeating the tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

MO409 Development of a method for the analysis of nanoparticles in the freshwater clam Corbicula fluminea


Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidentally. To date there is no shortage of studies concerning the environmental fate and ecotoxicity of widely used NPs, such as titanium and silver oxides. However, much less is known about NPs employed in novel cutting-edge applications as nanomedicine. In this study, we investigated five biomedical NPs, namely aminated polystyrene (PSNH2), europium-doped-cerium oxide (CeO2@Eu), carbon dot-doped silica (SiC@C), and polyethylene glycol-functionalized silica (SiO2B-SiO2PEG, respectively), and we assessed their behaviour and biological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic sizes were monitored for 30 days by dynamic light scattering (DLS) and showed remarkable differences in NRW compared to NSW of both bare and PEGylated SiO2 NPs. In fact, SiO2 NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PSNH2, CeO2@Eu and SiC@C NPs did not show such a clear distinction between the two natural media, reaching micrometric sizes after 24 h. In order to address sedimentation phenomena, normalized derived count rates (DCR) were used to estimate the fraction of suspended NPs in the both media. SiO2B and SiO2PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH2, CeO2@Eu and SiC@C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrofluorometric assays. SiO2-based NPs bioaccumulation studies were examined based on the aquatic test species Daphnia magna, which were employed with transmission electron microscopy (TEM) imaging, while PSNH2 maintained an intact structure in NRW and NSW. Finally, algal growth inhibition tests were performed using freshwater and marine microalgae (OECD, 1994). PSNH2 and CeO2@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NP types did not show any sign of toxicity. A significant (p < 0.05) reduction in PSNH2 and CeO2@Eu NP toxicity was observed repeating the tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

MO410 The ecotoxicity of a marketed nanosilver product - a direct comparison with ionic silver


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 nanoforms. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoform with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken considering the effects of this silver nanoform with silver nitrate using the following internationally standard aquatic 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 nanoform was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, ‘conventional’ dissolved silver (0.45 µm membrane filtered) and ‘truly’ dissolved silver (3 kDa centrifugation filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetrical Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoform only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rate via ingestion test of particulate Ag and submicron nanoparticles 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.

MO411 Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca

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Test nanostructures (NMs) under environmentally relevant conditions is an important aspect regarding the risk assessment of nanomaterials that enter the water cycle. If the fact, that sewage treatment plants (STPs) are the main point of entry of NMs into the aquatic environment we developed a coupled test system using the effluents of model STPs in a chronic exposure test with the epibenthic amphipod Hyalella azteca, which is commonly used for ecotoxicity studies. Previous studies with this test system showed that silver (Ag) from silver NMs is accumulated by H. azteca exposed to model STP effluents. However, the pathway of Ag accumulation, via ingestion or direct contact to the test item in test environment, of dissolved ionic silver is still unknown. To further elucidate the uptake pathway of silver from model STP effluent, two groups of H. azteca with five animals each were placed in a single test vessel. The two groups were separated by a stainless-steel strainer. One group was fed contaminated sludge from model STPs, loaded on glass fibre filters. The second group, located in the stainless-steel strainer, was fed uncontaminated control STP sludge. Both groups had no direct contact to the test item containing dissolved Ag NMs. The study was carried out with five replicated test trials with two groups of amphipods each. Water samples were taken within the strainers to measure the silver content in the media and to prove that the animals fed control sludge were not in contact with Ag NMs potentially released from the contaminated sludge. After an exposure period of 7 (21) days Ag content of the water and animal samples collected at the end of the exposure period was measured by ICP-MS or ICP-OES to determine the accumulation of Ag in both groups. The presence of NMs in the animals was examined by high-resolution transmission electron microscopy (TEM) and methods of correlative microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved ionic Ag to the accumulation of Ag from STP effluent.

MO412 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyporheic copepods as a function of their bioavailability by dissolved organic matter (DOM) and water hardness of environmental samples

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The development and product cycle. Due to the fact, that sewage treatment plants (STPs) are th...
liquid effluents 0.03 - 6.74 and 0.003 - 0.026 g/L, for Si and Ag NPs respectively. Environmental exposure models have shown that soils and sediments can provide important reservoirs of these nanomaterials, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are ones of the substances capable of interacting with ENPs. To understand and assess the effects of NPs on the environment, should be well established quantitatively the concentration–response relationships. Also, to know the role of other components in regulating their 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 *Metacyclops gracilis* 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 SnNPs, DOM and water hardness quantitative relationships were negatively correlated with ecotoxicity on this freshwater invertebrate.

**MO413** Long-term exposure of ZnO nanoparticles to freshwater microalgae cultivated in batch and semi-continuous mode A.F. Aravantinos, F. Andreou, I. Manariotis, University of Patras / Civil Engineering Nanoparticles (NPs) have always existed in the physical environment. The rapid development of commercial applications involving the use of a large variety of synthetic nanoparticles has resulted in the introduction of higher amounts of nanoparticles in the environment. As the use of NPs increases, their effect to the coastal food chain and ecosystems is crucial. The aim of this work was to investigate the toxic effect of zinc oxide (ZnO) NPs on freshwater microalgae in batch and semi-continuous feeding mode for longer period than the time used in typical toxicity tests. *Scenedesmus rubescens* was selected as model microorganism since it is a common freshwater microalgae. *S. rubescens* exposed to ZnO NPs concentrations varying from 0.081 to 810 mg/L for 28 days in batch mode conditions, while in semi-continuous mode it was exposed to 0.081mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effects of ZnO NPs on the growth of *S. rubescens* was assessed by monitoring of growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of *S. rubescens* was greater in the presence of ZnO NPs, and the lipid content was higher.

**MO414** Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms s. schiavo, ENEA CR; M. Oliviero, University Parthenope; A. Philippe, Universität Koblenz-Landau / Institute for Environmental Sciences Group of Environmental and Soil Chemistry; s. manzo, ENEA / SSPT-PROTER-BES Sunscreens represent one of the main source of engineeredTiO2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of NPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae (*Pseudokirchneriella subcapitata; Dunaliella tertiolecta*) and crustaceans (*Daphnia magna*). *D. magna* is a microalgae growth indicator for 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.

**MO415** Silver nanoparticles affect the early development of Tisbe battagliai: pristine vs aged particles A. Georgantzopoulou, Norwegian Institute for Water Research IV; K.J. Farkas, SINTEF Environmental Technology; K. Membrez, Norwegian Institute for Water Research; P.A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SEFS Ocean Technology / University of Kent; K. Halse, SINTEF Materials and Chemistry In this study the harpacticoid copepod *Tisbe battagliai* was selected as a relevant marine species and the effects on the naupliar development was assessed over an exposure period of 6 days. The mortality and the developmental stage of the organisms was assessed daily. Initial investigations focus on the study of Ag (Ag NP coated in 5 nmcocomposiX) 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 by 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 seawater. To evaluate the uptake, bioaccumulation and developmental effects of pristine and transformed particles on the marine organism *Tisbe battagliai*. This study aims to evaluate the effect of ENPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae (*Scenedesmus rubescens* was selected as model microorganism since it is a common freshwater microalgae. *S. rubescens* exposed to ZnO NPs concentrations varying from 0.081 to 810 mg/L for 28 days in batch mode conditions, while in semi-continuous mode it was exposed to 0.081mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effects of ZnO NPs on the growth of *S. rubescens* was assessed by monitoring of growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of *S. rubescens* was greater in the presence of ZnO NPs, and the lipid content was higher.

**MO416** Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanoparticles and silver chloride M. Vannucci-Silva, UNICAMP / Institute of Biology; S. Cadore, University of Campinas; G. Ubimuzeso, School of Technology, UNICAMP / LAEG The relatively recent development of engineered Ag nanoparticles has expanded significantly 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 into formulated fish feed (4% Ag NP). The amphipods *Parhyale hawaiensis* (8 months) were placed individually into a plastic container (100 mL of reconstituted saline water) and fed on alternate days with control, AgNP, or AgCl amended feed pellets. After 1 hour of feeding, each organism was washed and placed into a new plastic container with clean salt water to ensure that the exposure was only via food. The amphipods were exposed during 7, 14 and 28 days. After exposure, the haemolymph was collected using a thin glass capillary, weighed and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a Graphite Furnace Atomic Absorption Spectrometer (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feeding, reaching 8.4±0.7 ng g\-1 in comparison to 3.7±1.0 ng g\-1 for AgCl at the longest exposure time. The increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable than *P. hawaiensis* as AgNP than when it is in its salt form. Data strongly suggest that nanoparticles were uptaken by the gut and distributed in the
The use of carbon nanoparticles (CNMs) has increased rapidly in the last years, namely due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmacokinetics. Currently, carbon nanotubes (CNTs) are one of the most important and commercially used CNMs. CNTs are hollow graphene cylinders that are microns to millimeters in length and can be divided in single-walled (SWCNTs) with a diameter of 0.7 to 3 nm, and multi-walled (MWCNTs) with a diameter of 10 to 25 nm. CNTs are engineered with a wide variety of core structures and surface functionalizations that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available 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. Thus, in this study, we investigated the following: (i) exposure (28 days) to two carbonaceous CNMs (MWCNTs, HiPco SWCNTs) and (ii) 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. Alternations induced in clams’ oxidative status, neurotoxicity and metabolic capacity were performed. The results obtained clearly showing that both HiPco-MWCNTs and HiPco-SWCNTs 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 SWCNTs (Nam et al., 2012). We found that MWCNTs were able to induce slight IL-6 release at 100 µg/ml, NM203 induced also IL-6 release at 100 µg/ml of selected NMs to evaluate: cytotoxicity (trypan blue exclusion), genotoxicity and proinflammatory effects (IL-6 induction at 100 µg/ml and oxidative DNA damage at low concentrations. NM100 induced slight IL-8 release at 100 µg/ml, NM203 induced also IL-6 release at 10 and particularly at 100 µg/ml (262.2 fold of control). Both TiO2-NPs induced slight IL-8 release at 100 µg/ml but only NM101 induced significant IL-6 induction at 100 µg/ml. The findings show higher genotoxic/oxidative and inflammatory effects for NM203 in respect to NM200, probably due to its higher surface reactivity determining a strong interaction with the proteins in the medium and higher protein-mediated cell interaction. The findings also show DNA damage for both TiO2-NPs and oxidative DNA damage for NM101, correlated with the proinflammatory IL-6 cytokine induction, probably due to its smaller size, higher agglomeration tendency and capacity to induce ROS. This study is partially financed by FP7-NANoREG project, Grant n. 310584.
the sediment and lack of dissolution (< 1% of spiked cerium was extractable with water). Transdermal uptake of AgNP was attributed to dissolved silver in the pore waters and uptake of soluble silver, potentially through localised dissolution of particles at the worms’ surface.

MO421 Evaluating the role of TiO2 nanoparticle surface transformations on transport and toxicity
A.R. Deline, Oregon State University / Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering
Titanium dioxide nanoparticles (TiO2 NPs) have great potential for use in a variety of commercial and environmental applications, including the photocatalytic treatment of contaminants. While processes like microbial inactivation and the generation of reactive oxygen species (ROS) have been studied under a variety of irradiation and water chemistry conditions, there exists limited mechanistic insight as to how these processes are related to the molecular-level surface transformations that may occur under different environmental conditions. This study is using surface-sensitive characterization techniques, including x-ray photoelectron spectroscopy (XPS), to examine the impact of UV irradiation, temperature, and water chemistry exposures on the metal oxide surfaces of both pure anatase and mixed anatase-rutile TiO2 NPs. Initial XPS studies of the impact of simulated solar irradiation revealed that solar irradiation resulted in a decrease in the aliphatic carbon present on the TiO2 surface and an increase in the oxygen-bonded carbon, with no observable effect on the oxidative properties of the metal oxide. Additional studies will examine surface-chalcophile elements that form bonds to C and O. To this date, our Fresnel lens to increase the irradiation intensity and solution temperature. The relationships between these molecular-level surface properties and the extrinsic properties of the TiO2 NPs are being further explored using a suite of functional assays. Assays that have been optimized for the characterization of TiO2 NPs in this study include methylene blue dye degradation (photocatalytic activity), rose bengal dye photolysis (photodegradation), and fluorescein dye conversion (ROS generation). Ultimately, changes in the properties of the TiO2 NPs will be compared to larger scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

MO422 Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles
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Organic compounds released to the environment have the potential to affect the properties of nanomaterials (ENM) and 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 waterborne nanoparticles. We conducted in-solution buffered to pH 8 at concentrations of 1.3 mM CuO and 4 mg L\(^{-1}\) CuO, and the initial concentrations of 10, 100 and 1000 mg L\(^{-1}\). Reacted CuO NP were collected at selected time points and characterized using Cu K-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 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 aqueous environment both the reaction kinetics and the reaction pathway of the CuO sulfidation. In real municipal wastewater, however, lower protein concentrations and thus a complete sulfidation of the CuO NP 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 nanometrology, 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 integration of spICP-TOF-MS (spICP-TOF-MS) with the ability to overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 46μsec, covering nearly the entire atomic mass range (7-250 m/z). By examining differences in the chemical composition on a particle-by-particle basis, NNPs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique, we applied it to ten bioaerosol samples, seven 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 quadrupole ICP-MS and an ICP-TOF-MS, and using 3ms and 100μs dwell times on both instruments. Particles analyzed consisted of mixtures of well-defined AuAg core-shell NPs with Au and Ag only NPs, polydisperse ceramic NPs with well-defined chemical compositions, and environmentally relevant colloidal suspensions containing ENPs. These systems were used as test systems for both single-element and multi-element monitoring, and the TOF-MS technique demonstrated 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 (incl. 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. Depletion studies indicate a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

MO425 SETAC Nanotechnology Interest Group
C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology
Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)

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SETAC Europe 28th Annual Meeting Abstract Book
MO426
Effect of ageing on polycyclic aromatic hydrocarbon composition of biochar
G. Siegmund, Technische Universität München / Chair of Analytical Chemistry and Water Chemistry; T. Bucheli, Agroscope ART / Environmental Analytics; I. Hilber, Agroscope / Environmental Analytics; T. Hüffer, M. Kah, T. Hofmann, University of Vienna / Department of Environmental Geosciences
The influence of ageing on biochar properties has been investigated by comparing three biochars. Two biochars were additionally aged 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 ng/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 these biochars are not a source of releasable 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 passive samplers have to be used in kinetic mode and sampler calibration is unavoidable. Most commonly, exchange kinetics are derived from the release rates of performance reference compounds (PRCs) spiked into the sampler prior to usage. Unfortunately, PRCs can be expensive and are not always available for all compounds. Due to these challenges, a complementary calibration approach using passive samplers of different thicknesses has been developed and investigated in lab and field. This study describes the testing of the approach in situ 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 three 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 insecticidal properties. HCHs' toxic, carcinogenic, teratogenic and neurotoxic effects have been reported in humans; and the HCHs have a clear tendency to accumulate in the environment. For these reasons, HCHs are contaminants of worldwide concern. Recently, remediation of soils that are heavily contaminated is mandatory. Various remediation techniques have been used to remove HCHs in aqueous solution, among these, adsorption is the most common used one. Biochar (BC) is a carbonaceous material that is a promising sorbent amendment material due to its high adsorption of organic and inorganic contaminants, and to its low cost. In this study three standard biochars, from digestate (BCα), from greenhouse tomato waste (BCβ), and from durian shell (BCδ), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 m2 g−1), pore volume (5.1 - 186.6 cm3 g−1), pore dimension (1.05 - 5.85 Å), pyrolysis temperature (400 – 700 °C) and surface properties (including iron content). Batch isotherm tests were carried out in deionized water with the same isolers and the mixture of α-, β-, γ- and δ-HCH. The HCH concentration was ranged between 1 and 500 μg L−1 in the monocomponent isomers and between 5 and 2000 μg L−1 (total concentration) in the mixture isomers. Polyethylene (PE, 26 mm in diameter, 0.3 ± 0.05 m in thickness) was used as a passive sampler for assessing the HCHs concentration in water. The sorption performance of the biochars is related to their physicochemical properties. Preliminary results have shown the adsorption performances are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429
Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers
M. Renningen, RWTH Aachen / Biog; T. Parkerton, ExxomMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Engineering
Frequently, the total PAH sediment concentration reported for a sample is 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 (NARC) of PAHs is not recommendable for evaluating risks from sediment-associated contaminants, which are most often alkylated PAHs. The concentrations of dissolved PAHs in sediments express organic carbon normalized concentrations (Corg) for evaluating risks to benthic organisms based on the calculated magnitude of PAH toxic units (TU) (Hawthorne et al., 2006). However, due to the heterogeneous nature of organic carbon in field sediments, potential risks of adverse biological effects from sediment-associated contaminants are most often assessed by bioaccessible PAH concentrations (Cba) in sediment pore water, not to Corg. Recent advances in equilibrium passive sampling methods (EPSMs) offer a promising alternative to the measurement of Corg and support improved risk-based decision making since bioavailability of sediment contaminants can be directly quantified via Cba (Mayer et al., 2015; Burkhard et al., 2017). When using EPSMs, polymer to water partition coefficients are crucial for reliable calculation of Cba. To date partitioning coefficients are available for parent PAHs across different polymers (e.g. PDMS, POM) (Lydy et al., 2015). In this study, an equilibrium passive sampling method 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 polymers (PDMS coated glass fibers and hollow fibers). Partitioning coefficients for the PDMS coated fibers (KPDMS) were calculated for selected target alkylated PAHs which have previously not been available. KPDMS for additional alkylated PAHs of interest were then predicted based on the experimentally reported KPDMS 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 Cba 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
A.R. Taylor, University of California Riverside / Environmental Sciences; J. Wang, University of California Riverside; D. Schlenk, J. Gan, University of California, Riverside / Department of Environmental Sciences
Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminate soils and sediments all over the world. As they are hydrophobic in nature, these compounds are resistant to both chemical and physical degradation while also having a strong affinity for soil or sediment particles and organic matter. Often, this contamination is due to the historic or current use and manufacturing of these compounds, such as the widespread contamination of the Palos Verdes Shelf by DDTs and PCBs, which continue to pose health hazards to occupational and human health from these contaminants. Current use pesticides, such as fipronil and pyrethroids, have also been detected in sediment from the shelf during preliminary experiments, indicating that these contaminants may have been deposited onto the shelf via urban waterways. In this study, we assessed the spatial distribution of current-use insecticides pyrethroids and fipronil in the top 2 cm of sediment on the Palos Verdes Shelf Superfund Site. Concentrations of total pyrethroids (Pyrethroids = sum of bifenthrin, fenpropathrin, permethrin, and λ-cyhalothrin), lambdacyhalothrin, cyfluthrin, cypertymethrin, and cis-permethrin) ranged from n.d. to 170.15 ng/g and total fipronil (Fipronil + fipronil desulfenyl, fipronil sulfide, fipronil, fipronil sulfone) ranged from n.d. to 5.59 ng/g. On-going research also aims to understand the spatial distribution of legacy HOCs (PBDEs, DDTs, PCBs) in the shelf area 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.
MO431 PAHs in water and surface sediments from Douro River estuary and Porto Atlantic coast (Iberian Peninsula, North Portugal) — Risks for biota and human health? M. Joio Rocha, ICBAS – U.Porto, CINMAR – CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CINMAR – CIMAR LA, Porto, CEF FCTUC U.Coinhbra; E. Rocha, ICBAS – U.Porto, CINMAR – CIMAR LA The present study shows the occurrence of 16 priority pollutants (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seacoast. These areas bath Porto and Gaia cities, widely known by the production/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography–mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (Σ16PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/g dry weight for suspended fraction and ≈ 32 μg/g for dissolved fraction. 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 INNOVAMAR – Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0145-FEDER-000305), 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 Medicine and Biomedical Sciences and × Science and Technology Centre; M. Kingwell, Orebro University / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites, and occur as complex mixtures of thousands of PAHs and heterocyclic compounds (NSO-PACs) among others, collectively referred to as polycyclic aromatic compounds (PACs). The contaminant composition differ widely due to contamination sources, impacting public health and the environment. 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. AhR agonists in concentrations that were considered to be non-toxic were also measured. In addition, in soil concentrations of PACs in all soils, indicating low availability of the compounds in soils. The leachable fraction was generally greater for more hydrophilic PACs, such as more polar PACs composed of two or three rings. Contribution of the analyzed PACs to the overall AhR-mediated activities detected in soils, 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 Y. Verhaegen, CONCAWE; C. Hughes, Shell Health / Risk Science Team; L. Candidoni, ExxonMobil; M. Ward, Shell Global Product Stewardship; C. A.D. Redman, ExxonMobil Biomedical Sciences / Toxicology and Environment Science Division; M. Comber, Mike Comber Consulting; S.A. Villalobos, BP / Global Product Stewardship; V. Ochoa, Cepsa; S. Linington, BP; E. Vaiopoulou, European Petroleum Products Association Petroleum substances are examples of UVCBs (substances of Unknown or Very Limited Data) and commonly used biocides or Biocidal Products (BiP) and their chemical composition will vary depending on, amongst other things, the source of crude oil, the refinery processing and climate conditions. These substances present additional challenges when conducting environmental hazard and risk assessments under regulatory schemes such as REACH, and Concawe has developed bespoke models for these purposes. However, for purposes of hazard classification and labelling there is still a need for experimental aquatic toxicity test data on petroleum substances. Concawe substances have been organised into categories, based on similarities in refinery processes and physicochemical properties, resulting in a clustering of comparable chemical compositions and related hazard profiles. Applying read-across within a category is an established concept to fill in data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data for Concawe substances using a worst-case approach. ECHA recently released its Read-Across Assessment Framework (RAAF) for environmental endpoints, however the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hyrocracked gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted ELS0 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (SPME)–screening studies. The latter is a technique which measures bioavailable hydrocarbons and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a 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 C. Vitale, University of Insurbia; K. Knudsmark Sjholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; A. Di Guardo, University of Insurbia / Department of Science and High Technology; P. Mayer, Technical University of Denmark / Department of Environmental Engineering 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) 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.
chemicals within the logKow range of 4.4-8.6 will be included in the study, and results from both methods will be compared.

MO437 Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals

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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 alcanes 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-tridecane 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 response CONCAWE has initiated a comprehensive analytical program to extend analytical characterization of petroleum substances to further support hazard classification within and across petroleum substance categories. As part of this work, SPME and toxicity data for newly characterized substances (n=139), across approximately 10 major categories, were compared to historical data. New compositional data were used as input to PETROTOX to predict acute toxicity. In this study, the extr.

MO440 Bioaccumulation factors of synthetic musks and other hydrophobic contaminants in mangrove molluscs.

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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 molluscs. In the present study, bioaccumulation factors (BAFsw, wet weights) were calculated for all the samples/sites and log BAFsw averaged 4.0±0.3, 4.4±0.3, 4.7±0.3, 3. 9.6±0.7 and 4.3±0.4 for galaxolide, traseolide, phantolide, celestolide and tonalide respectively. Overall, the empirical models fit reasonably well the bioaccumulation of polycyclic musks in both caged and native molluscs in tropical mangroves. The study of the bioavailability of hydrophobic compounds in highly dynamic environments such as mangroves can be sometimes intricate, and the usefulness of passive samplers and sentinel species such as bivalves was confirmed in the present study.

MO440 Effect-based characterization of mixtures of environmental pollutants in sediments collected between the Arctic and Australia

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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 sorbed and retained in sediments. Hydrophobic organic substances can be degradable, with a slow degradation rate. The study of the presence of historic and emerging substances within the logKow range of 4.3-5.4 was an integral part of the project. The present work shows the existence of significant interactions between the substances investigated.

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 bioaccumulation (uptake + assimilation). This study builds on the previously established structure-activity relationship of HOCs transfer in aquatic food webs, across trophic levels and between environmental compartments (sediment, water, biota). The proposed approach is based on the use of ratios in chemical activity as a metric for bioaccumulation assessment. The proposed approach represents a major advance relative to the traditional ones, since it aims at expressing the data on a common basis to enable direct comparison among compartments. Passive Sampling Devices (PSD) have been developed and are currently used as simple and easy-to-use analytical tool for measuring chemical activity. PSDs have been used to explore the potential of bioaccumulation 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 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 persistently 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 more complex ones (Polyyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants were 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 (surface water 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. Phthalates 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 exposure in the Marn hydrographic network. Surprisingly, chubs infected by the achatinocephalan monogenean Notomochus laevis were not severely affected. For the study of UV stabilizer contaminations, marine biota 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 and 30 UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous other compounds are currently listed under the European community rolling action plan (CoRAP) to be re-evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data from coastal and marine ecosystems were utmost important. In the study of contaminations in sediment samples of the North and Baltic Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as following: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, DIONEX, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 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 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced in volume to 150 μL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple 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). Total Organic Carbon (TOC) analysis was carried out with aliquots of the freeze-dried samples using a LECO RC612 multiphase (Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the North and Baltic Seas for the first time. Several substances have been identified in concentrations in the low ng/g dw range.

**MO446**

Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish)

M. Peroni, University of Insinia (Como) / DiSTA; A. Buffo, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; R. Perna, University of Insinia; S. Polesello, Water Research Institute- CNR / Water Research Institute; S. Valsecchi, Water Research Institute - Italian National Research Council IRSA-CNR; R. Bettinetti, University of Insinia / DiSTA Lake Como, a subalpine lake (Northern Italy), is an oligomictic lake, with complete water mixing occurring after particularly windy and cold winters. It presents a typical shape of an upside “Y” where a western, eastern and northern basin can be identified. In more detail, the western branch is distinctly separated from the rest of the lake by an underwater ridge, where the highest depth is measured (425 m at

**MO443**

Real-time visualization and quantification of perylene bioaccumulation at single cell level

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Hydrophobic organic chemicals (HOCs) are of special ecotoxicological concern because they can be directly incorporated and bio-concentrated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and toxicity are still considered unknown. The current use of perylene (PER), a single-molecule fluorescence microscopy (SMFM) with a microfluidic flow chamber and temperature control has enabled us to record the dynamic process of perylene bioaccumulation in single bacterial cells and examine the cell-to-cell heterogeneity. Although with identical genomes, individual E. coli cells exhibited a high degree of heterogeneity in perylene accumulation dynamics, as shown by the high coefficient of variation (C.V=1.40). This remarkable heterogeneity was exhibited only in live E. coli cells. However, the bioaccumulation of perylene in live and dead S. aureus cells showed similar patterns with a low degree of heterogeneity (C.V=0.36). We found that the efflux systems associated with Tol C played an essential role in perylene bioaccumulation in E. coli, which caused a significantly lower accumulation and a high cell-to-cell heterogeneity. In comparison with E. coli, the Gram-positive bacteria S. aureus lacked an efficient efflux system against perylene. Therefore, perylene bioaccumulation in S. aureus was simply a passive diffusion process across the cell membrane. With the use of SMFM, the motion and distribution of perylene nano-clusters (PNCs) formed in water at very low concentration were visualized with high temporal and spatial resolution. Moreover, the transport of PNCs across the cell membrane was also real-time captured, demonstrating that the efflux systems in E. coli were endocytosis. Supplemneting the well-recognized routine of passive diffusion through membrane lipid bilayer, the uptake of HOCs in the form of nano-clusters by endocytosis was proposed to be an additional but important mechanism for their uptake into living cells. HOCs distributing in the environmental systems in the form of nano-clusters, as exemplified by PNCs in this study, may have significant implications for understanding their environmental fate and potential toxicological effects.

**MO442**

Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malapage in the northern Gulf of Mexico

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The blue crab, Callinectes sapidus, is an ecologically and economically important invertebrate species in the northern Gulf of Mexico (NGOM). The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab malapage collected over three years from multiple estuaries in the NGOM from Texas to Florida were tested for alkylphenol contamination using GC/MS. We found alkylphenols to occur in 100% of blue crab collected with 4-tert-butylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tert-butyphenol (DTBP). NP is an alkylphenol known to impair endocrine function and concentrations detected in malapage in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the U.S. Environmental Protection Agency. BHT is a common preservative in food, pharmaceuticals, and cosmetics and is considered safe. DTBP, butylated hydroxytoluene (BHT), and 2,4-di-tert-butylphenol (DTBP), nonylphenol (NP), and phthalates. 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

C. Apel, Helmholtz-Zentrum Geesthacht; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry

Organic UV stabilizers are of emerging environmental concern due to their large production volumes and ubiquitous occurrence in the marine environment. They 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 and 30 UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous other compounds are currently listed under the European community rolling action plan (CoRAP) to be re-evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data from coastal and marine ecosystems were utmost important. In the study of contaminations in sediment samples of the North and Baltic Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as following: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, DIONEX, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 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 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced in volume to 150 μL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple 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). Total Organic Carbon (TOC) analysis was carried out with aliquots of the freeze-dried samples using a LECO RC612 multiphase (Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the North and Baltic Seas for the first time. Several substances have been identified in concentrations in the low ng/g dw range.
MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain

E. Ko, National Museum of Marine Biology and Aquarium/ National Dong Hwa University / Institute of Marine Biology; C. Chu, National Dong-Hwa University / Institute of Marine Biology

Bioaccumulation and distribution of polycyclic aromatic hydrocarbons (PAHs) over different amounts of exposure time were investigated in the plankton food chain including phytoplankton and zooplankton. The simulated plankton food chain was using phytoplankton (Tetraselmis chuii), rotifers (Brachionus sp.), and copepods (Amphiprion spinosus) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-24 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-24 hour time intervals, then approached study-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared to higher molecular weight PAHs (FA and PY) that 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 ($K_w$) in plankton, however the different linear regression slopes of log BCF and log $K_w$ 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 fate. The study investigates if MWCNTs can be used as a suitable tool to study the potential sink for carbon-based nanomaterials. Nevertheless, during their stopover in the water phase they may interact with water dissolved xenobiotics, and thus alter the fate of these substances. Due to the lack of information on the influence of MWCNT on organic chemicals in aquatic ecosystems, proactive research is needed to estimate potential risks, especially for sediment-dwelling organisms as a part of the 'Trojan Horse' effect. In the present study MWCNT were irradiated by simulated sunlight (300-400 nm) for 90 days. The weathered MWCNT (wMWCNT) were used to investigate their influence on fate and distribution of the biocide triclocarban (TCC) in a sediment-water system. This substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in natural water. 100 µg and 1000 µg wMWCNT/L in Milli Q water led to an adsorption (log $K_{oc}$ in OECD medium: 7.6 L/kg) of 10% and 65% at 1°C-tissue respectively. We will report experiments on the distribution of TCC in water and sediments using wMWCNT spiked with 1 mg wMWCNT/L and subsequently incubated in a sediment-water system in the dark for 180 hours. A scenario with 1°C-tissue will only serve as control. TCC is expected to sorb onto the wMWCNTs 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 and 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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Final fate of substances in the environment are driven by numerous factors. Among them, substance’s properties such as Henry’s constant (i.e. water solubility and volatility) and hydrophobicity (in terms of $K_w$ and adsorption) have a non-negligible impact on how substance’s behaviour is modelled in the different compartments (soil, water, sediment, air), to predict exposure levels in risk assessments. Pharmaceuticals represent a specific category of substances as they are difficult to analyse and can lead to technical limitations for exposure and environmental assessment due to their relatively low volatility and the presence of multiple functional groups. Due to analytical difficulties, parameters such as water solubility and $K_w$ are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for $K_w$ 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 $K_w$ 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 setting 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

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Many aquatic ecosystems are under persistent stress due to influences of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the targeted chemical compounds are measured in their parent forms in environmental samples. However, in the case of highly hydrophobic compounds, their 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: Characterization of the matrix and 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), personal care products (PCPs), and others) can lead to adverse environmental impacts, such as influencing the fate and distribution of contaminants in environmental matrices. Thus, the development and optimization of analytical methods that can detect multiple classes of compounds at very low levels and the contamination assessment in marine and coastal areas are among the most complex and current issues in environmental chemistry. Possible adverse effects related to some groups of PCPs, such as potential to accumulate through the trophic food chain and in human adipose tissues, endocrine disruption and hazard to coral reef conservation...
have been recently detected. Consequently, their study has become a priority among the main bodies responsible for protecting public health and the environment, such as the European Commission and USEPA. However, the current knowledge about the occurrence and fate of PCPs is still scarce, especially in less developed or developing countries as Brazil. Thus, this study aims to evaluate the occurrence of PCPs in surface sediments of selected areas along the southern and southeastern Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained for surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyses (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EEMC) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction salients and clean-up procedures to improve the detection and quantification of these compounds. The final results of this work will provide the first extensive dataset on the occurrence, levels and fate of PCPs in the Southern Atlantic which will not only contribute with new and rather scarce data but also with valuable information for regional and global inventories.

MO453 IFRA Environmental Standards and RIFM Safety Assessment Program Advances Update for 2018

A. Lapačynski, RIFM / Environmental Science; D. T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; C. Gonzalez, IFRA

To assure safety of fragrance ingredients in consumer products, International Fragrance Association (IFRA) has developed the fragrance industry's self-regulatory safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessments for these Standards are incorporated in the Research Institute for Fragrance Materials' (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and 2008 IFRA volume of use survey as reported for both Europe and North America. The Framework for this evaluation was published in Environment Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank materials for risk assessment refinement. In an effort to provide greater transparency to the IFRA Environmental Standards, RIFM reports the most recent results of these additional tests (for both risk and hazard assessments) at both the annual SETAC NA and Europe meetings. These studies include persistence testing (ready biodegradation tests and die-away studies), bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented.

MO454 Comparison of different sampling techniques for the identification fire effluents from low-density polyethylene burning

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Huge amounts of various polymers are being used in many fields with numerous benefits. However, their great ability to ignition and rapid flame spreading make these materials dangerous for human life and properties due to the release of highly toxic combustion products. The present work aims to investigate several methods of sampling and analysis of polycyclic aromatic hydrocarbons (PAHs) produced by controlled burning of low-density polyethylene (LDPE) using a toxicity tube furnace. Five different sampling methods were used: solid phase micro extraction (SPME), syringe, tellar 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 tellar bags and sorption tubes, they did not give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such as benzene, naphthalene, anthracene and pyrene.

MO455 PbTk modelling of super-hydrophobic chemicals

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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 uptake of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Ellsberry C, Perdu-Durand E, Demmerle S, Cravedi J-P, 2008. In vitro biotransformation of surfactants in fish. Part I: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakuratani Y, Noguchi Y, Kobayashi K, Yamada J, Nishihara T, 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J. Environ. Biol. 29:89—92. 3. Durr, Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.11: PBTV/PvB assessment Draft Version 3.0.European Chemicals Agency, Helsinki. https://echa.europa.eu/documents/10162/23047722/ie_csa_r11_pbt_pegs_en.pdf/20ac9031-da4a-4995-8eef-3738162ba048

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. Bernw, 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. Cronin, Wildfowl & Wetlands Trust

MO459 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions

M. Taggart, University of the Highlands and Islands / Environmental Research Institute

MO460 Main scientific gaps in knowledge of deliberate poisoning to [migratory] wildlife globally

M. Odins, Independent Environmental Services Professional

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

TU001 Holistic evaluation of long-term field effect earthworm studies with the fungicide Bosalcid

F. Saul, BASF SE; J. Roemmke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF SE; S. Braaker, 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 term field effect earthworm studies with the chronic methodology for screening, testing, and risk assessment. The homogeneity of the different endpoints measured in these studies and the challenge to establish a reliable prediction approach for long-term earthworm studies are major obstacles to this approach. In this study, a comprehensive database of long-term earthworm studies with the fungicide Bosalcid was used to investigate the contribution of earthworm data for risk assessment and to develop a holistic evaluation strategy for long-term earthworm studies.
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set using the biodiversity descriptor "total earthworm species" to estimate the species richness and diversity. Statistical analysis revealed that diversity was influenced by factors such as the type of crop, the type of soil, and the application rate of the chemical.

ECOTOX Knowledgebase: New tools for data visualization and database interoperability


The ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated database that contains toxicity data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX Knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemicals for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g., Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100+ fields. Study details such as species, taxonomic hierarchy, chemical priority, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the coding of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicological assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. These improvements will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.

TU005 Edaphostat - A web application for automated and interactive meta-analysis of environmental data from the Edaphobase database

J. 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 manage data from different studies and research programs. Usage of these databases promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automation analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from various soil and water data that are collected in long-term use of the product regarding diversity and abundance of different earthworm communities.

TU003 Enhancing the utility of the ECOTOX Knowledgebase via ontology-based sensitive data mapping


The US Environmental Protection Agency’s Ecological Toxicology (ECOTOX) knowledgebase contains more than 30 years of reported single chemical toxicity effects data on aquatic and terrestrial organisms. Approximately 900,000 test results covering more than 11,000 chemicals and 12,000 species are available in ECOTOX. While the database is currently used by many sectors for a variety of purposes, a future goal is to allow for computational modeling of the data to identify novel adverse outcome pathways and networks, and assist in predicting species sensitivity. To accomplish these goals, the initial steps entailed: 1) validating the chemicals within ECOTOX 2) mapping species to NCBI taxids and 3) mapping all relevant ECOTOX codes to corresponding ontological terms so chemical effects can be turned into computable phenotypic ontology classes. To semi-automate the code mapping, a Java-based lookup tool was developed using the ontology browser BioPortal (https://bioportal.bioontology.org/) REST API to conduct batch code mapping. This tool was designed to make use of BioPortal’s annotator and recommend functions so that all ontological class identifiers relevant to a particular ECOTOX term would be returned and specific ontologies recommended. Using this approach, the majority of the 2000+ ECOTOX codes were mapped to ontological class identifiers; some terms required multiple identifiers to properly 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 for an assessment of biological relevance and thus the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU002 Contextualising statistically significant differences observed in mesocosm studies using historical control data

F. Joyce, Cambridge Environmental Assessments; H.S. Schuster, Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology

Mesocosms (which aim to replicate communities residing in edge-of-field waterbodies) are used as part of the higher tier aquatic risk assessment for plant protection products (PPPs) in the EU registration process. When setting up mesocosm studies, care should be taken to standardise communities present in each replicate to reduce variability and maximise statistical power; indicated by minimum detectable differences (MDDs). However, being dynamic and complex systems, variability can often still occur between replicates, which can affect the reliability and interpretation of the results. Statistically significant differences can occur due to natural variability rather than biologically relevant effects, but determining whether these differences arise from the results of a single mesocosm study can be challenging. One option is to contextualise the experimental results from a single study using available historical control data; this is an approach often used for laboratory studies performed under standard conditions. It is, therefore, proposed that this approach can be extrapolated to mesocosm studies, given that they are also performed under standardised conditions as much as possible. Cambridge Environmental Assessments (CEA) have a wealth of control data from historical mesocosm studies, with samples collected in spring, summer and autumn, thus capturing the variability in population and community dynamics over multiple years and seasons. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing for an assessment of biological relevance and thus the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU004 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. Bigagnoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; P. Karamertzian, European Chemicals Agency ECHA; S. Proenca, EU Commission Joint Research; D. Versteeg, EcoStewardship LLC Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” [2013/179/EU]. The potential impact of chronic exposure was assessed using the life cycle of a product as assessed via the USEtox multimedia fate model [3]. This model requires for single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and toxicity to human for cancer and no-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...
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 - Arithmetic mean 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

F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Proenca, EU Commission Joint Research; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC/ Sustainable Assessment Unit

Product Environmental Footprint (PEF) and Organisational Environmental Footprint Assessment (OSF) 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 and terrestrial plants. The toxicity data are derived for cancer and non-cancer effects. For PEF/OSF, 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 IUCILID 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 soil for inorganic compounds were determined. In order to provide high quality results, criteria were applied for selecting data on the basis of their reliability (assessed by 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 / STUDIO PROMETEUS

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 different trophic levels, in order to cover the entire exposure scenario 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 considered such as Toxicity test battery integrated index (TIB). This index has the advantage to put in evidence the differences between the samples. However there are still some open issues and TIB 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 physio-chemical behaviour and interaction with organisms should be taken into account. Therefore, the aim of this work is to study the suitability of TIB procedure for the NM to determine the needed modification for tailoring the data integration. In particular, we considered metal bearing nanoparticles (NPs) such as TiO2, SiO2 and ZnO and a battery of toxicity test with organisms of different biological complexity and representative of different trophic levels with the aim to establish a unique toxicity ranking. From the analysis of the results integration with TIB it could be highlighted that to define the hazard associated with NPs is necessary to tailor the index parameters on specific NMs physico-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009

Historical analysis of the use of plant protection products in apple orchards (1970-2014): Combining handwritten farmers records with electronic data

L. de Baat, Agroscope / Institute for Plant Production Sciences IPS; M. Mathis, J. Schärer, 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 emissions of PPP, both the beyond the agro-ecosystems. 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-ies, to evaluate farm economics. Up to the 1990-ies, data were only available in handwritten paper format. Since 1997 they were collected electronically. In this study, we digitised the handwritten records and combined it with the electronic data. We first developed a concept, how the handwritten records can be entered into a database, which contains similar information as the electronic data. We collected data on farms (productivity), apple plantations (year of plantation, size, type, variety), and plant protection measures per plantation (product, dosage, date of application). In We also developed procedures to handle missing data and to detect potential errors in the indicated dosage or field size. Finally, a database of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-ies and 80-ies, more than 75% of all insecticide treatments were organophosphates. After 1986, organophosphates were quickly replaced by carbamates and benzoylureas, and today only contribute to about 10% of all insecticide treatments. This study illustrates, that for a historic analysis of pollutants it is sometimes unavoidable to fire potential handwritten PPP data and beyond the agro-ecosystems. However, this effort resulted in a unique 44 year time series of PPP use in apple orchards. In a next step, we will analyse the historic development of ecotoxicological risks of PPP usage in apple orchards.

TU010

Using long-term datasets to assess the impacts of neonicotinoids on farmland bird populations in the UK over the last 21 years

R. Lennon, 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. This paper explores the majority of the 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 use in the UK, 2) establish whether species traits, such as body weight and home range are correlated with any effect of NNs on population growth, 3) to ascertain whether hypothesised exposure risk (direct) was able to explain differences between the impacts 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

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Research. We characterized spatial patterns of surface sediment concentrations of seven polychlorinated biphenyls (PCBs), seven polycyclic aromatic hydrocarbons (PAHs), three chlorinated pesticides and five metals in Norwegian waters and Skagerrak. In total, we amassed 5,036 concentrations of 22 chemical substances that were measured between 1986 and 2014 at 333 sampling sites by means of generalized additive models (GAMs). We found that GAMs with organic carbon content of the sediment and latitude and longitude were significant predictors explaining ca. 75% of the variability of the contaminant sediment concentrations. For metals, a predominantly hotspot-driven spatial pattern was found, i.e. we identified historical pollution hotspots (e.g. Sørjerd in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated and industrial regions, i.e. in the North Sea and in the Kattegat and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffuse atmospheric nature of their sources. Atmospheric inputs are the main sources of pollution for most organic chemicals considered, but north of the Arctic circle, we found that concentrations of PAHs increased from south to north most likely related to a combination of coal-eroding bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

TU012

Environmental quality assessments and monitoring plans are key tools to all activities related to potential contamination of ecosystems, including marine systems. Potential effects of oil/gas production activities in Adriatic Sea (Italy) are successfully investigated since 2000 by water and sediment chemical analyses, sediment grain and industrial organisms, and biocenosis. For this reason, a multidisciplinary approach was developed which includes chemical analyses, grain size analysis and biomarkers on marine sediment, together with bioaccumulation and biomarker integration in polychaetes exposed to sediment, is applied to assess potential impact due to offshore platforms and produced water (PFW) discharge. PFW is a complex mixture of contaminants and is the main discharge of gas/oil platforms. Marine sediment samples were collected on an Adriatic regional scale, phys-chemically characterized by sampling of twenty-four stations at increasing distance from the platform/discharge, and in particular four stations, located at 0, 25, 50 and 100 m along the main local current, also for ecotoxicity. Different inorganic and organic contaminants were analyzed in sediment. To assess the effects of pollutants at different levels of trophic web, results of a bioassays battery (ecotoxicological tests with Vibrio fischeri, DON media, Tetrastrum sp., Tigriopus fulvus) were considered. Moreover a battery of biomarkers at different biological levels together with bioaccumulation of some organic and inorganic contaminants were analyzed in polychaetes (Hediste diversicolor) exposed to sediment under laboratory conditions. A multidisciplinary weight of evidence (WOE) study was carried out, integrating different lines of evidence (LOE) as sediment grain and industrial organisms, biomarkers and ecotoxicological tests for each platform. These LOEs were elaborated within a quantitative WOE model which provides a synthetic hazard index for a comprehensive assessment of hazard associated to potential contaminated sediments. The WOE elaboration allowed to better summarize complex dataset of results, providing a more realistic evaluation of hazard and risk for produced water discharges.

TU013
Utilising biomarkers in a multispecies approach to relate organochlorine exposure and biological effects V. Weepen, North-West University - School of Biological Sciences / School of Biological Sciences; S. Vohannesburg, University of Cape Town / Zoology; R. Gerber, North-West University / Unit for Environmental Sciences Management; N. Smit, NorthWest University / Environmental Sciences and Management

Due to their persistence and global distribution the use of organochlorine pesticides (OCPs) have been banned in most countries around the world. However, in a number of countries, the use of DDT and other OCPs as biocontrol agents is still allowed. This practice is not without controversy and reports on ecological and human health effects are increasing. The Pongolo River floodplain in northeastern South Africa is a high risk malaria area where DDT is used as vector control agent through indoor residual spraying (IRS). This region is also regarded as a biodiversity hotspot in southern Africa and concern has been raised regarding the risk posed as a result of the long term use of DDT. Over the past seven year's studies have been undertaken to determine the degree of DDT exposure in the aquatic ecosystem through analyzing DDT and other OCP bioaccumulation in a number of different aquatic species. Concomitant biomarker analyses were undertaken to determine the biological effect of the DDT exposure. In this poster we collated and integrated the exposure (DDT and HCH bioaccumulation) and effect (biomarker) data of the different studies to test the hypothesis that increased DDT exposure will elicit similar biological responses across species. Bioaccumulation of DDT (and its metabolites) and HCHs were measured before and after IRS application periods in two decapoda, six fish and two amphibian species. Biomarkers of exposure (cytochrome P450 and acetylcholine esterase) and effect (catelase, superoxide dismutase, malondialdehyde, protein carbonyl, and cellular energy allocation) were analysed in the same organisms. Using principal component analysis and discriminant functional analysis the exposure and effect data were integrated to elucidate the responses of aquatic biota to OCP exposure. Although higher trophic level organisms (i.e. tigerfish - Hydrocynus vitulina and Mudfish - Tilapia molitrix) displayed the highest DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-Hexachlorocyclohexane, were included in the analysis, significant relationships with cytochrome P450 and lipid energy reserves were obtained. The result therefore indicated that biological responses were not related to DDT but rather to HCH exposure.

Microbial community ecotoxicity in environmental risk assessment and ecosystem monitoring (P)

TU014
Identifying bacterial indicator taxa along an urbanization gradient in stream ecosystems M. Simonin, Duke University / Biology; K.A. Voss, Regis University; B.A. Hassett, J.D. Rucca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department

The extent of high throughput sequencing enabled microbial ecotoxicologists to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microorganisms led us to focus our analyses mainly at the community or phyllum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we tried to move beyond biodiversity analysis by applying a high-throughput sequencing data by characterizing the response of individual taxa (OTUs) to a multiple stressor gradient and identifying bacterial indicator taxa. Taking inspiration from classic gradient analyses used for macro-organisms in Ecology (Threshold Indicator Taxa Analysis - TITAN, logistic and quadratic regressions), we identified bacterial taxa that presented positive, negative, neutral or subsidy-stress responses to a well characterized urbanization gradient in 41 streams in the Raleigh-Durham area (North Carolina, USA). We used a combination of environmental variables (% development, % forested, sediment Zn concentration, biotic index) that were significantly correlated to bacterial community structure to identify reliable bacterial indicator taxa along this multiple stressor gradient. Using TITAN, we identified more bacterial indicator taxa negatively impacted by urbanization than positively impacted (138 and 56 OTUs respectively). Using quadratic regressions, we found 140 OTUs presenting a subsidy-stress response to the gradient. We observed that two bacterial families were strongly and consistently decreased by urbanization: Acidobacteriaceae (Acidobacteria) with 50% of OTUs identified as pure and reliable indicator taxa and Xaraciaceae (Alpha-Proteobacteria) with 39% of indicator taxa. Positive responders were distributed all over the phylogenetic tree and the family Comamonadaceae (Beta-Proteobacteria) presented the highest number of indicator taxa (14%). We calculated with TITAN that the community-level threshold, indicating the peak along the gradient where the maximum decline in all negative responders happened, was at 12.1% development. This community-level threshold occurs at a very low levels of urbanization patterns and expose a full potential of microorganisms to urbanization and the potential of bacteria to be used in biocorridance or monitoring along with more traditional indexes.

TU015
Diatom sorption in freshwater biofilms: determination of isotherms B. Haumiet, IRTesia; I. Moreau, IRTesia; M. Simonin, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA / National Center for Laboratory Networking, Ecotoxicology Area; C. Sebbio, G. Chiaretti, O. Faraponova, M. Simonin

In 2000, the EU Water Framework Directive (directive 2000/06/EC) was implemented with the objective of reaching the good ecological status of rivers. 45 chemicals were indexed as priority including 19 pesticides. The biofilm is at the basis of the trophic chain in aquatic environments and considered as an excellent bioindicator for water quality assessment (Edwards and Kjellnerup 2013) because of its ability to integrate contamination (Vercraene et al. 2010). In this study, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances to the EU Water Framework Directive. Previous experiments carried out in order to characterize diuron bioaccumulation in biofilms, with two different exposure concentrations, suggest that pesticide uptake by microorganisms was not proportional to contaminant concentration in the water. For this experiment, we suspected that diuron absorption was highly saturated and, in order to confirm this hypothesis, bioaccumulation and toxic impact were simultaneously assessed at field conditions.
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 capacity of diuron bioaccumulated in biofilm from concentration in the water. The environment was expressed as an equilibrium constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlight a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium constant of the maximum capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about behavior and impact in periphytic microorganisms.

TU016
New insights into the biotransformation of 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 perchloroethyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and human health. N-ethyl perfluorooctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide, Sulfurlamid. Sulfurlamid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated the biotransformation of diuron in various sludge, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-EtFOSA. This study used Alillythiourea (ATU), an inhibitor of ammonia monooxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria and ammonia oxidizing archaea (AOB) and ammonia oxidizing archaea (AOA) to the biotransformation of N-EtFOSA, since AMO is an important enzyme involved in the degradation of aromatic compounds. AOA and AOB are two distinct groups of ammonia oxidizers with different growth requirements. AOA requires oxygen for growth, while AOB tolerates oxygen. The study further investigated the potential of AOA and AOB in the biotransformation of N-EtFOSA by degrading 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 Protothelphus 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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New insights into the biotransformation of sulfurlamid: role of ammonia oxidizing bacteria and community shifts
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TU016
Use of BioLogEcoPlateTM to evaluate the effects of ZnO nanoparticles on soil microbial communities
V. Romano, Parthenope University of Napoli / Science and technology; v. pasquale, University Parthenope; s. schiavo, ENEA CR; M. Oliviero, s. dumontet, University Parthenope; s. manzo, ENEA / SSPT-PROTER-BES

Nanoagrochemicals seem to be the new frontier in modern agriculture due to their increased efficacy and the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used nanofertilizers their speedrengro crops seem to increase their growth and yield. This increasing use could lead to their introduction in the environment occurring also via unintentionally pathways. Actually, some studies reported ZnO NPs negatively affect soil microbial activities and consequently the biogeochemical cycles. These effects could be evidenced by assessing metabolic profiles of culturable, aerobic, heterotrophic microorganisms (Biolog). BioLogEcoPlate was successfully used to detect short and long-term changes of functional diversity of soil microbial communities. This method was based on the determination of the oxides profiles related to several different carbon sources. This study aims to investigate the changes in the metabolic profile of amoeba soil microorganisms in response to ZnO NPs. A series of experiments was performed with ZnO NPs at two different concentrations (50%). At time 0, 15, 30 days fresh soil samples were assessed by using the BioLogEcoPlate approach. The occurrence of the microbial oxidation of each BioLogEcoPlate™ C source was calculated as probability’p’ on a binomial scale in order to identify the treatments able to preserve the highest possible oxidizing ability of C substrates and those negatively affecting it. ZnO-nanofertilizers were more toxic than fertilizers with ZnO in bulk form, for algal growth, instead for plants, the effects of “ZnO-nanofertilizers” depended on the type of applied fertilizer. Zinc oxide NPs have been largely used nanofertilizers their speedrengro crops seem to increase their growth and yield. This increasing use could lead to their introduction in the environment occurring also via unintentionally pathways. Actually, some studies reported ZnO NPs negatively affect soil microbial activities and consequently the biogeochemical cycles. These effects could be evidenced by assessing metabolic profiles of culturable, aerobic, heterotrophic microorganisms (Biolog). BioLogEcoPlate was successfully used to detect short and long-term changes of functional diversity of soil microbial communities. This method was based on the determination of the oxides profiles related to several different carbon sources. This study aims to investigate the changes in the metabolic profile of amoeba soil microorganisms in response to ZnO NPs. A series of experiments was performed with ZnO NPs at two different concentrations (50%). At time 0, 15, 30 days fresh soil samples were assessed by using the BioLogEcoPlate approach. The occurrence of the microbial oxidation of each BioLogEcoPlate™ C source was calculated as probability’p’ on a binomial scale in order to identify the treatments able to preserve the highest possible oxidizing ability of C substrates and those negatively affecting it. ZnO-nanofertilizers were more toxic than fertilizers with ZnO in bulk form, for algal growth, instead for plants, the effects of “ZnO-nanofertilizers” depended on the type of applied fertilizer: only F1 + ZnO NPs resulted more stimulating than F1 + ZnO Bulk. Preliminary BioLog results seemed to highlight that the microbial community
was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiogeoCope approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TT020 Environmental factors-regulated disease dynamics of tilapia lake virus (TILV) transmission in farmed tilapia ponds

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BACKGROUND: Outbreaks of tilapia lake virus (TILV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TILV disease dynamics should be clearly elucidated to prevent the potential economic impacts on aquaculture.

OBJECTIVE: The main objective of this study was to make the TILV disease dynamics by constructing an epidemiological model to implicate aquaculture management among farmed tilapia ponds.

METHODS: The mortality of Nile tilapia infected by intraperitoneal (I.P.) injection with different TILV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explore the TILV highly artificial environmental conditions, sacrificing some of the experimentally 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 TILV under treatment of cohabitation.

RESULTS: In toxicity assessment, LD50 estimate of Nile tilapia infected by I.P. injection with different TILV dosage was 57±2.7 TCD50 mL-1. Under certain environmental conditions, TILV survival time and the cyanobacterium that has the smallest cell of the four tested species, was standard OECD medium (biomass photosynthetic apparatus). The sensitivity to CuO remained at a similar level in the NPs and solubilized ions. The biofilm parameters at 72 h were inhibited in ANW with concentrations up to 100 µg/L. TiO2-NPs and solubilized ions were analyzed for dissolved organic carbon (DOC) quality or preserved to determine mortality rate (α), transmission rate (β), and basic reproductive number (R0) for Nile tilapia posed by TILV under treatment of cohabitation.

CONCLUSIONS: TILV transmission could be affected by environmental factors such as temperature and aquaculture density. Results of toxicity assessment and disease epidemics could provide insights into aquaculture management of TILV disease by controlling potential factors in tilapia ponds.

Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

TT021 Natural organic matter alleviates TiO2 and CuO nanoparticle toxicity in four algal species

E. Marujo, V. Arujo, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology; K. Olli, University of Tartu / Institute of Ecology and Earth Sciences; A. Kahrul, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted on TILV highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoated CuO (Cu5O4 as ionic control) and TiO2 NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-deprived (anoxic) medium, using four freshwater species from three major algal groups: green algae (Raphidocelis subcapitata) and the cyanobacterium that has the smallest cell, 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 TiO2 NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO2 at concentrations up to 100 µg/L. Cu5O4 significantly inhibited biomass production of both green algae in the standard medium (EC50 = 14.1 ± 3.0 µg/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 morphology heteroagglomeration. Overall, Fv/Fm was a less sensitive toxicity parameter at concentrations up to 100 µg/L. TiO2-NPs and solubilized ions were analyzed for dissolved organic carbon (DOC) quality or preserved to determine mortality rate (α), transmission rate (β), and basic reproductive number (R0) for Nile tilapia posed by TILV under treatment of cohabitation.

CONCLUSIONS: TiO2-NPs and solubilized ions were analyzed for dissolved organic carbon (DOC) quality or preserved to determine mortality rate (α), transmission rate (β), and basic reproductive number (R0) for Nile tilapia posed by TILV under treatment of cohabitation.

TS023 Impact of the antihistamine fexofenadine on structure and functioning of less-mass-associated microbial communities

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Effects of pharmaceutical design and 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 we microbially colonized two plant substrates (i.e., black alder leaves and hay). Both precolonized substrates were subsequently exposed towards fexofenadine at concentrations of 0, 2, and 200 µg/L. Replicates (n=10-15) were harvested after 15 and 30 days. Substrates were used to determine mass loss or preserved to estimate microbial communities’ structural or functional composition including fungal biomass, sporulation of aquatic fungi, bacterial abundance and diversity, fungal and bacterial activities. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to determine microbial communities’ structure and/or functional composition. 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 microbial uptake in surface waters. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing variables related to microbial community structure and functioning.

TU024 Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INT-CATCH

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Environmental Health; L. Mancini, Italian Institute of Health ISS; C. Mancini, AECCOM / Environmental Health; M. Deldelome, M. Rossato, University of Verona; F. Fatone, Università Politecnica delle Marche; A. Farinelli, J. Blum, D. Bloisi, University of Verona; A. Cordioli, Azienda Gardesana Servizi S.P.A. Peschiera del Garda; P. Varotto, Azienda Gardesana S.P.A. Peschiera del Garda; A. Tittonel, Technical S.P.A. Milan; D. Calisi, Algorithmica S.r.l. Roma; F. Giannone, Algorithmica S.r.l.; R. Allabahadi, Boku University; A. Parsons, L. Parsons, Denmark Environment Research Ltd.;; T. Runnalls, Brunel University / IFE; G.E. Brighty, Environmental Sustainability Associates limited; T. Licha, Gottingen University; S. Malamis, Athens Technical University; T. Knutz, Go-Sys; A. Merkoci, ICREA. The European Project Horizon 2020 INTCATCH (Development and Application of Novel, Integrated Tools for monitoring and managing Catchments) has the main goal to recommend and deliver new innovative approaches 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, Enterococci coli, some of them are mounted on aquatic drones. An innovative tool of Intcacht 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 approach by linking it to other data that shows that 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. Similarly, the metagenomics data, linked to the informations of the other tools, can be also be used for the identification of pollution sources because the proportions of the bacteria groups vary in relation to several stressors (agricultural, urban, living stock, etc.).

TO/025 Tolerance of sediment-microbial communities to copper indicates lake contamination
A. Tili, Eawag / Department of Environmental Toxicology; C. Bonineau, Irstea Lyon; A. Dabin, Irstea Lyon-Villeurbanne / UR MALY; E. Lyautey, Universite Savoie Mont Blanc; B. Ferrari, Centre Ecotax EAWAGEPLF, S. Pesce, Irstea Lyon-Villeurbanne / Microbial Ecology of Anthropised River Systems. In lakes, and fresh waters in general, sediments play a crucial role in biogeochemical cycles, and are often at the basis of the food-web. Heavy metals such as copper, zinc or silver can accumulate in lake sediments, which represent a 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, allowing determining the gradient by heavy metals in lake Geneva. Sediments were sampled with an Ekman grab sampler at four sites, located around the lake and close to the shore. Samples were analysed for total metal concentrations, organic matter content, abundance of metal-resistant genes (e.g. copA and cusA), bacterial biomass, and bacterial community composition. Moreover, tolerance of microbial communities to copper was measured by applying the pollution-induced community tolerance (PICT) concept by measuring the inhibition of bacterial secondary production and the extracellular enzyme β-glucosidase activity. Results showed a clear gradient of copper contamination, ranging from 30 to 310 mg.kg⁻¹ DM sediment. The results also demonstrated that chronic in situ exposure to copper induced a decrease of bacterial biomass and a structural shift in the community composition. Interestingly, tolerance measurements to copper were strongly and positively correlated to the copper concentrations in the sediments. Overall, our findings support the fact that microbial communities in sediments are a good indicator for metal contamination in aquatic ecosystems, and the suitability of microbial tolerance measurements to pinpoint specific effects of metals at the community level.

TO/026 Current challenges and perspectives in aquatic and soil microbial community ecotoxicology
K.K. Brändle, University of Copenhagen / Department of Plant and Environmental Sciences; M. Schmidt-Jensen, UFZ - Helmholtz Ctr for Enviro. Research / Department of BioAnalytical Ecotoxicology; A. Tili, Eawag / Department of Environmental Toxicology. Assessing the impacts of chemicals still largely relies on approaches that are based on assays in simplified laboratory settings at the single-species or subspecies level. Yet, it becomes increasingly recognised that to draw conclusions on potential effects on ecosystems, it is essential to consider higher levels of ecological organisation, and more intricate risks on ecosystem structure and function. Microbial communities provide a large range of ecosystem services such as primary and secondary production, nutrient recycling, pollutant degradation, and are sources of biochemicals. Microorganisms are also primary targets for chemicals, which can lead to structural and functional alterations of microbial communities, with potential negative consequences for ecosystem functioning and environmental selection of antimicrobial resistance. Hence, a microbial community-level perspective in ecotoxicology is more important than ever. In this presentation we will first provide an overview on the current status of microbial community ecotoxicology research, in aquatic and terrestrial ecosystems, and to which extent this field is considered in environmental risk assessment in the future. We will also describe the challenges within both aquatic and terrestrial microbial community ecotoxicology. Finally we will discuss future research directions in microbial community ecotoxicology to accurately assess and predict impacts of chemicals on ecosystems, and to develop specific response indicators of chemical exposure and effects.

TO/027 Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress
B.H. Polst, Helmholtz centre for environmental research - UFZ / Department of Biocatalytic Ecotoxicology; E. Larrañ, Helmholtz Center for Environmental Research - UFZ GmbH; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology; C. Anlander, U. Risse-Buhl, M. Weitere, Helmholtz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmitt-Janssen, UFZ - Helmholtz Ctr for Environm. Research / Department of Bioanalytical Ecotoxicology. Biofilms in rivers are complex communities built of bacteria, fungi, algae and protozoa embedded in a matrix of extracellular polymeric substances (EPS). They are important hotspots for biogeochemical processes in aquatic systems. A variety of stressors can potentially affect the structure and function of biofilms. Therefore their tolerance to one stressor may be influenced by former exposures to another stressor. Community composition and physical structure is influenced by hydrodynamic conditions. Even though hydrodynamics influence biofilm communities, we reported to decrease with higher mean flow velocity and turbulence, the cell-to-EPS ratio increased. As the EPS content of a biofilm may influence the bioavailability of toxics, 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 PICT approach. Focusing on the phototrophic part of the 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.

TO/028 Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf-decomposition? - A case study using species-specific qPCR assays
N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; M. Koschel, University Koblenz-Landau / Institute for Environmental Sciences; C. Baschien, Leibniz Institute DSMZ - German Collection of Microorganisms and Cell Cultures; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment Aquatic hyphomycetes, a polyphyletic group of freshwater fungi, are considered key players in leaf litter breakdown, an important ecosystem function in aquatic systems. Structural implications of anthropogenic stressors in aquatic hyphomycete communities have mainly been analyzed using spore morphology, which does not allow assessing direct influences on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the structure of a model fungicide mixture on aquatic hyphomycete communities' leaf decomposition to individual species' abundances quantified via species-specific quantitative real-time polymerase chain reaction (qPCR) assays. Using a factorial design, every possible single, binary and quaternary species combination of four different aquatic hyphomycete species (Alatospora acuminata, Heliscella stellata, Neocentria lugdunensis and Tetracladium marchalianum), was exposed to the model fungicide mixture composed of four single species or subspecies with different modes of toxic action (four sum concentrations, ranging from 5 to 2500 µg/L, and a fungicide-free control; n=5, N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 µg/L resulting in significantly reduced abundances. Interestingly, only the two tolerant species (i.e., N. lugdunensis and T. marchalianum) were capable of decomposing leaf material to a significant degree. Moreover, abundances of single species within the model communities as well as their functioning were governed by dominance interactions (e.g., one species outcompeting the other), probably as a result of competition for leaf substrate. Depending on 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 key taxa and ecologocal 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 Metagenomic Analysis
D. Conduto Antonio, European Commission Joint Research Centre / Directorate Space, Security and Migration; R. Loos, I. Sanseverino, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; A. Beghi, F. Pandolfi, ARPA Agenzie Regionale per la Protezione dell’Ambiente della Lombardia; P. Genoni, Lombardy Regional Environmental Protection Agency; D. Napierska, T. Lettieri, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

The increasing anthropogenic eutrophication and climate changes are contributing to the intense proliferation of cyanobacteria in waterbodies so causing a phenomenon known as bloom which may compromise the quality of drinking and recreational water. The dynamics of bloom events are not yet fully understood, however it is scientifically accepted that external factors such as water temperature, nutrient concentrations and light intensity, may influence the potential of a bloom. Our study focuses on the relationship between environmental factors and the composition of the microbial community of the lake Varese (Italy) for a period of several weeks before and after the bloom event. Sampling campaigns were performed on a weekly basis. Water samples were collected from the depth region of 0-1.5 m and 0.5 m from surface depth (MEZO-1.5 m), 13 m (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCCHI). The samples were characterised for their chlorophyll a content, nutrients, cyanotoxins and genomic DNA was extracted for metagenomics. Purified DNA samples were subjected to 16S sequencing (variable region V3- V4) and for shotgun analysis. All 16S samples were MiSeq sequenced as 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 16S and 2.5x SECCCHI. The results showed that a peak of cyanobacteria was observed around 14/9-21/9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the first week of sampling at t0. The 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 SECCCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanotoxin results in water samples which are likely higher than the coliform and E. coli concentrations. Thus, the qPCR results revealed that several cyanobacteria species were detected in the water samples which are likely responsible for the bloom. This suggests that cyanobacteria are the main cause of the bloom event in Lake Varese.

TU030 Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope 
J. C. Elverson, Institut des Milieux Aquatiques, Ecologie et Pollutions (MAEP); J. Gahou, Irstea Lyon-Villeurbanne; m. masson, c. brosse, Irelte Lyon; B. Volat, Irelte Lyon-Villeurbanne; C. Bonnimeau, Irstea Lyon; S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; M. Coquery, Irstea Centre de Lyon - Villeurbanne / Unite de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP)

In small streams, microbial communities form river biofilms attached to solid substrates by producing extracellular polymeric substances (EPS). This matrix may act as a protective layer by limiting cellular contact with surface water contaminants. Thus, several studies have suggested that during biofilm growth, biofilm and EPS matrix thickness could limit cellular bioaccumulation. To test this hypothesis, copper (Cu) bioaccumulation of the cyanobacterial strain Synechocystis PCC 7942 was studied as impacts on algal biomass, photosynthetic pigment profiles and primary productivity. A better understanding of effects of metals on cyanobacteria would improve risk assessment of metallic exposure in aquatic ecosystems.

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, stable Cu isotopes 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 is 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 (C0). One slide per section was sampled after 1, 2 and 4 weeks of exposure. For each section, fresh slides were kept to determine the chlorophyll a content, the total biomass, and the Diatom growth rate in the C2 condition was significantly higher than that in C0 and C1. Results obtained by pigments fluorescence measurements showed significant cyanobacteria decrease in the C2 condition over the exposure time as well as the brown algae between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microeukaryota composition and to the reference (C0) and the C2 condition. Gliates 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 microeukaryota would improve risk assessment of metallic exposure in aquatic ecosystems.

TU032 DNA metabarcoding demonstrates effects of copper at environmental concentrations on microbial diversity in marine periphyton biofilms 
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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. Microbially and chemically based approaches were used to investigate the effect of copper exposure on the periphyton community composition which was also analysed for its impact on freshwater periphytic communities. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring. Copper exposure would improve risk assessment of metallic exposure in aquatic ecosystems.

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induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU033
A Time-series Study of Soil Microbial Community Composition and Fertilization Shift in Biodiesel vs. Petrodiesel Contaminated Soils
D.L. Carr, Texas Tech University / Biological Sciences; M. Dong, Texas Tech University / Biological Science
The spoil of petrodiesel on land can irreversibly damage the soil ecosystem, and there are limited studies comparing petrodiesel and biodiesel impacts on soil microbial communities. Biodiesel has been considered as a viable substitute for petroleum, however, the biodiesel in which it is more microbially friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolog EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesels were not statistically different from petrodiesel in terms of their adverse impacts on soil microbial communities. In conclusion, our results suggested that biodiesels should not be automatically conditions under different pedo-climatic conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green alga was sensitive to alkalinity, SO4, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine, and carbamazepine/irbesartan/valsartan induced growth stimulation of N. palea and P. pellucida by an automated fluorometric microplate assay to evaluate the groundwater and river quality in four riparian wetlands in the south-west of Europe (Monbèqui (France), Saragossa (Spain), Bidasoa (Spain) and Toledo (Spain)). Four campaigns of water sampling were realized during contrasting hydrological conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green alga was sensitive to alkalinity, SO4, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine, and carbamazepine/irbesartan/valsartan induced growth stimulation of N. palea and P. pellucida, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidasoa. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).

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

TU035
Can post mortem data be used to monitor population health in response in the barn owl? L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Shor, Centre for Ecology & Hydrology (NERC)
The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) is national long-term project that monitors contaminant residues in a range of avian predator species. Each bird that is submitted to the scheme is given a post-mortem examination during which approximately 60 macroscopic observations and measurements are made. The information gathered during this examination could potentially be used to monitor health status of the birds at the time of their death or at a particular stage of their development. Previously we have focused on examining health indicators for the sparrowhawk, Accipiter nisus. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by fluctuating asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was outside these bounds could be considered years of unusual health status. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (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 focus of this poster is to show the applicability of the Guidance Document 75 (2007; OECD GD 75) 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 uses the calculation of risk quotients (TRQs) for honey bee larvae. This considers exposure routes for the different PPPs applied as seed and off-field (PPP) and as seed treatment (granules) scenarios. Where a substance or use should not pass one of these screening level risk quotients, EFSA provides 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 flower 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 able to 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. 

TU040 Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference of the brood termination rate under semi-field and field conditions*  
J. Lueckmann, Rifcon GmbH; R. Becker, BASF SE Agrarzentrum Limburgerhof; S. Schmitzer, IBACON GmbH; B. Szczesniak, Eurofins Agroscience Services Ecotox GmbH  
* on behalf of the ICPPR Non-API working group and the ICPPR seed treatment working group, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens). In the evaluation of historical data from field trials, it is known, they can be used for ecotoxicological semi-field and field trials to provide new data for the risk assessment, and consequently impacts of pesticides on bumble bees have already been tested for years. Currently, an ICPPR Non-API working group is developing a standardized method for semi-field studies with bumble bees. Based on the protocols of the ICPPR working group, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens). However, the production of young queens in semi-field trials is challenging. Many variables influence the number of produced queens, such as the right timing for the termination of the study or the condition of the colonies at study start. Based on data collected in the past years, several parameters influencing this most important endpoint were analyzed. We tried to answer some open questions concerning the colony reproduction success, such as the experimental set-up can influence queen numbers and queen weights, how high the natural variation between colonies is and how the selection of bumble bee colonies for the studies can be improved.
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 ECPA company data evaluation

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A preliminary data evaluation was conducted by ECPA 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 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 fold chronic exposure scenario indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

TU045 Bumblebee (Bombus sp.). 10 day feeding laboratory test design: First results from an ICP-PR 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. Haupts, 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 range test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honeybee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity test guideline OECD 247 a 10 day feeding test was set-up using dimethoate as reference substance. The response of adult Bombus spp. workers to the test chemical Dimethoate EC400 (Perfekthion) was evaluated within a 10 day feeding scenario. The test item was provided ad libitum for a period of 10 days. During the exposure phase bumblebees are kept individually in cages –“single housing”. Bumblebees do not share food via trophallaxis and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen-less BB workers) potentially introducing mortality. Mortality and behavioral abnormalities in the test groups were observed and recorded daily and compared to the untreated control groups. The endpoints calculated were: LC50 (median lethal concentration) and LDD0 (median lethal dietary dose) values after 10 days and if possible the NOEC (no observed effect concentration) and NOEDD (no observed effect dietary dose). First results indicate that with this method reproducible results were obtained. The mortality in the control groups seem not to exceed 15 % (evaluation currently ongoing) and the overall food consumption allowed for a proper evaluation of the intended endpoints.

TU046 Standardization of method to test toxicity on stingless bees

The I. Roessink, Alterra / Environmental Risk Assessment; N. Hanewald, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; N. Exeler, Bayer AG, Crop Science Division; E. Noël, SynTech Research; A. Schnurr, BioChemagrar GmbH; A. Molitor, Eurofins AgroScience Services GmbH; E. SOLER, TRIALCAMP SLU / Ecotoxicology; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology

Toxicity Test protocol of OECD guidelines (214) established to European honeybees. Within the current project of the ICP-PR Non-Apis working group a start was made to develop a first-tier acute oral test for Osymia 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 Osminia 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, responses of Os. 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 bodyweight. Hence, the LD50 values after 96 hours ranging from 2.6 – 7.1 ug a.i./gg bee indicate that a validated and workable methodology has been set up and a guideline is within reach.

TU047 2 Years of Solitary Bee Semi-field Ring Testing and Final Conclusions (ICPPR Non-Apis Working Group)

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The publication of the proposed EFA risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set-up. The ringtest design was based on the EFSA guidance document, OEP/EPPO Guideline No. 170 and representatives of the Solitary bee working group of the ICPPR non-Apis workgroup 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 (Osman biicornis L. and Osminia cornuta Latt; 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 activity in front of the nest units, nest occupation (i.e. number of nesting females), the production of complete cells and cocoons per female; the brood feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to European honeybee for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we used 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.
termination rate during the larval development as well as the success of emergence of their progeny (F1-generations) 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.

TT049 Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach
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Plant protection products (PPP) play a vital role in modern agricultural practice. Nevertheless, their potential off-target effects on managed (e.g. A.apis mellifera) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In order to assess a potential risk and to mitigate it, a method that considers the unique bodyweight and nectar and pollen feeding habits of a given species is necessary. Here, we present recently employed methods for quantifying the potential of A. mellifera to be sensitive to AChE inhibitors, AChE inhibitors are a class of PPPs, and results from studies on foraging behaviour as well as methods to adequately determine residues 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 to residues. Methodologies and their data set is compared and advantages and disadvantages of non-standard uses, such as foraging studies, studies on foraging behaviour as well as methods to adequately determine residues are discussed. The different methods are compared and advantages and potential pitfalls are illustrated.

TT050 New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experiences
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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 regulatory endpoints, there is a need to re-evaluate exposure to pollinators in the presence of neonicotinoids. The methods discussed include the determination of residues as parts 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 honey and garden uses, ornamentals and grains with a slow release formula. The different methods are compared and advantages and disadvantages are illustrated.

TT051 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; C. Wolf, Tier3 Solutions GmbH
In the Brazilian overall approach is to develop 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 insecticide, we will address the subsequent steps of the normative scheme (the "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

TT052 An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan
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Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothiazin, Dinotefuran, Thiamethoxam and Nitpyram 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, there are increasing worries about the occurrence and potential influence of these neonicotinoid residues for bees in Japan though these neonicotinoid pesticides are considered to be one of the reasons for losses of bees in EU, Canada and the US. It should be noticeable that the residual levels of neonicotinoids in residue concentrations in adult honeybees, pupae, pollen and honey. These samples were collected from beekeepers around in Japan. Information about condition of colonies was also collected from beekeepers. Wild honeycomb were also collected. The six neonicotinoids were detected in all samples including honey, pupae and adults. Especially, more than ten times higher concentrations were detected in some 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 sarcroied 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.

TT053 How the new Brazilian risk assessment framework for bees works
K.d. Coelho, ADAMA BRASIL / Regulatory Affairs; G. Weyman, ADAMA
The Environmental Assessment of pesticides in Brazil is performed by the Environmental 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 insecticide, we will address the subsequent steps of the normative scheme (the "normative") works for two use patterns, foliar and soil application, considering the main aspects of Tiers 1 and 2 of the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil

TT054 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 higher for 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 CGA232704 (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 CGA232704 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 CGA232704 residue of 6.3 µg/Kg was detected in pollen, while residues in nectar were less than the 1.0 µg/Kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of colonies to levels of thiamethoxam in pollen and nectar of seed treatment 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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Evidence-based knowledge on pesticide-effects on pollinators, such as honeybees, has become mandatory in many countries. It is important to establish lines of action approved internationally to provide farmers and policy-makers more information about the applications of pest management programs. With this in mind, this work evaluated whether sublethal doses of the insecticide thiamethoxam, the fungicide carbendazim, and the herbicide glyphosate would be capable of altering the alternative splicing patterns 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 metazoa, 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 highly variable region and be able to generate more than 38,000 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. Disease transmission of two bee colonies with putative cases of a spider mite with one P32 γ-ATP radioactively labeled primer for Elav and Dscam. Because the PCR products have very similar sizes but differ in sequence, we digested the PCR products with restriction enzymes and then separated these fragments on denaturing polyacrylamide gels. It was not possible to observe a differentiated pattern of splicing for Elav neither for Dscam, comparing the control groups with the bees exposed to pesticides. The doses used and the exposure time in our study was not sufficient to indicate these genes as biomarkers in Apis mellifera. However, further studies are needed, exploring different doses, contamination routes, and increasing the exposure time to verify if these pesticides are capable of altering the alternative splicing pattern of genes directly related to the nervous system. (Fapesp: 2015222368-5).

TU057

Non-uniform distribution of treated sucrose solution via trophallaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates

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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 (Brodtschneider, R., et al. (2017))it seems that food sharing via trophallaxis might lead to a non – uniform distribution of the tested sucrose solution between caged bees. This can cause high variability on measured parameters among group members, replicates and treatments. For homing success rate and gene expression endpoints, bees were orally exposed to different sub-legal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bees, based on the homing flight ring-test protocol. For mortality, bees were exposed orally to dimethoate at 0.033, 0.07, 0.1, 0.13, and 0.35 µg/bees, based on the acute oral toxicity test guideline OECD 213. For both methods, the treatment-feeding regime, was conducted with ten bees/cage and two bees/cage. Homing flight success rate, at 1ng TMX/bees, was significantly lower with ten bees compared to the two bees approach. A large variability of success rate and gene expression evaluating treatment groups have been 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 trophallaxis 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] Brodtschneider, 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
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. 

TU 061 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, such 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)

TU 062 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 can ultimately make their passage into the tissue. This study aimed 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 to determine the levels of the metals by Atomic Absorption Spectrophotometric technique. Results show that there were significant differences (< 0.05) in the concentrations of the metals in the different parts and sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range; lead: 1.11–6.00 mg/kg and Cadmium: 1.25–6.52 mg/kg while that of the essential metals are Zinc: 1.27–7.65 mg/kg, copper: 17.00–72.30 mg/kg and iron: 98.93–352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and iron exceeded the stipulated permissible limits. Higher-than-limit concentrations are observed more in the various parts of cows than in bulls of the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both the meat and 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.

TU 063 Assessment of metal bioaccessibility, bioavailability and toxicity in soil using the earthworm

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Simultaneous contamination of ecosystems by various substances sets a challenge as regards to environmental assessment. One of the aspects is appraisal of pollutant bioavailability. Such an analysis was performed on a mixed contaminated site. The earthworm Eisenia andrei was exposed to different soils according to a contamination gradient. An integrated approach including a suite of biomarkers and chemical analyses was adopted to determine site toxicity. Parameters of the antioxidan system (catalase [CAT] and superoxide 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, NRRT) were used as tools. Overall toxicity endpoints (lethality, body weight change, reproduction) were assessed. Lethal effects were detected in some soils whereas chronic endpoints significantly decreased. A significant response of time-growing extent and consistency was recorded for SOD from 2–28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also significantly decreased after 28 days, revealing that the current soil contains heavy metals to which earthworms are more exposed and suffered 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 biacessibility of Bi, and describes bioavailability and chronic effects of bismuth on the earthworm Eisenia andrei. In reproduction tests, adult earthworms were exposed to natural sandy soil spiked with Bi citrate. Results indicate that Bi fraction decreases decreased lipid and protein contents of adult earthworms as well as a complete impairment in reproduction at 56 days. 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.

TU 064 Assessment of subcellular metal-binding ligands in white suckers (Catostomus commersonii): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins?

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The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which can ultimately make their passage into the tissue. This study aimed 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 to determine the levels of the metals by Atomic Absorption Spectrophotometric technique. Results show that there were significant differences (< 0.05) in the concentrations of the metals in the different parts and sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range; lead: 1.11–6.00 mg/kg and Cadmium: 1.25–6.52 mg/kg while that of the essential metals are Zinc: 1.27–7.65 mg/kg, copper: 17.00–72.30 mg/kg and iron: 98.93–352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and iron exceeded the stipulated permissible limits. Higher-than-limit concentrations are observed more in the various parts of cows than in bulls of the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both the meat and 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.

TU 065 Assessment of Toxicological Impact of Anthropogenic activities on Onitsha Stretch of River Niger in Southeastern Nigeria

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The impact of anthropogenic activities on an urban stretch of a major river in Nigeria with respect to endocrine disrupting compounds and heavy metal concentrations was investigated. Three sampling points were selected along the Onitsha stretch of River Niger, based on the inlets of different tributaries into the river. Heavy metal contents of the water samples were analyzed after acid digestion, while the endocrine disrupting compounds were analyzed using gas liquid
chromatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Cr>Cu>O>Cr. The HPI and MI values were far above the critical values. Results also showed EDCs to include PAH, phthalates, PCDs, PCDs, PBDEs, bisphenol A and PCBs. This study established that Onitsuka 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. Thus, there are need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

**TU 066**

Bioaccumulation, DNA damage and metallothionein expression in plants grown on heavy metal contaminated soil supplemented with sewage sludge

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Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Contamination of soil and water with HM not only decreases the growth of plants but since metals can be accumulated in plant tissues they cause a severe threat to animals and humans the food chain. Identification of plants response mechanisms to contamination is becoming a prime objective in research since this knowledge can provide a solution for soil contamination and metal accumulation in plants. Studies on plants have demonstrated the ability of specific proteins - metallothioneins (MTs) to hyperaccumulate heavy metals, and play a significant role in their detoxification and overall oxidative stress. The physiological roles of MTs are not completely understood and much is still unknown concerning their characterization in many higher plants. The main study was to evaluate the effects of fertilization of contaminated with HM soil by sewage sludge on the genotoxicity levels and the expression of metallothioneins in plants shoots and roots. The toxicity assessment was conducted using selected measurement endpoints: germination index, root length, the severity of DNA damage, chromosome aberrations and the expression level of metallothioneins. Simpina alba L. was chosen as a model plant for this experiment. Plants were grown for 28 days in a growth chamber where they were exposed to soil contaminated by HM from metallurgical activities and to contaminated soil amended with different concentrations of sewage sludge. The study showed the effects of sewage sludge on the level of genotoxic effects caused by heavy metals as well as on MT expression. As such, a significant increase in the expression levels of MT was observed in plants grown under metal stress. The differences showed statistically significant changes between related conditions which means that presented assay can be used as a sensitive stress marker for phytoremediation process.

**TU 067**

Chronic toxicity assessment of Ni contaminated rivers in Japan using Ceriodaphnia dubia for development of biotic ligand model for Japanese surface waters


Ni is one of industrial essential chemicals and have been widely detected in Japanese river. US and EU have already established the water quality standard/criteria for aquatic life protection; however, it is still under development in Japan. In metal toxicity assessment, bioavailability of metals is an important factor and Ni bioavailability models (i.e. biotic ligand model (BLM)) for both acute and chronic toxicity have already been available for plant, invertebrates, and fish. They were developed mainly based on the data from several rivers (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 unconcataminated 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.

**TU 068**

Comparing metallic elements in corals from South Africa and the Mascarene Basin

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Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in their dead and living 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 Alibow Shoal constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Mascarene basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected 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. A few were found to be similar to the South African soft corals. Soft corals contained relatively higher concentrations of most of the post-transitional metals that were analysed. *Sinularia* is the coral genus with the most elements at the highest concentrations. *Pocillopora* from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WIO than in certain regions of the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in *Sinularia* (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

**TU 069**

Cytochrome P450, fat and ageing: new insights into metal toxicity

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Toxic metals are among the most persistent environmental pollutants worldwide and have been implicated in metabolic disorders, including diabetes, obesity and neurological diseases. Long-term exposure to metals increase the susceptibility of healthy individual to hematological and developmental disorders. Several genetic markers including metallothioneins, heat shock proteins and oxidative stress related genes have been used to analyse metal toxicity in many 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 completely elucidated. C. elegans is an excellent 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. But the upregulation was above 15 fold in the metal mono-GC exposed nematodes. Fat staining with Nile red also showed significant increase in the level of stored fats on metal mixture and environmental sample exposure. Further, fatty acid metabolism related genes such as fasn-1, pod-2, acs-2 and fat-5 were also altered on exposure to both the metal mixture and environmental sample. Our result shows 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.

**TU 070**

Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers

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Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIEU/PEHU; U. Izaguirre, University of the Basque Country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; J. Schäfer, Université de Bordeaux; B. Zaldívar, University of the Basque Country UPV/EHU / Department of Zoology and Animal Cell Biology, Centre of Experimental Marine Biology & Biotechnology Platinum (Pt) is a trace metal present in aquatic ecosystems at natural concentrations, but since the 1970s the strongly increased industrial use of Pt, especially for car catalyst converters, has totally modified its global biogeochemical cycle increasing its presence in many natural compartments.

Oysters have been widely used as sentinel organisms in environmental biomonitoring programs for decades because of their sedentary way of life and ability to accumulate pollutants with little metabolic transformation. The present work addresses the effects of Pt on the Japanese oyster (Crassostrea gigas) at low levels of organization, such as cellular and tissue. For this, oysters were exposed to different Pt concentrations (Control = 0 nL/L; Low = 50 nL/L; Medium = 100 ng/L and High = 10 µg/L) for 3 (T3), 7 (T7) and 28 (T28) days. The condition index of each individual was calculated as well as the gametogenic development stage. In addition, the histopathology of the oysters’ digestive gland was studied, including atrophy levels, tissue structure and parasite prevalence among other anomalies. Different histochemical parameters such as lipofuscin and neutral lipids were also measured and combined with autometallography to detect the location and quantity of Pt. An increase of autometallographical black silver deposit in the digestive gland was observed and a significant increase in lipofuscin content occurred at all exposure times.

On the other hand, neutral lipid levels showed a significant decrease at T28 for the exposure conditions Medium and High. Only minor and non-significant alterations occurred at histological level. This experiment has shown that short-term (28 days) exposure to relatively high Pt concentrations in seawater do not alter inductions of histological levels to cellular levels of biological organization as in cellular (lipofuscin accumulation, neutral lipids deployment) are impaired in oysters.

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TU071 Ecological Risk Assessment of Trace Metal Contaminated Tropical Estuarine Sediment, Southwest Nigeria
A. Usese, University of Lagos, Nigeria / Department of Marine Sciences; O.L. Chukwu, University of Lagos Nigeria / Marine Sciences; R. Naidu, The University of Newcastle / Global Centre for Environmental Remediation GCER, Faculty Science and Information Technology; M.M. Rahman, The University of Newcastle / Global Centre for Environmental Remediation GCER, Faculty of Science; S. Islam, The University of Newcastle / Global Centre for Environmental Remediation Faculty of Science and Information Technology.; E.O. Oyewo, Nigerian Institute of Oceanography and Marine Research / Victoria Island, Lagos Lagos, Nigeria. The largest of the eight lagoons that make up the lagoon systems of Nigeria has been under intense pressure from several anthropogenic influences over the years. This study evaluates the level of contamination and potential ecological risk of trace metal (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) concentrations in surface sediment from 15 sites in Lagos lagoon during the wet and dry season by an Agilent 7500c (Agilent Technologies, Tokyo, Japan) Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The study was carried out with only the surface trace metals in the order Fe > Mn > Zn > Cu > Cr > Pb > Co > Ni. Ni could rarely exceed threshold element levels for the protection of aquatic life. Risk analysis using contamination factors (CF) and Enrichment factor (EF) suggests very significant enrichment from Zn and Cd as well as a high degree of contamination (Cd) from Cd (16.88-21.56) at locations closest to urban runoff, industrial activity, domestic and solid waste dumps. Estimated pollution load index (PLI), geochemical accumulation (Igeo ? 0) index as well as the applied sediment quality guidelines (SQG) values by the World Health Organization (WHO) and United State Environmental Protection Agency (USEPA) indicates low to moderate degree of contamination from sediment metals concentrations and the unlikely risks to ecological receptors during the study period.

TU072 Effects of culture medium on metal toxicity and new approach for ectocytosis assessment
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Pollution of aquatic ecosystems is a global problem affecting the biological continuity of living organisms. In this context, metals is a group of pollutants occurring naturally in the environment, however human activity increase its concentration in the environment. Therefore, for environment surveillance purposes, metals entering aquatic ecosystems are regulated by water quality guidelines. The last one is based on the results obtained in toxicity tests using aquatic organisms, nonetheless the reported medium Effective Concentration (EC50) of a tested metal in a species widely varies. Here, our first purpose was to 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 to study metal species play an active role in their metabolism. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplate (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (453/685 nm). In the first experiment, the microalgae was exposed for 72 hours to each metal using three different types of culture medium, OECD medium or 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 72 hours were 140, >1200 and 293 µg/L for Cu, Pb and Zn in OECD medium, respectively, in mOECD they were 34, 219 and 134 µg/L, respectively and in BBM, they were >300 µg/L in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg/L for Cu, Pb and Zn, respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affects 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. Manzor-Najera, G. Barrera Escrig, Universidad Autonoma Metropolitana (Iztapalapa / Hidrobiologia; P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiologia Human population has seen the deterioration of resources derived from its overexploitation and contamination by anthropogenic activities, an example of this is water. Due to the growing demand for this resource, associated to human population growth, the need for its protection and conservation is more evident than ever. In this study, the objective was to evaluate the water quality and the population status of Oreochromis niloticus located in the Tenango dam, in Puebla, México, which is used for fishing, irrigation, recreation and electric power generation, among other purposes. For this purpose, the study was carried to evaluate the ecotoxicology status and environmental quality. Five field trips were made in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, nitrites, nitrates/n and phosphorus; also metals: cadmium, chromium, copper and lead were determined in both water and tilapia. Results indicated that the n physicochemical parameters are within Mexican admissible ranges. Nitrite and n 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 limits allowed by n Mexican law, while in tilapia, cadmium only exceeded the acceptable limits/n for consumption in two seasons. Based on the concentrations of nutrients and n metals, it is concluded that water and the Tenango dam is not suitable for n 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/n associated with this artificial water body. The diverse uses and the absence/n 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/n natural area.

TU074 Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks 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 presence of heavy metals in lipsticks is a recent issue and 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 calculate 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 560.59 and the lowest value was obtained in Arsenic with 1.43×10^-4. However, target cancer risk (TR) was highest for Lead with the value of 2.10×10^-14. 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 samples 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 usage and abuse of these chemicals, has been the reason of the increase over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper may affect biochemical processes, such lipid metabolism of some organisms and enriched in the change of Liver weight was 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 experiments were exposed under laboratorial conditions to copper sulphate to determine lethal concentration; at a second phase, it was conducted under field conditions. Nutrient status and other environmental factors were kept constant. The fatty acid profile was evaluated both at the field and in the lab. Our results state C. edule is more sensitive to copper sulphate (LC50 = 0.818 (0.595–0.987) mg/L; 1.129 (0.968–1.289) mg/L, to big and small organisms, respectively) than S. plana (LC50 = 2.563 (2.229–2.903) mg/L; 4.705 (3.540–12.292) mg/L, to big and small organisms, respectively). Furthermore, the last one presents greater abundance and variety of FA and essential fatty acids (EFA), notably DHA and EPA, rates than C. edule. Still, big size class of both bivalve species is the most affected by the contaminant.

TU076 Heavy metals in soil and vegetables of allotment gardens in the Cape Town, South Africa
M. Pieterse, T. Oosthuysen, T. Farrar, A. Giwa, Cape Peninsula University of Technology / Chemistry
Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are persistent environmental contaminants which ultimately accumulates in soil with possible translocation into the tissue of vegetables, thereby posing a potential risk to human health. While most research focus on major agricultural areas, less attention has been paid to the accumulation of heavy metals in home gardens, schools and rural areas where subsistence farming is increasingly used in South Africa as a means of poverty alleviation and increasing food security. This study was conducted to investigate the concentration of selected heavy metals in soil, water and vegetables. 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 (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 d tests. Dry Buffalo River sediment, a sediment with reasonable worst-case properties for metal binding, typically removed 70% Cu and Ni from the water column at 1 mg/L loading. Incubated sediments removed metals significantly faster than non-incubated sediments (p < 0.05). Higher sediment loading rates removed metals faster as expected. Sediment type and loading rates affected pH, which started at 6.0 Cu removal (96 h) and resuspension (1 h post 96 h) resulted in no significant increase in Cu, but did elevate Fe concentrations. The results show that 70% of Ni and Cu is removed from the water.
column using this test modified OECD 29 test method, using a variety of sediments and conditions.

TU079 Modelling the chronic toxicity of copper to fish at low pH
S. Baken, European Copper Institute; K. De Schamphelaere, Ghent University (UGent)
Sediment 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 updated 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 several different capping materials for decreasing Zn dissolution during periods when the hypolimnion is anoxic and acidic (pH=5.5). Capping materials were selected based on results from laboratory batch testing and included AquaBlok, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Limnocorals (LC) to isolate water columns above various capping treatments, simulating lake-mesocosms. Simultaneous in-situ and ex-situ toxicity tests were conducted using Daphnia magna, Hyalella azteca and Chironomus dilutus. Test organisms were protected from temperature shock by pre-acclimatizing over 24 hrs and then deploying the test chambers in a Toxicity Assessment Container System (TACS), which protected the organisms from warm surface waters until reaching the bottom sediments and colder water. Test organisms were exposed to surficial sediments in reference LC or capping materials and overlying water. In-situ 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 REREchange - Rare Earth Elements Ecotoxicology in a Changing Environment
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REREchange 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 issue management 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 REREchange 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 subcapitata so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are of the same magnitude as for cadmium. (2) by substance flow analysis (SFA) for La and Gd, exemplarily performed for Germany. Information has been collected from published work for a variety of potential sources for La and Gd in rivers and lakes. Additionally, water and sediment samples have been analysed at specific locations. Current data point to wastewater and specialised industries as prominent sources of emission. (3) by investigating the impact of changing environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests were 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 current results of the microcosm experiments along with the information on bioavailability based on biotests and speciation data.

TU082 Sediment characteristics of natural and anthropogenic origin and their possible association with benthic macroinvertebrates in a minimally affected river in South Africa.
C. Wolmarans, H. Pienaar, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology
Sediment characteristics generally entail metals, minerals, organic content, elements, particle size 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. Weathering of minerals originating from the primary lithology can on the one hand add to the metals in sediments and on the other hand to the particle size composition. Although it is well known that chemical pollutants, due to anthropogenic impacts, act as a major determinant for the macroinvertebrates composition in surface waters the influence of the above mentioned components in a pristine river is less known. The aim of this investigation was firstly to determine the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structures in the Min桢 River. In South Africa the Min桢 River is a small estuarine system consisting of a river in South Africa. One of the main objectives of the current research was to investigate the relationship between the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structures in the Min桢 River. In South Africa the Min桢 River is a small estuarine system consisting of a
through thiobarbituric acid reactive substances (TBARS) measurement in the muscle tissue. The results showed changes in the behaviour and enzymatic activity at the different copper sulphate concentrations to both size classes. Moreover, according to TBARS levels, lipid peroxidation possibly occurred on the big size class of C. edule. The muscle tissue (foot) showed to be a good tissue to use in biochemical analysis to detect response to the exposure to toxicants.

TU084
The impact of single metals and mixtures in nature: a microcosm experiment
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Even though ecotoxicological risks of metal-contaminated systems remains an important challenge. While laboratory experiments with metal mixture exposure are receiving more attention in the literature, little research has examined the interaction of natural stressors with metal mixtures. In the lab, we already performed experiments on Axelius aquaticus, exposing this freshwater isopod to a combination of metal mixtures and temperature stress. This way we could study effects on the individual level and relate metal contamination to relevant sublethal endpoints (e.g., growth rate, feeding rate). The present study, a microcosm experiment in a greenhouse, was designed to gain more insight into the effects of these metals on populations and communities. Small ecosystems with several species of macroinvertebrates were exposed to Cd, Cu, Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed Axelius aquaticus, Daphnia magna, Chironomus riparius with different life stages, Physa spp., Ephemeroptera (macrophyes) and Raphidioellus subcaespitiae (algae). The theoretical metal concentrations were 1.5 µg/L Cd, 70 µg/L Cu, and 72 µg/L Pb. Half of the medium was renewed weekly. The effects of the metal mixtures and natural stressors were examined after 4 and 8 weeks, on the individual level (total metal accumulation, survival, shoot and root length), the population level (species densities, biomass) and the community structure (diversity, evenness). Preliminary results show a high variability between replicates. We observed no significant differences in species densities between the metal treatments after 4 or 8 weeks. After 4 weeks, we found that Cu and the tertiary mixture negatively affected shoot and root length of E. nuttallii compared to the control treatment. However, after 8 weeks, we did not find these significant differences. As we could not find any significant effects of the metals at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

TU085
The influence of soil properties on lead bioavailability and toxicity to Enchytraeus crypticus
L. Zhang, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Soil properties are important factors modifying metal bioavailability to soil organisms and subsequently affecting the metal toxicity. The present study aimed at investigating the bioavailability and toxicity of lead to the potworm Enchytraeus crypticus on different soils. Effects of Pb concentrations in the enchytraeids, as Pb availability, internal Pb, mortality and general, pH was an important soil property affecting LC50, EC50 and internal Pb concentrations (R² = 0.86) or organic carbon content (OC) (R² = 0.90) or pH concentration increased linearly with increasing CEC (R² = 0.94). The differences in Pb toxicity among soils could be explained from CaCl2 basis of total Pb concentration increased linearly with increasing CEC (R² = 0.96 - 0.99) and Freundlich sorption constant K_f increased linearly with increasing cation exchange capacity (CEC) (R² = 0.86) or organic carbon content (OC) (R² = 0.76). Pb bioaccumulation in the enchytraeids was soil-dependent, but differences between soils almost disappeared when relating Pb bioaccumulation to available Pb concentration in soil. Toxicity values varied greatly among soils, with median lethal concentrations (LC50) based on total Pb concentrations ranging from 246 to >3092 mg Pb/kg dry soil. LC50 on the basis of total Pb concentration increased linearly with increasing CEC (R² = 0.70-0.90) or pH (R² = 0.87-0.94). The differences in Pb toxicity among soils could be explained from CaCl2 extractable Pb concentrations in soil (R² = 0.97) and internal Pb concentrations (R² = 0.97). Median effective concentrations (EC50) based on total Pb concentrations varied 12-fold among soils from 81 to 1008 mg Pb/kg dry soil. EC50 on the basis of total Pb concentrations increased linearly with increasing pH (R² = 0.70-0.94). The variation in EC50 was best explained by differences in the CaCl2 extractable Pb concentrations in the soils (R² = 0.94). In general, pH was an important soil property affecting LC50, EC50 and internal Pb concentrations in enchytraeids, as Pb availability, internal Pb, mortality and reproduction were inversely related to soil pH. Soil properties should be taken into account during the ecological risk assessment of metals in contaminated soils.

TU086
Toxicity evaluation of soils sampled in the vicinity of an Aluminum smelter in Montenegro using the Ames, Biomiminescence and DR-LUC bioassays
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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. This area with intensive industrial activity is also rich with agriculture and is just in 5km distance from Podgorica (Capital of Montenegro). Waters of several rivers in this area, which are significantly influenced by municipal wastewaters of tree cities, are abundantly used for watering crops in area. We tested mutagenic potential of samples organic extracts in the Ames test, on bacterial strain Salmonella typhimurium TA98, acute toxicity by biomimenscence test Vibrio fisheri 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 exceed 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 Insurbia / Department of Theoretical and Applied Sciences (DiSTA)

The prohibitive economic and social cost of testing, necessary to provide extensive information on fate and effects of existing chemicals to humans and the environment, highlights the need to focus on rational and safe design of chemicals before synthesis (i.e. Safe by Design – SbD approach). This approach applies the principle of green chemistry “Design safer chemicals and products,” and is useful to prevent hazardous substances from being developed and entering the environment, as well as to build safer alternatives to existing hazardous chemicals. While in the last decades computational chemistry and in silico models have been widely and successfully applied in the design of drugs with desirable pharmacological activity, these strategies have not yet been applied extensively in the design of sustainable, “safe by design” industrial chemicals as well as no real guidelines exist at the regulatory level. Modelling approaches based on Quantitative Structure-Activity Relationships (QSARs) rely on the assumption that biological activities/properties of chemicals are intrinsically dependent on the molecular structure. Endpoints like for instance toxicities, physico-chemical properties as well as biotic and abiotic degradations can be predicted starting from models based on molecular descriptors of the chemical structure, which serve as basis to develop the SbD approach. Therefore, in silico strategies such as the aforementioned QSAR (and QSAR-like) models and multivariate analysis (MVA) can be successfully applied to screen 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 QSARINS and available in the freely distributed QSARINS-Chem module to screen “safe” from “unsafe” compounds on the basis of different endpoints of scientific and regulatory interest. Different classes of emerging pollutants were investigated using in silico models, such as Flame Retardants (FR), Personal Care Products 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
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Recently the International Center for Pesticides and Health Risk Assessment (ICPS) – Wageningen University, Safety Authority (FRSA). The aim of the project was to investigate the comparability of the EC, approach (Effect Concentration affecting a percentage x of test organisms) to the current NOEC approach (No Observed Effect
Concentration), both derived from chronic and long-term studies of a data sets of 70 active substances of plant protection products (PPPs). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC_{50} or EC_{20} as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depend on the experimental study design, whereas EC_{50} values are considered more appropriate and to which 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_{5} with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSARs) were used to validate the Effect Concentrations of the active substances of the selected pesticides, and to predict missing data. The whole approach is mainly oriented to the aquatic environment, and can provide useful information to screen the potential undesired toxic effects of new pesticides, and of alternatives to existing active substances, starting just from the chemical structure.

TU009

**Influence of coatings in the bioaccumulation of TiO$_2$ and CeO$_2$ nanoparticles in rainbow trout**

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In the framework of the EU Project GUIDEnano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on the the toxicity and bioaccumulation of these NPs trying to establish some relationships between coatings and the related effects. Bioaccumulation studies with rainbow trout have been performed for CeO$_2$ NPs and TiO$_2$ NPs of 4-8 nm uncoated and coated with citrate or polyethylene glycol phosphoric acid ester (PEG). OECD Test Guideline (TG) 305 (diet administration) has been followed. Fish (5±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hematopoietic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO$_2$ NPs. A difference was observed for the uncoated NP for which Ti levels in the fish were higher than for the other coated NPs. Ti levels reached basal values already in the first day of depuration indicating a very fast elimination of these NPs from the organism. Higher levels of Ce with respect to the control group could be measured at the end of the uptake phase in stomach, intestine and gills but not in liver. Ce levels were found in fish treated with the coated NPs but not in the group treated with the uncoated NPs. Levels of Ce could be measured the first day of depuration in stomach and intestine of fish treated with CeO$_2$ NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO$_2$ NPs uncoated or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO$_2$ NPs. These results indicate a different behavior for the CeO$_2$ NPs and TiO$_2$ NPs. No relationship could be observed between the coating and the observed effects. Acknowledgements: EU FP7 project 604387 GUIDEnano.

TU010

**Colloidal characterization of nano-enabled products for the restoration of 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 technologies are still little known and requires an adequate assessment and management of potential risks [2,3]. ENM formulations are increasingly preferred for conservation interventions compared to the corresponding bulk materials formulations because of their small size and enormous specific surface area that favour their interaction with the material to be conserved/restored. But the small size, coupled with their capacity to adsorb biomolecules and reach their target tissues, makes it very difficult 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 complicate the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In the present work, in the framework of the EU FP7 project 604387 GUIDEnano, innovative nano-enabled formulations for the conservation and restoration of modern and contemporary artworks 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 these 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).

TU011

**Considerations for Safe Innovation: The Case of Graphene**

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Safe-by-design in chemistry may possibly contribute to a circular economy by avoiding the introduction of hazardous substances. Specifically in nanotechnology the terms “Safe innovation” and “Safe-by-design” are popular, 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 perform the potential hazard assessment of the substance before its standardization. This is important in order to reach a more reliable exposure assessment and enable use of exposure reduction measures where needed. Furthermore we outline what information on graphene is already available for assessing potential human and environmental hazard, exposure, and risks. For example a first indication of the hazard of an (intended) product can be obtained by collecting information on a limited number of physicochemical properties of the intended 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.

TU012

**Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine**

M. Schmutz, C. Somi, EMMA 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 nanocomic materials. The framework comprises sustainable material design considering the whole life cycle of polymeric nanobiomaterials, environmental and human health risk assessment. Difficulties in the nanomedicine field arise at different levels which are at the research, regulatory and manufacturing levels. Nanomedicine is still considered as a young field and needs further research to better understand the interactions of nanomaterials at the bio-interface 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 health and environmental risks, manufacturing, storage and transport and the regulations related to the topic at hand. At the end of the project, the Safer-by-Design framework will be used as a structural backbone for creating nanospecific guidelines for medicines. These 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 toxicological and environmental assessments
C. Fernandez Dacosta, University of Utrecht / Copernicus Institute; P. Wassenaar, National Institute for Public Health and the Environment (RIVM); I. Dencic, Corbion; M.C. Zipf, RIVM / Centre for Sustainability Environment and Health; A. Morao, Corbion; L. Shen, University of Utrecht / Copernicus Institute; E. Heugens, RIVM / Centre for Safety of Substances and Products; L. Posthuma, RIVM / Centre for Sustainability Environment and Health.

The chemical industry strives for the development of bio-based alternatives for present fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. Many sustainability assessment methods are developed for this purpose. The aim of this study is to evaluate a selection of 12 early-stage methods (ESMs), their applicability, the relevance for bio-based chemicals and the coherence of their outcomes, using bio-based lactic acid as a retrospective case study. The selected methods contain at least one of the following themes: energy, climate change, eutrophication, land use, human toxicity and ecotoxicity. These six themes were considered as most relevant for the case of bio-based lactic acid. The selected early-stage methods were tuned to the right hotspots concerning energy and climate change, which is promising for application during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have lower data requirements and are faster to implement than full assessment methods. However, the results they provide have intrinsically a higher level of uncertainty. Besides, the ESMs existing in the literature do not meet important criteria for utility. They are often not clear in the definitions of the environmental and toxicity indicators neither transparent in background data sources and not up-to-date. Important limitations of the selected ESMs are: 1) narrow life cycle scopes (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based materials that should be considered 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 hydrocarbon carriers (LOHC) - comparative hazard assessment
M. Markiewicz, Technical University of Dresden / Sustainable Chemistry Group; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. 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 (ICP-81), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants (Lemna minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinoline, ethyl-, propyl-, butyl-, and hexyl-LOHCs. In each LOHC system H2 was loaded: H2-lean, H2-rich and partially hydrogenated. Low to moderate (eco)toxicity, comparable to automotive diesel oil, was observed for the quinoline LOHC system. No effect occurred in aquatic tests for H2-lean alkylcarbazoles due to unstable exposure. The H2-rich forms were moderately cyto-ecotoxic. High cytotoxicity was observed for partially hydrogenated alkylcarbazoles, with the effect increasing with the chain length. Alkylcarbazole LOHC systems were generally more toxic than diesel oil. None of the LOHC chemicals show appreciable biodegradation except quinoline. Further biodegradability test under less stringent conditions are needed to investigate potential persistence. Additionally, hydrophobicity of H2-lean and intermediate forms of alkylcarbazoles (log D 3.6–4.8) indicates that they might be bioavailable. Nonetheless, undesirable socioeconomic benefits come from the fact that LOHC energy systems can operate on renewable energies. Moreover, this LOHCs are more favourable in the terms of handling and transportation safety. The composition of LOHC chemicals is much better defined than it is in case of fossil fuels, which facilitates standardisation or quality control. This study also showed that many of the standard (eco)toxicity testing approaches are not well suited for LOHC systems showing moderate to high hydrophobicity as it is the case for diesel oil.

TU095
1-Octanol and 2-Butanone as biofuel candidates - Using “Green Toxicology” for abiofuel 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; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry.

The development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute eye and respiratory toxicity (Danio rerio). Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates: 2-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 “Production of 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 deuterated 2,2-dimethylpentane solvents (DMPs) on the environment and human health
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The development of environmentally benign and green synthetic protocols, due to the growing concern over the environmental impact 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 eye and respiratory toxicity (Danio rerio). Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates: 2-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 “Production of fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

The development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute eye and respiratory toxicity (Danio rerio). Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates: 2-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 “Production of 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. Klusnerts, 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 CO; 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 registrations in each country. However, Korea's agricultural and livestock LCA DB does not meet the ISO requirements, it is time to revise. The purpose of this study is to develop the LCA database for the estimation of the environmental footprint (PEF) of major domestic food exports to Europe and to use the common protocol and food - specific guidelines (PCR) to estimate environmental footprints, and aims to obtain EPD certification of food. To do this, we benchmarked the protocol and PCR for the Korean conditions by examining the cases of the calculation guidelines of the developed countries. In the future, it is meaningful to construct a database that can be used as basic data for obtaining PEF certification for foods exported to Europe and overseas.

TI099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; E. Diaconu, JRC European Commission; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
In 2013 a Communication from the Commission to the European Parliament (COM/2013/0196) established the Environmental Footprint (EF) scheme. The common methodology, nomenclature and requirements were implemented through a Life Cycle Impact Assessment (LCIA) method. The new database has been partially changed and adapted to fulfill the scope. Beyond that, the reference data contained in the ILCD package was found to contain some format, syntax and conceptual errors which were inherited from several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors as well as when implementing the ILCD validation tool. In the implementation, further, 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 EPDCA 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.

TU101 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, OxokoW; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
Aachen University
Life Cycle Impact Assessment (ILCD) has been recommended as a baseline for data development in the EF scheme. However, in the development of a high-quality environmental information database, several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors as well as when implementing the ILCD validation tool. In the implementation, further, 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 EPDCA 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 whoever the LCA practitioner is. This will be the basis for the calculation of the consumptive water (output minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operational water inputs in a chemical plant and the link to the life cycle inventory phase and ILCD flow names. This paper is based on the ecoinvent methodology for calculating eco-profiles. It is expandable or adaptable to all kind of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to go LCA. The presentation aims to tackle LCA’s 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 N. Negishi, CSTB; L. Barna, INSIA Toulouse / LISPB; Y. Pigné, Université de l’Havre; T. Navarrete-Gutierrez, LIST; N. Schiopu, A. Lebert, CSTB; T. Gibon, Luxembourg Institute of Science and Technology (LIST)/Environmental Research and Innovation, U. Bonn; B. Basso, Luxembourg Institute of Science and Technology (LIST)/Environmental Research and Innovation Nowadays in France, environmental and energy rules for the construction sector are based on environmental performances of products assessed through LCA methodology. However, the actual practice of LCA is lacking of temporal dimension whereas the long life temporal during the long life time 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://www.dyplca.pigne.org/), aiming at calculating time dependent environmental interventions and the related impacts of toxicity and climate change. The aim of this study is to investigate the environmental performances over a large time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions matrix was then used with DyPLCA web tool for temporal LCI calculation. The temporal characterization of the product system considered two parts. Temporal characteristics of the foreground system were related to the building construction, materials replacement and renovation activities during the building’s life time of 100 years. The temporal characteristics of background processes were previously integrated in a dedicated database and used with DyPLCA tool. Temporal LCI, i.e. environmental interventions distributed in time, was then used for climate change impact calculation in function of time. Two indicators were calculated in function of time: mean temperature change and radiative forcing. The new method allows considering fossil and biogenic carbon for climate change proposes without clashing on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic method allows better understanding of our carbon footprint 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 ILR; J. Godar, Stockholm Environmental Institute That location matters when it comes to quantifying environmental impacts of agricultural commodities is the increasing understanding that the increasing importance of the LCA literature. Authors tackle the influence of spatial variability by capturing differences in agricultural practices, transport options and industrial processing sites in the life cycle inventory (LCI). This information is, however, incomplete when quantifying impacts of agricultural commodities that are produced in large amounts and traded worldwide, e.g. soybean. Despite the efforts from the Input Output approach, they do not consider the impacts of the entire commodity chain, 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 Trade 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 relative contributions that add up to further the entire supply chain, mainly LUC, for which considering sub-national scales is crucial in the quantification of climate change impacts. Outcomes support the argument that importing countries of soybean-based commodities should take responsibility on deforestation and associated carbon emissions, provided that spatial explicit data is available. This transparent tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

TU104 Carbon Footprint Projections for Japan Using Computable General Equilibrium Models Y. Ichisugi, Tokyo City University; T. Masui, National Institute for Environmental Studies; N. Isbou, Tokyo City University In 2015, Science Based Targets (SBT) has been paid attention to the world. The targets adopted by companies reducing greenhouse gas (GHG) emissions to keep global temperature below 2 degrees increase from 2018 of preindustrial revolution. Currently, approximately 300 companies in the world declared to follow their targets. The target to the mitigation would be based on the calculated results of Integrated Assessment Models (IAM) such as Asia-Pacific Integrated Model (AIM), Integrated Model to Assess the Global Environmental (IMAGE). However, these results usually don’t consider the entire supply chain, because of the differences of the aims of application. In contrast, Life Cycle Assessment (LCA) considers the entire life of the material chain. On the other hand, most LCA studies use current environmental data and normally don’t include the dynamism of system. Therefore, this study aimed at the development of a dynamic evaluation of environmental impact method based on life cycle thinking to use both advantages of IAM and LCA. Currently, we try to develop the database using AIM developed by the National Institute for Environmental Studies (NIES). That model uses Computable General Equilibrium (CGE) which can estimate economic efficiency in the future, based on price mechanism in the market. In this study, we collect fundamental data using LCA database and estimate GHG emissions in the future considering the supply chain among industrial sectors. We estimated GHG emissions in 2005 as a tentative result in Japan. The total emission is approximately 1.13E+08t-CO₂eq. We confirmed the validity compared with the existing report published by the ministry of the environment in Japan. In the future, we will estimate environmental impact projection considering the scenario like Shared Socioeconomic Pathways (SSP).

TU105 Network LCA as a tool to enhance data collection and usage in a value chain context Y. Vihol, VTT Technical Research Centre of Finland; M. Myllysilta, S. Majaniemi, VTT Technical Research Centre of Finland Ltd. Keywords: LCA, data collection, value chain Life cycle assessment as defined by the ISO (14040) consists of four phases. First, the goal and scope are defined, after that the inventory analysis is performed followed by the life cycle impact assessment. At the end, the results are interpreted. The inventory analysis includes the collection of relevant data. However, the methods analysis is the part in which environmental burdens are compared. Firstly, it is seen as the most time consuming phase of every Life Cycle assessment study. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is bigger than those of the competitors. In other words, network members can independently run test and investigate the impacts of the changes e.g. on material and the time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions matrix was then used with DyPLCA web tool for temporal LCI calculation. The temporal characterization of the product system considered two parts. Temporal characteristics of the foreground system were related to the building construction, materials replacement and renovation activities during the building’s life time of 100 years. The temporal characteristics of background processes were previously integrated in a dedicated database and used with DyPLCA tool. Temporal LCI, i.e. environmental interventions distributed in time, was then used for climate change impact calculation in function of time. Two indicators were calculated in function of time: mean temperature change and radiative forcing. The new method allows considering fossil and biogenic carbon for climate change proposes without clashing on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic method allows better understanding of our carbon footprint 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.

Keywords: LCA, data collection, value chain Life cycle assessment as defined by
TU110 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 of energy, space that are directly used, or are directly released to the environment or released directly back into the environment. Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An early activity within the UNEP-SETAC Life Cycle Initiative was the creation of a recommended list of flow exchanges by the Data Availability and Data Quality Workgroup (de Beaufort-Langeveld et al. 2003). Elementary flows in all life cycle inventory and life cycle impact assessment sources used in a model must correspond, or match, in order to build a functional LCA model. Edelen et. al. 2017 formulated recommendations on formatting and management based on a critical review of elementary flows from eleven LCA sources. These recommendations have been used to categorize flow information into three components and flow metadata into six components. These structured components of flows allows for systematic analysis and structuring of flow components through a knowledge organizational structure (KOS). The ISO 14048 standard was used to structure the different flow and metadata components as exclusive, inclusive or user-defined nomenclatures. The KOS is maintained in a user friendly, publically accessible interface through the US EPA terminology services. This research presentation will focus on describing the benefits of the KOS approach and the tools used to build out the nomenclature system and provide an example application of the KOS to current elementary flow nomenclature. References [1] de Beaufort-Langeveld A, Bretz R, Hirsch R, Huijbregts M, Jean P, Tanner T, van Hoof G (2003) Code of life-cycle inventory practice. SETAC Press, Pensacola, FL [2] Edelen A, Ingwersen W, Rodriguez C, Alvarenga R, de Almeida AR, Wernet G (2017) Critical review of elementary flows in LCA data. INT J LIFE CYCLE ASSESS. https://doi.org/10.1007/s11367-013-1354-3 [3] ISO 14044 (2006) ISO 14044: Environmental management--Life cycle assessment--Requirements and guidelines. International Organization for Standardization, Switzerland

TU106 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 direct recipient of anthropogenic inputs, 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 days exposures of mussels to 32P of varying dose rates (i.e. 0.10, 1.0 and 10.0 mGy/d) taking into account a current no-effect screening value of 0.24 mGy/d (European Commission). The first set of studies determined 32P accumulation in specific mussel tissues (i.e. adductor muscle, digestive gland, mantle, gills and ‘other’), internal mussel water (water inside the mantle cavity), shell and faecal matter using scintillation techniques. From this bioaccumulation study, we were able to highlight key tissues of interest; the digestive gland for example, received the greatest proportion of 32P independent of mussel species. In the next set of studies, a suite of biological responses of the mussel were investigated in digestive gland and gill cells. This included the induction of DNA damage (Comet assay) and repair response (Gamma-HAX), 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 mGy/d in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to fresh water (DP), marine bivalve (MG) displayed a higher induction of MN and 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 radionucleide uptake, and (c) the importance of adopting a multi species, multi biomarker approach when assessing the possible effect of contaminants in the aquatic environment.

TU107 Building a Life Cycle Inventory of stormwater pollutant fluxes: model evaluation for a separate residential urban catchment E. Risch, IRSTEIA Montpellier / UMR ITAP; P. Roux, Istre, ITAP ELSA-PACT; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istre / UMR ITAP; C. Sinnfort, ITAEP, Istre, Montpellier SupAgro, Univ Montpellier / ELSA Research group and ELSA-PACT Institute

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 in the freshwater eco-toxicology 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, this paper presents a LCA inventory implementation 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 urban catchment was modelled on elementary urban surfaces with 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 Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a viable inducer candidate? L. Fernández González, P. Sanchez Marin, University of Vigo / Ecology and Animal Biology; G. Grueiro Noche, S. Muniategui Lorenzo, University of A Coruña / Analytical Chemistry Department; A. P. Díz, University of Vigo / Biochemistry Genetics and Immunology; r. beiras, University of Vigo / Toralla marine sciences station (eicma);

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 synthetic estrogen 17a-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 significantly higher than mussels exposed to a solvent control. These results suggest that EE2 does not induce Vtg in Mytilus 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 endocrine disruption studies.

TU110 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 deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted for understanding and delaying effects on the offspring and population dynamics observed from four 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 deposits through toxic effects to the liquid media or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having high levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

TU113 Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river

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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 amphipods. Numerous species have been characterized with respect to pollution burdens of water and amphipod tissues. Amphipods from three sampling points were brought alive to the lab and exposed to the insecticide Imidacloprid, which was found in water and animal samples beforehand. Lethal time for 50 % (LT50) values were determined and movement activities and moulting rates were recorded. Mortalities in the Imidacloprid treatments clearly differed for amphipods sampled at different sites; animals from more polluted sites were more sensitive to the toxicant and also exhibited reduced movement and moulting activities. We examined whether these differences in toxic sensitivities were related to differences in toxicokinetics of Imidacloprid by quantifying imidacloprid tissue levels after different times of exposure to the compound but toxicokinetics of imidacloprid proceeded similarly in animals from different sites. Population genetics approaches (sequence comparisons of a DNA stretch of the cyctochrome oxidase I (COI) gene and comparisons of 9 microsatellite loci) revealed that differences in conditions between sites did not lead to the separation of distinct subpopulations suggesting that survival of individuals at each site is based on individual acclimation and not on adaptation to specific conditions by a distinct subpopulation.

TU114 Antennae Regeneration of the Marine Amphipod Parhyale Hawaiensis as a Possible Endpoint in Ecotoxicology - Preliminary Data

O. Diehl, P. Assano, G. Umbuzeiro, School of Technology, UNICAMP / LAEQ Parhyale hawaiiensis is a marine amphipod of worldwide circumtropical distribution. In an ecotoxicological test, P. hawaiiensis 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. hawaiiensis has local progenitor cell in each part of body. It was already been demonstrated that P. hawaiiensis has a fast regeneration of thoracic limbs, within a week, but no information on antennae's regeneration was found. Thus, the aim of this study was to obtain data on regeneration of antennae of P. hawaiiensis 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

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The (pseudo)existence of emerging contaminants and other organic micropolutants in the environment represents a risk for the organisms that are exposed to them. Metabolomics is playing a powerful tool within environmental toxicology to better understand the effects of the exposure scenarios. However, metabolomics is an emerging field and to interpret the use of metabolite data for the understanding of toxicological responses is challenging. We need to know what is ‘normal’. The variability in individual metabolomes for a species, or a ‘background metabolome’ should be established to determine possible confounding factors such as age, sex and moulting (among others) that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolic variability in the freshwater invertebrate, G. pulex. Herein, an analytical method is presented for the extraction and non-target analysis of the metabolome in G. pulex. Briefly, a dual phase liquid extraction was used followed by HILIC-HRMS to enable detection and annotation of metabolic features extracted from individual animals. Animals collected from the field were analysed immediately and compared to animals that were extracted after a fixed period of acclimatisation to laboratory conditions. The results indicated that sex, moulting stage and acclimatisation period affected the metabolic variability and factors that are likely to influence metabolomic analyses should be investigated to aid understanding of pathways involved in effect-based studies. Furthermore, it may be possible to select and use particular organisations that are more useful in the data. Overall, the characterisation of metabolic variance for invertebrates along with the use of metabolomics shows a very powerful approach for understanding adverse effects that may be associated with environmental contaminants. References. 1) Zhang, T., et al. (2012). Analytical chemistry, 84(4), 1994-2001. Keywords: metabolomics; invertebrates; pharmaceuticals; modelling
organism transferred to recipients containing 100 mL salt water and a picture of each of these organisms was taken under an stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were fed every three days, and necessary conditions for salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertook full regeneration. At the last day of the experiment, another pictorial data was done to determine the difference between the first and last day length (mm) before and after full regeneration. A complete regeneration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently. Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxicants to understand their abilities to tolerate in the regeneration process in the developed experimental conditions. Acknowledgement: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-PVE Process: 400362/2014-7) for funding and PIBIC for undergraduate fellowship. Amanda dos Santos e Gabriel Rampazzo Magalhães for technical contribution.

TU115
Added value of community approaches in environmental risk assessment
M. Hammers-Wirtz, T. Strauss, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaia
Community studies are an ecologically relevant tool to assess effects of stressors on population and community level and become pertinent to stand for the current evolution of European regulatory requirements regarding the establishment of cause-effect relationships in the assessment of environmental quality. Under this approach, the European Marine Curie QWATER project was aimed to gauge the ecological relevance of integrating short-term toxicity bioassays and biomarkers into quality elements in the WFD, as these may contribute to our ability to assess and manage EU water bodies. Ecologically relevant in situ cost-effective toxicity bioassays were used in a battery of in situ bioassays using representative species for several key functions in the ecosystem. Biomarkers, determined on the individuals used for the bioassays, were also integrated. Principal component analyses (PCA) were performed independently for each source of information, in order to improve the interpretation of the resulting PCA-factors in biological terms, and to verify whether the integration of ‘quality elements’ (bioassays and biomarkers) did (or did not) strengthen the robustness of the standard Ecological Quality Status approach used to assess water quality. Results shown some discrepancies in the water quality determined from each independent factor, i.e., the sampling sites were not equally ordered by all factors. Therefore, only by interpreting the values of all PCA-factors together is it possible to perform a complete assessment of water quality status. The European regulatory authorities are presently in the phase of implementing the WFD based on community level approaches all over Europe. Interestingly, bioassays developed here and biomarkers, are available tools to be introduced as new feasible, cost-effective and sensitive protocols in the WFD. It might then become pertinent to stand for the combined/complementary use of ecological indicators and biomarkers, and to verify whether the integration of ‘quality elements’ strengthens the robustness of the standard Ecological Quality Status approach used to assess water quality status. Overall, this project allowed us to efficiently contribute to national and international efforts focused in evaluating the water quality in European water bodies.

TU116
Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa
J. Licias, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences; B.G. Syrman, Cape Peninsula University of Technology / Biodiversity and Conservation; J. Odendaal, Cape Peninsula University of Technology / Department of Environmental and Occupational Studies
Freshwater ecosystems are considered among the most threatened, as a result of current trends in water utilization globally. Within the Western Cape, 76% of rivers are polluted and run the risk of irreversibly losing their ability to support 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 the development of a test system for stonefly larvae Pantonemus sp., 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 surroun...
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 snail larvae, which is performed in Cu-reduced dilution water, moderately hard reconstituted water (according to EPA) works best for testing of mayfly larvae. Instead of Tetramin®, which was used in snail testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. As a result, the mayfly larvae were acclimated for 48 hours, the acclimation period was extended to seven days before test start. Under these conditions mayfly larvae showed an acceptable mortality of test organisms. The next step is to perform a test with the test substance Imidacloprid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and snail larvae to Imidacloprid will be compared. The new testing method can provide toxicity data of aquatic testing with 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 snail species will be presented.

TU119
Toxic effects of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation

Carbamate insecticides are commonly used in agriculture for crop protection exerting their toxicity through the inhibition of the enzyme acetylcholinesterase. In Argentina, the maximum concentration of carbaryl (CAR) detected in surface and subsurface drainages was 45.7 μg L⁻¹. In this study, we evaluated the subchronic toxicity of environmental concentrations of the active compound and a commercial formulation of CAR on biochemical and reproductive parameters in Daphnia magna, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 12.68 μg L⁻¹, and the equivalent to 12.68 μg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were chosen so as to have the same molarity as azinphos-methyl, an insecticide previously used in our laboratory. In bioassay 1, eight glass vessels per treatment were used with six snails each. After 14 days of exposure, homogenates were made with the organisms’ soft tissues (pool of five snails per vessel). In the supernatant fraction, the following parameters were measured: cholinesterases (ChEs), carboxylesterases (CeEs) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassay 2, two glass containers per treatment were used with a single recently-laid egg mass each. The time and success of hatching were registered and, after one month, the survival of the offspring was evaluated. In both bioassays, CAR solutions were renewed every 48 h based on previous stability studies. The active compound caused an increase in the activity of SOD with both CAR concentrations (28 and 83%, respectively, compared to the solvent control). The formation of MDA increasing SOD activity (72%), and inhibited CAT activity by 23% and inhibited CAT activity by 47% (compared to the water control). Regarding the reproductive endpoints analyzed, no toxic effects were found neither to the primary target, ChEs. However, other toxicity pathways, in which antioxidant enzymes are involved, seem to be affected by this insecticide, mainly by the commercial formulation.

TU120
Toxicity of lanthanides to freshwater microcrustaceans
M. Muna, TU120; E. N. Vebrosky, Freshwater Vertebrate and Invertebrate for Ecotoxicological Analyses: Potential Phototoxic Effects Comparing a Freshwater Vertebrate and Invertebrate
TU121
Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; M. Muna, Louisiane State University / Department of Biology; M. Basirun, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

In Louisiana, crayfish are not just a standard invertebrate species found in bayous and rice fields but also a staple in the cuisine and culture. Over 82 million pounds of crayfish are harvested annually, resulting in a $45 million industry; therefore, they are both ecologically and economically valued in the region. 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 shows 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
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; M. Muna, Louisiane State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

In Louisiana, crayfish (Procambarus clarkii) is a standard freshwater crustacean species found in the bayous that are of such high importance. The use of crayfish, or other crustaceans, in ecotoxicological testing may benefit the overall risk assessment for the ecosystem. In some states, such as Louisiana where they are of such high importance, the use of crayfish, or other crustaceans, in ecotoxicological testing may benefit the overall risk assessment for the ecosystem. In some states, such as Louisiana where they are of such high importance, the use of crayfish, or other crustaceans, in ecotoxicological testing may benefit the overall risk assessment for the ecosystem.
Biomagnification in corals can occur through both filter and suspension feeding. It is also known that metals in corals will consistently reflect metallic element composition of the water of a particular area—hence, bioconcentration. Other methods of metal uptake are difficult to assign to one of these categories. Metal particles in suspension in the water are trapped by the defensive mucus layer and ingested by the coral colony as ‘food’. This might be seen as biomagnification. However, biomagnification is traditionally associated with trophic transfer through prey items, and thus the term ‘biomagnification’ does not fit the normal description. In this case, we propose that this route of uptake be called ‘particulate vectored accumulation’.

Coral species can also include other elements into their skeleton lattice by substitution of Ca\(^{2+}\) with other divalent metallic elements. ‘Latticine inclusion’ might be an apt novel term for this occurrence. The crystalline structure of the CaCO\(_3\) coral skeleton differs between hard and soft corals, being either aragonite or calcite. Different metals may bind differentially with the different crystalline structures. Small metal particles in suspension can also simply become lodged in the pores and cavities of 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’. Zoanthellate 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.

TU126
Survival, metabolic rates and locomotory activities of a groundwater-obligate copepod species under long-term exposures to tetrachloroethylene
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Tetrachloroethylene (TCE) is a contaminant frequently found in groundwater of industrialized areas worldwide. The degradation of this chlorinated aliphatic hydrocarbon (CAH) is often incomplete in groundwater and takes several decades. Contamination from TCE is considered persistent and difficult to remediate, due to its high density that favors a gravity-driven vertical infiltration into groundwater bodies. Through means of the Water Framework Directive the European Union has demanded Member States to provide TCE threshold values (TV) for assessing groundwater body quality. In Italy, TCE TV is 1.1 μg/L in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in different organisms, however the effect of this contaminant on groundwater-obligate species has not been investigated to date. More importantly the effect that 1.1 μg/L TCE may have on groundwater species under chronic exposures is unknown. In this study, we investigated the effect of 1.1 μg/L TCE on survival, oxygen consumption, and locomotory activities of a groundwater-obligate copepod species (Moruaria sp.) under different time exposures. The specimens required for the trials were collected in the Antro del Corchia Cave (Tuscany). We measured the individual-based oxygen consumption of this species as a proxy of possible metabolic reactions to long-term (4+ days) exposures to TCE at 8.0°C, i.e. about the mean annual temperature of groundwater in the cave. To this end, we used a sealed glass microplate equipped with planar oxygen sensor spots with optical isolation glued onto the bottom of 80-μL wells (Losil Systems, Denmark) and connected to a multiwell oxygen sensor (MultiWave Sensor Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 2 replicates and 4 controls. Survival and locomotory activity assessments were performed by counting the number of alive individuals and measuring the number of moving animals in 5 mL glass vials each containing 20 individuals.
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster Crassostrea brasiliana exposed to pyrene (50 mg L⁻¹ and 100 mg L⁻¹) and fluorene (100 mg L⁻¹ and 200 mg L⁻¹), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcript levels of phase I (CYP1-like, CYP2-like, CYP2A11 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 medium. After fluorene exposure, transcript levels of phase I gene were higher in 200 mg L⁻¹ (96 h). Transcript levels of all genes were higher in oysters exposed to 100 mg L⁻¹ of pyrene (24 h). Besides, CYP2A11 (24 h and 96 h); GST-like (24 h and 96 h) and SULT-like (24 h) were higher in oysters exposed to pyrene and fluorene, respectively. 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 CYP2A11 gene in the biotransformation process of PAHs in gills of C. brasiliana.

TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB PACHYGRAPSUS MARMORATUS TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOUR (ITALY) AND OF AN ADJACENT MPA
I. Caliani, F. Bellucci, M. Vitale, University of Siena / Department of Physical, Earth and Environmental Sciences; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; S. Fratini, University of Florence / Department of Biology; C. Petti, CIBM Centro Interuniversitario di Biologia Marina; S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente. 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 Impact on Marine Protected Area: cross-border co-operative actions), which has the purpose to design cross-borders 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 Marine Protected Area (MPA) on the eastern side of the Livorno harbour, where we intended to explore the eventual adverse effects of port contamination. A battery of biomarkers was employed to assess neurotoxic effects (acetylcholinesterase, AChE activity), energy metabolism (isocitrate dehydrogenase, IDH; lactate dehydrogenase, LDH), oxidative stress (lipid peroxidation, LPO; glutathione S-transferases, GSTs), which still were not enough to prevent cellular damages (erythrocytic nuclear abnormalities, ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sampled specimens. Results showed that the crabs sampled at Livorno harbour are exposed to contaminants able to cause oxidative stress and genotoxic effects. LPO and ENA assay showed a statistically significant difference between specimens collected at Livorno harbour and the specimens coming from the MPA. The average values of LPO were about three times higher in crabs sampled in Livorno harbour in comparison with that sampled in the MPA. The results trends are not influenced by the sex and the female showed higher values of biomarkers in comparison with the males. The crab P. marmoratus, used for the first time as a bioindicator to investigate the toxicological status of a port and an MPA area by the use of a multi biomarker approach, was found to be a good sentinel species to monitoring coastal marine environment.

TU129 Toxicity of titanium on the mussel Mytilus galloprovincialis
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Titanium (Ti) is at forefront of research related to nanomaterials. Due to their physical and chemical properties, Ti nanoparticles (TiNPs) are widely used in various industries and materials, such as additives in pharmaceuticals and food colorants, toothpastes, solar cells, sunscreens, cosmetics and boat paints. With the increasing production and use of TiNPs, Ti has been inevitably released into aquatic systems through wastewater treatment plants, surface run-off, direct inputs and atmospheric deposition. The increasing input of TiNPs in the aquatic environment has raised concerns about the toxicity of Ti to inhabiting organisms. Once in the aquatic environment TiNPs interact with the surrounding water components, including other contaminants, which may change the availability of Ti to organisms, namely the ability to penetrate into cells which may result in toxicity. In the present study the mussel species Mytilus galloprovincialis was used to evaluate the impacts caused by the exposure of Ti (II) solutions with the initial concentrations of 5g/L, 50g/L, 100g/L of Ti (II) (i). Biochemical (oxidative stress related biomarkers, metabolic capacity and energy reserves) markers, after 96 hours and 14 days exposure periods, were evaluated. The obtained results revealed significant alterations in contaminated mussels, varying with the concentration and time of exposure. Mussels exposed to Ti presented lower metabolism, represented by lower electron transport system (ETS) activity, which decreased along exposure time, decreased their membrane permeability, leading to the maintenance of their glycogen (GLY) and protein (PROT) contents. Moreover, contaminated individuals activated their antioxidant defences increasing the activity of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione S-transferases (GSTs), which still were not enough to prevent cellular damages (revealed by the increased of lipid peroxidation in mussels exposed to Ti).

TU130 Comparing interspecific Artemia responses to chronic zinc exposure
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The invasive species Artemia franciscana is displacing native Artemia (A. salina and A. parthenogenetica) from eastern Atlantic coasts and across the Mediterranean region. In order to study the physiochemical and toxicological responses of the native Artemia in comparison with the invaders, the species was used to evaluate differences in response to chronic exposure to Zn. The species was chosen due to their adaptation to different environmental and ecological conditions during their invasion process, including brackish and marine waters, and different trophic settings. The enriched Artemia species were collected from contaminated sites and used as model organisms, able to provide information on the acute and chronic toxicity of zinc. In the present study, Artemia franciscana was exposed to the following concentrations of Zn (mg L⁻¹): Zn (0.01, 0.05, 0.1 and 0.2 mg L⁻¹). The species exposed to Zn presented lower reproduction (higher number of broods and offspring production), higher % of non-viable nauplii and decreased growth (growth rate and survival). The results of this work highlight the competitive advantages of native species (A. parthenogenetica) from contaminated areas to prevail under the selective pressure of abiotic factors as environmental pollution. Based on the results, the species A. franciscana would not be a suitable species for early warning purposes or as a model organism for ecological studies due to their low invasion potential. Keywords: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.

TU131 Promising invertebrate species as model organisms in ecotoxicology: ephyrae of the jellyfish Aurelia sp. and Sanderia malayensis
E. Costa, C. Gambardella, V. Piazza, CRN ISMAR; S. Lavorano, Costa Editauniment spa Aquario di Genova; M. Faimali, F. Garaventa, CRN ISMAR
In aquatic toxicology, one of the most important steps is the selection of suitable model organisms, able to provide information on the acute and chronic toxicity of marine pollutants. In this context, invertebrates species are being used extensively in laboratory tests for their usefulness in 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 also easy to maintain under laboratory conditions, widely distributed and ecologically relevant. Although Cnidarian jellyfish (Scyphozoa) are known to play an important role in marine and estuarine systems, 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 endpoints, and to test the potential of Aurelia sp. and Sanderia malayensis as a tool for early warning systems. For this purpose, the authors evaluated the application of the sub-lethal response 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 ephyra jellyfish in ecotoxicology. The experiments allowed to identify two end points (sub-lethal, frequency of pulsatia 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 epibrye jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that epibrye are an interesting and promising invertebrate model with a very high ecological relevance to be used in ecotoxicological investigations.

TU132 Paracentrotus lividus and Artemia sp.: never too old model organisms to give new end-points
S. Morena, C. Gambardella, M. Faimali, F. Garaventa, CNR ISMAR
In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental instrument of chemical analyses. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount.
Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in ecotoxicology 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 urchin Paracentrotus lividus. We tested chemical analyses that do not necessarily elicit overt effects, such as a chronic abnormal swimming, as behavioral endpoint. In detail, we optimized and improved an automatic recording system, namely Swimming Behavioral Recorder system (SBR), by developing i) a new swimming speed alteration test using for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (± 1) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU133 Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media
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Since target chemical analysis often cannot explain the cause-effect relationship between certain contaminants and the observed effects in organisms, effect directed analysis (EDA) can be applied to unravel the drivers of toxicity in complex mixtures. In this study, the sea-urchin embryo test (SET) was implemented for the first time in a EDA approach in order to evaluate an estuarine environment influenced by the effluent of the main waste-water treatment plant (WWTP) of Bilbao, Spain. The effluent was extracted 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 determine the toxic effects after 48 h: the growth rate of the larvae and the rate of skeletal malformation. 6 levels (n=3) of dose-curve were prepared in units of relative enrichment factor (REF), REF final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-target analysis was performed by means of UHPLC-QXactive Plus MS in positive and negative modes with a C18 column. Toxic compounds were identified using MS2 spectrums, Metfrag and Compound Discoverer (Thermo) interfaced to MZmine. Among the collected C18 fractions, only fraction 13th (F13) showed a clear toxicity and, therefore, it was tested separately to establish the concentration-response model. The curve-dose response of the raw sample (EC50 = 10 REF and EC20 =19 REF) could be explained by the contribution of active F13 (EC50=14 REF and EC20=39 REF). Regarding the chemical analysis, among the final candidate list (206 compounds), methenazone (an antihelminthic agent) was confirmed chromatographically with standards. Nervertheless, 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, lipoygenase 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 toxic or drugs such as ibuprofen and aspirin. However, invertebrate model to evaluate eicosanoid pathway related toxicity has not yet been developed well though similar eicosanoid pathway was expected in invertebrate species. Therefore, the purpose of this study was to identify genetic information of key genes of eicosanoid pathway in Daphnia magna, a widely used invertebrate model, and to evaluate the transcription levels of the genes after the exposure to eicosanoid targeted drugs. To this end, we collected amino acid sequences of eicosanoids from other species and then compared the sequences in water flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as pl2a, cox, pgd2a and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoids pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 mM. Then, we analyzed transcriptome. To emerge priority, 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 KClO3 (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, excepting 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. simulans). And also, opposite outcomes regarding monophyletic species indicates that is not accurate 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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Planktonic human activities are constantly exposed to environmental contamination (e.g. industries, agriculture). Those contaminants may have continuous or pulse sources and may influence organisms from natural habitats. In different latitudes even phylogenetically close related species may present divergent chemical tolerance. Therefore, it was used in this study the model species from temperate areas Daphnia magna and the tropical species Daphnia similis. Most studies rely on short term acute and chronic tests. To emerge priority, 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 KClO3 (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, excepting 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. similans). And also, opposite outcomes regarding monophyletic species indicates that is not accurate use species from different climates to estimate toxicity.

TU136 Chronic effects of BPA, BPS, and BPSip in Daphnia magna
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Since bisphenol A (BPA) can act as a weak estrogen agonist and disrupt steroidogenesis, concerns on adverse health effects are increasing. In response to the regulatory pressures to eliminate BPA in plastics, bisphenol S (BPS) and
4-hydroxyphenyl 4-isopropoxyphenylsulfone (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (p < 0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appeared to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-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. The Test Guideline n. 202, 2004, on plastic phthalate (MEHP) as well as other phthalates is preferred elimination chemical in aquatic organisms 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 cladocers of Daphnia magna (OECD test guideline n. 202, 2004), taking advantage of its well-experienced sensitivity and reliability for a huge number of known and unknown toxicants. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data requirement in EU Regulation 2008/1050/EC on the presence of MEHP as acts as a hormone 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.

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius
M.S. Bordalha, University of Aveiro; A. Rodrigues, University of Aveiro / Biology Department and CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM; 3819-193 Aveiro; I. Pestana, CESAM & University of Aveiro / Biology
Natural populations are constantly facing a large array of environmental stressors, from both natural and anthropogenic origin, which represent a strong selective force shaping the behaviour, physiology and morphology of organisms. Genetic diversity acts as a key component of adaptation, providing the source of genetic variability for potential to adapt to changing environmental conditions. Ecological risk assessment needs to couple quantitative genetic analysis with ecotoxicological studies in order to understand the mechanisms underlying evolution of tolerance. Research on genetic variation regarding tolerance to contaminants has been mostly performed with clonal lineages. An alternative methodology has been applied for sexually reproducing organisms, investigating for example, sensitivity (at the population level) and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbial insecticide exposure under two levels of salinity). Each egg mass was considered a single family (full-sib genotype). Within each family, larvae were randomly allocated to all treatments. Emergence rate, time to emergence, and adult longevity weight were used as response variables. Relationships between genetic variation, life-history traits and fitness costs in response to microbial insecticides, and the potential of a key aquatic insect species to evolve tolerance to these compounds will be discussed as well as an evolution of disease resistance on aquatic species. The study also highlights the suitability of C. riparius, a model organism in aquatic toxicology, for quantitative genetic analyses.

TU141 Effects of Amitraz on Chironomus riparius: life history and biochemical responses
H.R. Monteiro, University of Aveiro / Department of Biology and CESAM; J. Pestana, CESAM & University of Aveiro / Biology & CESAM; 3810-193 Aveiro; J. Pestana, CESAM & University of Aveiro / Biology
Amitraz is a very effective formamidine insecticide used in agriculture to control pests, such as leafhoppers and cotton pests. The compound is also known to affect reproduction 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 µg 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 Cu(OH)₂ nanoparticles while there was a significant decrease in DNA damage levels at 10 and 40 µg L⁻¹ treatments. Therefore, results reveal possible biochemical targets of amitraz toxicity and suborganismal responses associated with amitraz exposure. The assessment of biochemical biomarkers may support the interpretation of toxic responses observed at organism level and therefore in the assessment of the ecological effects of environmental contamination. Moreover, it increases the information available on the outcomes of amitraz exposure in freshwater invertebrates, and underlines the importance of risk assessment studies of formamidine pesticides. Acknowledgements: This study had the support of the Fundação para a Ciência e a Tecnologia through project PROTEOME (PTDC/AAG-MAM/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-161773).

TU142 Multigenerational exposure of Folsomia candida to copper agrochemicals: conventional and nano-pesticides
C. Malheiro, Department of Biology, University of Aveiro / Biology; A.R. Silva, University of Aveiro / Dept.of Biology & CESAM; D. Nunes Cardoso, CESAM, Unikind, University of Aveiro / department of Biology & CESAM; T. Neves, University of Aveiro / biology; J. Ulcar, 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; T. Neto, Universidade de Aveiro / Biology Architectural practices include the use of agrochemicals for crop maintenance and enhanced productivity. Although soil contamination may result, inorganic agrochemicals, like copper pesticides, have been used in a range of agricultural applications, which may result in environmental problems. More recently, nanopesticides were introduced in the market with the intent to improve efficacy and decrease environmental negative effects. However, the chronic ecotoxicological effects of 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 nanoparticulate 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 (renewal reproduction) measured for three generations (i.e., renewal soil exposure). After three generations in both soil treatments, the surviving collembola were moved to uncontaminated soil for three generations to assess their recovery potential. Similar response patterns were observed in the two soil treatments for all three Cu formulations. Exposure to aging soils revealed an increasing tolerance across generations of F. candida. In contrast, in treatments with renewed Cu spiking, the collembolan populations showed ongoing sensitivity to Cu exposure. In both treatments, after being moved to clean soil, all treatment populations showed some recovery by displaying increased reproductive output. Copper forms presented difference 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 behaviour of amoebocytes and eleocytes
N. Gozalbe-Velasco, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU; E. Uriñonabarrenetxea, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology. Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU; M. Cabello, University of the Basque Country / Zoology and Animal Cell Biology. Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU. Earthworm immune cells (coelomocytes) have become a target system in ecotoxicology due to their sensitivity against a wide range of pollutants. Moreover, endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at longer exposure times and higher complexity levels (organism, population). Since soils are subjected to multiple environmental stressors (i.e., temperature, acidification, organic matter depletion, new pollutants) it is of great interest to assess how those stress scenarios pose changes in earthworms at cellular level. Coelomocytes compose a heterogeneous cellular group where two major cell populations are distinguished, amoebocytes and eleocytes. However, the behaviour of those subpopulations against different stressors is still unclear. Hence, the aim of the present work was to address the effects of different stressors (increase in temperature, low OM content 6% vs. 10%, thermal stress (19ºC vs. 26ºC) and pollution conditions (Cd: 5-25 mg kg⁻¹, Ag NPs: 0-100 mg kg⁻¹) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometry analysis was used to determine mortality of coelomocytes and changes in the relative proportion amoebocytes/eleocytes. Coelomocytes extracted from earthworms maintained under low OM content 6% showed a decreased cell viability, but no changes were recorded in the relative proportion of amoebocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoebocytes. Thus, we can conclude that the response of the different subpopulations was dependant on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential of this model system to assess environmental risk assessment studies of soil agrochemicals. The multigenerational effect of long-term exposure of the soil contaminant is confirmed and the effects are persistent up to the third generation.
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms

D. Fornasiero, N. Mori, P. Tirello, A. Pozzebon, C. Duso, University of Padova / DAFNASE; E. Tescari, Dow AgroSciences Italia srl; R. Bradacchio, Dow AgroSciences Italia srl / RD; S. Otto, Italian National Research Council Spray drift of pesticides has a negative impact on aquatic ecosystems and the environment, including damage to non-target organisms. Particularly, the drift of some insecticides can have detrimental effects on beneficial arthropods such as predatory mites. According to the recent EU Directive, the reduction of spray drift is required for a sustainable use of pesticides, yet without reduction of efficacy against pests. In this framework, eight field trials were conducted from 2012 to 2014 in two typical growing areas of Verona district (Northern Italy), four on apple orchards and four on vineyards. The aim of these trials was to evaluate, for two spray drift reduction techniques: 1) the spatial patterns of in-field droplets, 2) the efficacy against key pests on apple (Cydia pomonella and Lobesia botrana respectively), 3) the side effects on predatory mite populations. Four insecticides, chlorpyrifos, chlorpyrifos-methyl, methoxyfenozide and spinetoram, were applied with three different spraying techniques: high-drift nozzles (Albuz, ATR 80), low-drift nozzles (Albuz, TV1 80005 green), and high-drift nozzles with an anti-drift adjuvant (rapeseed oil). Results showed that the two spray drift reduction techniques effectively increased droplets amounts next to sprayer, reducing potential drift on both apple orchards and vineyards and were generally as effective as standard nozzles without additional side effects on beneficial arthropods. Results suggest that the use of spray drift reduction techniques such as low-drift nozzles and anti-drift adjuvants can be effective in managing key pests and also in decreasing the environmental impact of using insecticides. Full article in: Crop Protection 98 (2017) 283-292, DOI:10.1016/j.cropro.2017.04.010.

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

TU149

Freshwater organism can recognize microplastics as microalgae

S. Kim, Y. Chae, D. Kim, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science The plastics are slowly weathered into nano- (< 100 nm) and micro- (< 5 mm) sized particles owing to physical, chemical, and biological processes in the environment. In this study, we investigated the behavior of freshwater organisms and evaluated whether they recognize and respond to microplastics. Adult zebrafish was exposed to the different concentration of microplastic (MP, 250-300 μm) and food materials (F) 20 mg MP; MP20; 20 mg F; F20; 10 mg MP + 10 mg F, MP10F10. The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrafish, which exposed under MP10F10 and F20 conditions, and the ingestion rate was quantified. The number of capturing patterns were counted as 21±4, 8±5, and 14±3 under F20, MP20, and MP10F10 conditions, meanwhile the spitting patterns were determined as 0±0.0, 2.8±3.1, and 5.2±0.4, respectively. Ingestion rate of diving beetle on control group was calculated as 0.63±0.10 zebrafish wet/ sec. The exposure group, which fed the MP10F10 exposed zebrafish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrafish wet/ sec) during 591±85 seconds. On diving beetle, the MP were finally caught at crop organ until 720 min after ingestion, and did not transfer to another organ. The digestive organs, especially crop, seemed to separate the microplastic as indigestible food. We concluded that the freshwater organisms recognize the microplastic, and exhibit the defence behaviour. This research was supported by Biopesticide Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

Microplastic shedding from functional textiles

C. Bengston, Swerea IVF AB / Energy and Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); P. Mellin, Swerea KIMAB AB; O. Levenstorm, University of Borås; A. Manning, Swerea IVF AB; S. Roos, Swerea IVF AB / Energy and Environment Microplastic pollution of marine environment is an environmental issue which is intensively discussed on a global level. Synthetic based textiles contribute to microplastic pollution of the marine environment. Besides littering and the size-shape effects that microplastics have when being exposed to humans and animals they provide an additional vector for chemical pollutants, i.e. possibly providing a new entering mode into organisms of pollutants already existing in the sea. But fibers generated from consumer articles such as textile garments might carry chemical pollutants due to different chemical treatments. This study investigated Dye loss from cotton and polyester/cotton blend (PES/CO) textiles that were functionalised with durable water repellent (DWR) treatment. The chemical treatment consists of polymers that are based on per- and polyfluoroalkyl substances (PFAS). Question 1: Do we have release of fluorinated fibers from functional textiles? Question 2: What is the amount of fluorinated fibers lost during the washing which can have an impact on the environment? The microscopic investigation identified that the extracted fiber fragments were generated during the simulation of industrial washing (Gyro wash). Fiber fragments were identified with REM and the EDX analysis of showed fluorine (F) as part of the fiber surface.
composition. The results will be further verified using combustion ion chromatography (CIC) of shedded fibers with and without DWR treatment. These results will then be used to model a scenario simulating for instance Swedish consumption and use of DWR treated outdoor garments and the total exposure of fluorine contaminated fibers to the environment, from washing via waste water treatment to the recipient. This study proved that functional textiles can contribute to the release of microplastic pollution due to the formation of synthetic fiber fragments during polymerization reaction. The detection of the fiber such as fluorescence 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 this similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

**TU151**

**Fate of 14C-labelled Calcium Poly(styrene sulphonate) (CaPSS) Microplastic in waste water treatment at environmentally relevant concentrations**


The past ten years has seen increasing scientific and public concern over the microplastic problem. Microplastic fibres, being produced from the polymerization reaction. The resulting CaPSS in WWTPs. Due to the high sensitivity of CaPSS in WWTPs. Due to the high mass balance was established to identify the most relevant processes for the fate of CaPSS in WWTPs. Due to the high detection limit of CaPSS, the test can be performed at realistic/environmentally relevant concentrations. As the detection limit of CaPSS in environmental matrices is currently orders of magnitude below that of non-labelled polymer particles, this study can serve as an example how future studies on the general topic “microplastics in the environment” can be supported.

**TU152**

**Microplastics in the environment: Evaluating the risks and identifying knowledge gaps**

E.E. Burns, University of York / Chemistry; A. Boxall, University of York / Environment Department

The past ten years has seen increasing scientific and public concern over the harmful effects of microplastics (MPs) in the natural environment. In 2010, < 10 scientific publications contained the word ‘microplastic’ while this number had risen to around 170 in 2016. Alongside this, there have been significant policy and regulatory developments around the use and emissions of MPs. We present the results from a systematic review of the published literature to attempt to answer the question “what is the evidence that microplastics adversely impact freshwater and marine systems?” In answering this question, we explore the evidence-base for a number of potential impacts of MPs in freshwater and marine systems. We have summarized the global coverage of microplastic occurrence studies in both aquatic and sediment compartments. We found that of the many 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 impact on whole organisms such as fish eggs, juvenile fish, invertebrates, growth, tissue inflammation and mortality. Studies have also assessed the potential of MPs to act as a vector for hydrophobic organic compounds to accumulate in organisms. No conclusive evidence was found in the literature to support this theory, instead most studies exploring this effect disprove the hypothesis while a few are inconclusive due to flaws in the experimental design and interpretation. Comparison of monitoring and effects data indicates that concentrations of MPs currently detected in the environment are orders of magnitude lower than those where effects/no-effects are observed in the laboratory. Moreover, enough ecotoxicology data is now available to begin building species sensitivity distributions.

We demonstrate that based on current data concentrations of MPs measured in the environment are not high enough to elicit the effects reported from laboratory studies. There is however a mismatch between the size ranges and types of MPs used in laboratory ecotoxicity tests and those detected in the environment. There is an urgent need to address this mismatch by performing better quality and more holistic monitoring studies alongside environmentally relevant effects studies. Only then will we be able to determine whether these materials are having real impacts or not.

**TU153**

**A cost-effective methodology for separation of microplastics from freshwater systems**

M. 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; M.O. Rodrigues, Department of Biology & CESAM

Plastics, one of the most demand material worldwide, are considered one of the most emerging aquatic pollutants due to their ubiquity, high persistence and insufficient management. Especially, microplastics (< 5 mm) are of scientific and social apprehension as they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. Currently, the concerning about the occurrence of microplastics (MPs) in freshwater systems has been increasing, notwithstanding there is no unified method for MPs separation in these systems. This result in inaccurate data that differs in quality and resolution, not allowing data comparison between different studies (large-scale spatial and temporal comparisons). Hence, this work aims to assess the effectiveness of distinct separation methods as an attempt to identify and establish the most cost-effective method. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (e.g. low/high-density polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate) were prepared (secondary MPs) and subjected to distinct methods. These methods included density separation methods using sugar, olive oil and zinc chloride, as well as organic matter degradation methods using hydrogen peroxide (peweroxide oxidation) and multienzymatic detergent (enzymatic digestion). The samples were then undergoing the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of separation and organic matter degradation, the total mass of recovered MPs. Three methods to get reliable information about the best method used in future studies of monitoring of MPs in aquatic systems, notwithstanding the use of hydrogen peroxide must be cautious and only applied when necessary.

**TU154**

**Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems**

S. Piehl, University of Bayreuth / Department of Animal Ecology 1; E.C. Atwood, RSS Remote Sensing Solutions GmbH; M. Bochow, Helmholtz Centre Potsdam GFZ, German Research Centre for Geosciences; E. Heitinger, RSS Remote Sensing Solutions GmbH; F. Siegert, Ludwig Maximilians University of Munich / Department of Biology; C. Laforsch, University of Bayreuth

Recently, there have been intensified research efforts to get reliable information about sources, sinks, and transportation pathways of microplastic in aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Earth remote sensing is a base for a holistic monitoring studies alongside environmentally relevant effects studies. Only then will we be able to determine whether these materials are having real impacts or not. There is however a mismatch between the size ranges and types of MPs used in laboratory ecotoxicity tests and those detected in the environment. There is an urgent need to address this mismatch by performing better quality and more holistic monitoring studies alongside environmentally relevant effects studies. Only then will we be able to determine whether these materials are having real impacts or not.
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. Astorea, RSS Remote Sensing Solutions GmbH; F.M. Falcieri, CNR - ISMAR; 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 41.8% in 2016, of which most is done post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to increase the recycling rate in South Africa. Although legislation is in place to promote recycling and e-waste disposal infrastructure and protocols, especially for improved accuracy of results. Further, high variability of plastic 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 their identification of cellulose and other fibre-like microfibres 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.

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 e-waste disposal infrastructure and protocols, especially for improved accuracy of results. Further, high variability of plastic 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 their identification of cellulose and other fibre-like microfibres 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.

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 water. The MPs were extracted from 5-1 L samples at the end of the 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 of plastic 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 their identification of cellulose and other fibre-like microfibres 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

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 41.8% in 2016, of which most is done post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to increase the recycling rate in South Africa. Although legislation is in place to promote recycling and e-waste disposal infrastructure and protocols, especially for improved accuracy of results. Further, high variability of plastic 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 their identification of cellulose and other fibre-like microfibres 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.

TU159 Occurrence and characteristics of fine microplastics in sewage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscopy method

Y. Kameda, Chiba Institute of Technology / Creative Engineering; N. Yamada, T. Yasuda, Chiba Institute of Technology

The occurrence of Microplastics (MPs) is of great concern in aquatic environment, especially ocean. Many current studies evaluate MPs ranged from 100 μm to 5 mm. However, MPs used in personal care products and other industrial processes are reported to be smaller according to previous reports. Because MPs are very
important substances to current economic activities, new materials for MPs will be needed such as cellulose. Though alternative of the materials is mainly conducted in personal care products, effect of the volunteer actions and various regulations on decrease of MPs in aquatic environments has not been evaluated. It is necessary to reveal their sources such as sewage water, sewage treatment water, wastes in aquatic environments and so on. This research shows occurrence and characteristics of MPs in various sewage samples, sewage treatment water and river water by coagulation and FT-IR microscopy method developed in our laboratory. MPs in the various contaminated water were collected by a plankton net whose mesh size is 10 µm. The collected particles were separated by a density separation method. After that, MPs in the collected particles were separated by coagulation process. Finally, the MPs were passed through a membrane and were identified by standard analysis. All the MPs by FT-IR spectroscopy, MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.  

**TU160** Detection of micro-paint particles and microplastic in harbour soil samples using FPA-aµFTIR-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 (32%), alloy coating (Aalborg University / Civil Engineering Department)  
Microplastic (MP) pollution is nowadays recognized as a global concern affecting both marine, freshwater and also the terrestrial environment. Beside microplastic pollution, also micro-paint particles (MPP), originated by the degradation and abrasion of painted surfaces (buildings, ship-paint materials) have been reported in some recent studies. As many paints also contain organic compounds and heavy metals used as biocides aimed to inhibit the growth of biota on painted surfaces, these particles could be even more harmful to the environment and wildlife than microplastics. Here we present some results obtained from the analysis of soil samples collected in a recreational boating facility in the North of Denmark. A “Microplastic-based” approach has been used, extracting the particles from the soil matrix using air-assisted density separation followed by FPA-aµFTIR-Imaging analysis. This approach allows to identify and quantify microplastics and micro-paint particles down to 10-20 µm in size. Surficial soil samples were collected along three transects located in different areas of the shipyard. The samples, previously sieved (5000–500 µm and 500–10 µm) were submitted to flotation using ZnCl₂ followed by sample cleanup using enzymes and H₂O₂ oxidation to remove organic matter. The analysis was carried out using FPA-aµFTIR-Imaging spectroscopy and the data were processed with a dedicated software (MPHunter) developed at Aalborg University. The first results highlighted a high micro-paint and microplastic particles contamination. The total MP and MPP concentration were 222,500 particles Kg⁻¹, while the estimated mass was 17.1 mg Kg⁻¹. The most abundant polymers/paints detected were polyester (30%), acrylic coating (21%) and polyethylene (16%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 40 - 80 µm. The high MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-paint particles were successfully extracted and detected in a recreational harbor. The use of the art analytical approach including multi-step sample preparation and FPA-aµFTIR-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. Herling, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecotoxicology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; L. Nizzetto, NIVA  
More than 90% of microplastics (MPs) present in raw wastewater are captured by wastewater treatment plants and removed from the wastewater at the sludge phase. Therefore, the use of sludge as a fertiliser for agricultural soils may be a relevant source of MPs in the terrestrial ecosystem and, thus, runoff, in surface waters. The fate of MP applied with sludge is strongly dependent on weather conditions (rain, temperature, etc.). The objective of this study was to determine the fate and distribution of MPs in the agricultural soil-water system. The study was performed in experimental plots at the HUASA (Instituto de Desarrollo Rural, Agrario y Alimentario) located in central Spain, in an area characterised by semi-arid climate: hot and dry summer, low rainfall (about 450 mm per year) which is concentrated in spring and autumn. Suitable devices for runoff collection (modified Pinson collectors) were placed on three different plots with different MPs treatments: (i) soil never treated with sludge (control), (ii) soil treated with sludge in the past (in 2013), and (iii) soil treated with sludge at the start of the experiment (November 2017), according to usual agricultural practices. Besides sludge application, soil characteristics (composition, texture, etc.) were comparable in the three plots. Sludge was applied early November and the plots were sown with barley. After each relevant rainfall event, runoff water was collected and filtered in-situ and to isolate the MP fraction. Soil samples were taken in all plots at the start of the experiment, as well as 3, 6 and 12 months after the start of the experiment. To determine the vertical MP transfer within the soil, soil cores were divided into three fractions (0-5, 5-10, 10-15 cm). Separated plots receiving the same sludge treatments and soil conditions were used to sample earthworms and to evaluate potential accumulation and MP impacts for the soil fauna. The content of MPs in runoff water, soil and biological samples were extracted using organic matter digestion (soil and organism samples), density separation (soil samples), and filtering (all samples). MPs were identified visually and characterised chemically using FTIR. Preliminary results of this experiment, which can be used to quantify fluxes and emissions of MPs in agro-ecosystems under semi-arid conditions, are presented.  

**TU162** Microplastics in wastewater and freshwaters: a case-study in the Henares river watershed (Central Spain)  
T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences  
Wastewater is considered to be one of the major sources of microplastics (MPs) entering surface waters. Although a high retention potential of wastewater treatment plants (WWTPs) for MPs in raw wastewater has been reported, the composition and quantity seems rather variable. Finally, the more efficient cleanwater treatment processes. MPs not retained by WWTPs are directly discharged into the aquatic 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 and characteristics of MPs in WWTPs and cleanwater treatment processes. The risk of plastic uptake from drinking water is currently unpredictable and further spreading of MPs, entering waterways from WWTPs, is anticipated. To assess and possibly optimize a standardized fast, sensitive protocol for sampling and quantification of nanomicroplastics 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 prevalent polymers. Levels ranged from 0.02 to 16 ng/L. Time and space related trend are presented.

**TU164**
Macro and Micro(plastics) in the Environment of Some French rivers
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It is now known that the vast majority of microplastics found in the seas and oceans originate from lands. In such a process freshwater environment (rivers and riverbanks) play a major role. It is therefore necessary to imagine the scenario that a used plastic, becoming a waste after use, will be found in the environment if it has escaped to a waste treatment stream. Its stay in the environment can persist for a very long time and this waste will then be exposed to a set of environmental constraints (UV, rain, wind, mechanical erosion, ...) which will continue and amplify its degradation, leading to its fragmentation. The work we have undertaken consists of: 1. Mapping the presence, the frequency 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 macroplastics 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 Plastiglages project supported by the CNRS(1, 2). 4. Collect and analyze the composition of microplastics in the surface waters of different rivers (Allier, Charente, Loire, Tourn, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babybag sampling net [3,4], which makes it possible to multiply samples and analyses. 1. Occurrence of plastic litters in the Allier River in France, Vincent Verney, Gaëlle Bissagou Koomba, Alexandre Garreau, Florence Delor-Jestin, Erwan Roussel, Olivier Voldoire, Jean-Luc Peiry; To be published 2- https://www.researchgate.net/project/PLASTICGAGES 3- Committey among, the case of babybags, Max Liboiron, Engaging Science, Technology and Society 3(2017), 499-527 4- http://lapagaiesauvage.org/laboratoirerecyclier/}

**TU165**
Spatial and temporal trends of microplastics in an urbanized Canadian river
M.S. Ross, T. Bujaczek, S. Kolter, MacEwan University / Department of Physical Sciences; D. Locky, MacEwan University / Department of Biological Sciences
Microplastics are ubiquitous contaminants in the marine environment, but quantification of their presence remains a challenge, especially in the freshwater environment. This study investigates the occurrence, composition, and potential sources of microplastic contamination in the North Saskatchewan River, an urbanized river flowing through the city centre of Edmonton, Alberta, the fifth largest city in Canada. Surface water samples were collected monthly during the summer of 2017 using plankton nets with 53µm mesh. Samples were collected from seven sites throughout the river, including sites both upstream and downstream of the city and potential point sources (i.e., a wastewater treatment plant, WWTP). Microplastics were found in all samples, and at some sites concentrations exceeded those reported in other urbanized rivers. Various coloured fragments, films, beads, and fibers were identified, with the majority of microplastic contamination being in the form of fragments. Both the total concentrations and the proportion of each type of microplastic varied with distance downstream and size class, suggesting changing inputs as the fragments. Both the total concentrations and the proportion of each type of microplastic varied with distance downstream and size class, suggesting changing inputs as the fragments. Both the total concentrations and the proportion of each type of microplastic varied with distance downstream and size class, suggesting changing inputs as the fragments.

**TU166**
A Historical Sediment Record of Microplastics in an Urban Lake, London, UK
S. Turner, University College London / Geography; A.A. Horton, Centre for Ecology and Hydrology; N. Rose, University College London / Department of Geography
A historical record of microplastics extracted from a radionuclide (14C) and (137Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particle abundance and calculated accumulation rates are indicative of plastic usage in the 20th century. Concentrations of microplastics extracted from the sediment, by sieving and flotation using dense liquid separation range from 30 to 880 particles per kg of dried sediment. Fibres dominate the assemblage of microplastic particles identified in the time-resolved sediment samples. Polystyrene microplastic particles were identified and are found in post-1950s sediment and up to the present day. An increase in microplastic concentration is evident in recent sediments (post 2000) but a peak in concentration is also observed in late 1960s-1970s age sediment. Raman spectroscopy of selected particles and fibres provides compositional data on the fibres and particles found in the sediment. The size and nature of microplastic pollution found in the sediments in the Eastern part of the lake, based on sediment source analysis, suggests that atmospheric deposition has been an important vector of plastic transport to the lake. Microplastic analysis of temporally well-resolved lake sediment sequences will greatly assist in quantifying the historical flux of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

**TU167**
Microplastics from sewage treatment works and storm water outfalls discharging into the Victoria Harbour, Hong Kong SAR
C. Mak, Y. Tsang, The Chinese University of Hong Kong / School of Life Science Environmental Science; K. Chan, The Chinese University of Hong Kong / Life Sciences
We conducted surveys of microplastic pollution in the surface waters and sediments from Deep Bay, Tolo Harbour, Tsing Yi, and Victoria Harbour in HKSAR. In the microplastics survey (June 2015 to March 2017), the averaged concentrations of microplastics in local coastal waters and sediments respectively ranged from 51 to 27,900 particles per 100m(2) and 49.0 to 27,900 particles per kilogram. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m(3) in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW, and two stormwater outfalls (SWOs) (Kwun Tong Ferry Pier, New Ya Ma Tei Typhoon Shelter STW) to determine the amount of microplastics entering into the Victoria Harbour. Effluent samples from each of these sewage systems were collected in three weekdays per month and different seasons (December, March, June and September) to determine spatial, seasonal variations of microplastics in treated sewage and stormwater discharges. The highest concentrations of microbeads present in effluents from STWs and SWOs respectively ranged from 137,239 to 1,081,597 particles per 100m(3) (December 2016 to March 2017) that consider as moderate emission level. Biological samples (fishes and mussels) are also collected in two SWO for the assessment of microbeads abundance and composition in its digestive system. Microplastics of different shapes from sewage and biota (mainly fragments, lines, fibres, and pellets) were identified by means of Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy. Zebrafish exposed to microbeads individually would ingest different sizes of polystyrene microbeads (10-22µm, 45 to 54µm, 90-106µm, 212-250µm & 500-600µm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1(CYP1A1) and 27,900 particles per 100m(2) and 49.0 to 27,900 particles per kilogram. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m(3) in March 2016 in Victoria Harbour (West Kowloon).

**TU168**
Models for Data Synthesis, Sampling Design and Scenario Analysis: Some using the INCA-MP model of microplastic fate and transport in soils and surface waters
M. Futter, Swedish University of Agricultural Science / Aquatic Sciences and Assessment; J. Crossman, University of Windsor; J. Ledesma, V. Russo, E. Lannergård, SLU Swedish University of Agricultural Sciences / Aquatic Sciences and Assessment; L. Nizzetto, NIVA
Quantification and classification of microplastics in soils, sludge and surface waters is both time consuming and expensive. Ideally, measurement campaigns can be focussed on areas that are likely to provide the greatest returns on effort yet this is often difficult to accomplish. Here, we show how INCA-MP, the Integrated Catchments model for Micro Plastics, the first published model of microplastic terrestrial fate, riverine transport and contaminant co-transport can be used to synthesize available data, identify knowledge gaps, plan monitoring, and perform risk assessments. Synthesizing available data involves collation of microplastic and proxy data. We show how proxy information, including timing and size, can be used as model-based measures of fate and transport. INCA-MP includes sophisticated routines for tracking the environmental fate of current and emerging micropllontants, the model can be used for risk assessment of co-transported contaminants. Such information is needed both for more targeted sampling...
campaigns and for communicating risks associated with microplastics in terrestrial and freshwater environments. We illustrate these concepts using data from Swedish and Canadian catchments. Our results show the importance of autumn storms and spring snowmelt for microplastic mobilisation to surface waters and highlight the potential knowledge gains associated with targeted sampling of riverine sediments, constructed wetlands and waste treatment facilities.

TU169 Occurrence and concentration of microplastics in an urban river C. Campanale, C. Massarelli, G. Bagnuolo, 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 watery column and in sediments. In 2005, it was proposed that microplastics should include all fragments ≤ 5 mm. Over the past decade, microplastic debris in both marine and freshwater systems has become an emerging environmental issue. Although 70–95 % of the marine litter, including microplastics, come from land environment, studies of microplastics in freshwater systems are limited with respect to those focused on marine habitats. Rivers and inland waters may transport microplastics to marine habitats and may be a novel vector for the downstream transport of organic persistent pollutants suggesting an overlooked and potentially significant component of the global microplastic life cycle. Herein we report results from a monitoring study with the main objective of evaluate the occurrence and concentration of microplastics in an Italian urban river and assess the hypotheses that microplastics amount could vary in response to temporal and seasonal studies the efficiency of a disc filter to remove microplastic concentrations, two seasonal sampling campaigns have been planned (February and April 2017).

Superficial waters samples were collected with three surface plankton nets fixed in the middle of the river simultaneously for two different time slot (11:00-13:00 and 13:00-15:00) for a total of six replicates for each campaign. After sample extraction and purification, validation of visually based microplastics identification was achieved using fluorochrome chromatography-mass spectrometry (Pyrolysis GC-MS). The composition of microplastic was studied in term of size, shape, color and polymer type. Results from the six replicates are expressed as mean values (± DEV. ST.) of number of particles per cubic meter (p/m³). Microplastics were found in each net sample for a total amount of 22152 items collected, photographed, enumerated and categorized. Sample concentrations ranged from 3.52 to 13.43 p/m³ showing significantly higher abundances during February than April campaign (Mann–Whitney U Test = 18.00; p-value = 0.028). A total of five polymer have been characterized: PE, PP, PS, PVC and TDI-PUR. All samples contained at least three polymer types: PE, PP and PS. PE accounted for 77 % of the total particles identified, followed by PS (12 %), PP (10 %), PVC (9 %) and PU (4.7 %). The removal of microplastics by a disc filter have been correlated with the size of the plastic particles 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 Sludspande A/S. The treated wastewater was sampled before and after the disc filter by suction into 10 L stainless steel vials and freeze-preserved for large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical oxidation and flotation in order to eliminate the sample matrix and extract the microplastics. Non-degradable particles were stored in ethanol, and a fraction of the ethanol particle suspension transferred to a transmission window to quantify particles by infrared imaging technique. The entire window was scanned to create a mosaic with 3.3 µm pixel resolution on the FPA. The spectra of all particles in a scan were analyzed to quantify their chemical composition and to determine whether they were of plastic, and if so, of which plastic material. The optical analysis was carried out with a semi-automated IR spectra analyzer software developed at Aalborg University, Denmark. The size and shape of plastic particles were recorded and their mass was estimated. Preliminary data shows that the removal efficiency of the disc filter was 96 % in terms of both mass and particle number. The material composition of plastic in the sample before the filter (polystyrene, polyethylene and acrylates) was somewhat dissimilar to the composition in the effluent sampled after the filter (polystyrene and polystyrene).

TU170 Removal of 10-500 µm microplastics from wastewater effluent by disc filter M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department; K. B. Olesen, Aalborg University / Department of Civil Engineering; F. Liu, J. Voltersen, Aalborg University / Civil Engineering Department

In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10-500 µm and the identification technology was micro-FTIR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grindsted, Denmark operated by Billund Sludspande A/S. The treated wastewater was sampled before and after the disc filter by suction into 10 L stainless steel vials and freeze-preserved for large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical oxidation and flotation in order to eliminate the sample matrix and extract the microplastics. Non-degradable particles were stored in ethanol, and a fraction of the ethanol particle suspension transferred to a transmission window to quantify particles by infrared imaging technique. The entire window was scanned to create a mosaic with 3.3 µm pixel resolution on the FPA. The spectra of all particles in a scan were analyzed to quantify their chemical composition and to determine whether they were of plastic, and if so, of which plastic material. The optical analysis was carried out with a semi-automated IR spectra analyzer software developed at Aalborg University, Denmark. The size and shape of plastic particles were recorded and their mass was estimated. Preliminary data shows that the removal efficiency of the disc filter was 96 % in terms of both mass and particle number. The material composition of plastic in the sample before the filter (polystyrene, polyethylene and acrylates) was somewhat dissimilar to the composition in the effluent sampled after the filter (polystyrene and polystyrene).

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions N. Thomemann, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Shortly after the introduction of many types of plastics (e.g. polystyrene, polyethylene terephthalate, polypropylene) in the 30s, 40s and 50s, first traces of plastics in the environment have been detected. Packaging, pellets and parts of a kitchen sponge were found in the stomachs of seabirds; Whales and seals were caught in polypropylene cords. By weathering and fragmenting larger plastic objects (macromastics) into smaller pieces (microplastics), plastic waste in the environment seems to be gradually disappearing. However, as recent research shows, microplastic is found in freshwater, on beaches and in open water, in the deep sea and in the Antarctic ice. It is taken up by organisms and possibly also by the food chain. The long distance transport of plastic debris will widely spread and plastic waste will accompany, if not outlast, mankind for a long time to come. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps. Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish consume 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. by the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU172 How do we know that microplastics are different from natural particles in their effects on biota? Z. Gerdes, M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES)

Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of microplastics types and sizes. 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 the response caused by natural particles. This separation is crucial for testing MP-specific effects, as many test organism are suspension-feeders that have evolved in turbid aquatic environments. To highlight and provide examples of the importance of particle controls in MP-effect studies we will present: I) results of a review on effects of particle suspensions (MP, or natural nutritionally inert particles), and II) case studies employing control particles. The data presented will strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics S. Seidensticker, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Applied Geoscience

The ubiquitous contamination of all environmental compartments with microplastic particles is extensively discussed in both science and public. Large numbers of microplastics have been measured in effluents of wastewater treatment plants. These particles might act as sorbent and transporter for frequently occurring wastewater contaminants and are hence a factor that needs to be considered if the environmental fate of pollutants is examined. Some contaminants, among those also micropolllutants like pharmaceuticals, can be charged under certain pH conditions. While it is known for many microplastics that charged under certain pH conditions, also micropollutants like pharmaceuticals, can be charged under certain pH conditions. While this is known for many microplastics, the amount of accumulated organic pollutants is principally dominated by the neutral fraction, while the charged...
species did not contribute. Thus, with increasing pH sorption of acids decreased while the sorption of bases increased. Whereas electrostatic interactions between charged species and polyethylene could not be detected, this might be different for other polymers, such as polystyrene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil

T. Huffer, S. Sławek, 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 proton transfer, because they can interact [5].


TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses

S. Kraus, University of Tübingen / Animal Physiological Ecology; H. Schmiegel, Tübingen University / Animal Physiological Ecology; E.E. May, University of Tübingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tübingen / Animal Physiological Ecology; R. Triebkorn, University of Tübingen / Animal Physiological Ecology; D. Prada, The University of Birmingham / Geography Earth Environmental Science

Most of the studies on microplastics have focused on the marine environment, although there is hardly any data on microplastic occurrence, fate, and effect in terrestrial environments. We assessed this using several parameters including: (1) quantifying the proteins and polysaccharides secreted by the organism’s behavior; (2) assessing how we can mitigate this, leading to changes in legislation, although more is needed. Micro, and recently nano, plastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. Effects are typically dose-dependent and include reduced feeding and successful reproduction, change in organism’s behavior 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.

Microplastics are defined as plastic materials or fragments with diameter below 5 mm. These microplastics occur due to the release of manufactured (primary) plastics 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 up to one thousand years, being photo-oxidation by UV light its primary degradation pathway. The small fragments of microplastic created by weathering are detrimental to ocean ecosystems for multiple reasons. In the frame of the BASEMEN project (JPI Oceans) 9 natural microplastics of different polymers materials, in two size presentations (100-500 µm and pellets ≤1 mm) were artificially weathered. A pilot-scale simulated weathering system (dry conditions and simulated marine conditions), using UV/Vis metal halide lamps, was deployed. This study focuses on the characterization of the changes that an accelerated artificial weathering process produces in 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 difficult the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done, and the microcharacteristics of the plastic were visualized. Some indexes that reveal the microplastics experienced mechanical erosion and weathering. These results reveal that an adequate pretreatment of the sample along with an adequate customized polymer library that contains real/weathered plastics spectra are highly recommended for the adequate monitoring of microplastics in the environment. Acknowledgments: Program of Consolidation and Structuring of Units of Competitive Intensity funded by the University of Santiago de Compostela (Xunta de Galicia) partially financed by ERDF (ED431C 2017/28). Ministry of Economy and Competitiveness: PCIN-2015-170-C02-01 BASEMEN-JPI Oceans and, project CTM2016-77945-C3-3-R (ARPA-ACUA).

TU176 Effects of artificial weathering on polypropylene microplastics

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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 up to one thousand years, being photo-oxidation by UV light its primary degradation pathway. The small fragments of microplastic created by weathering are detrimental to ocean ecosystems for multiple reasons. In the frame of the BASEMEN project (JPI Oceans) 9 natural microplastics of different polymers materials, in two size presentations (100-500 µm and pellets ≤1 mm) were artificially weathered. A pilot-scale simulated weathering system (dry conditions and simulated marine conditions), using UV/Vis metal halide lamps, was deployed. This study focuses on the characterization of the changes that an accelerated artificial weathering process produces in 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 difficult the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done, and the microcharacteristics of the plastic were visualized. Some indexes that reveal the microplastics experienced mechanical erosion and weathering. These results reveal that an adequate pretreatment of the sample along with an adequate customized polymer library that contains real/weathered plastics spectra are highly recommended for the adequate monitoring of microplastics in the environment. Acknowledgments: Program of Consolidation and Structuring of Units of Competitive Intensity funded by the University of Santiago de Compostela (Xunta de Galicia) partially financed by ERDF (ED431C 2017/28). Ministry of Economy and Competitiveness: PCIN-2015-170-C02-01 BASEMEN-JPI Oceans and, project CTM2016-77945-C3-3-R (ARPA-ACUA).

TU177 Freshwater microplastics and effect of conditioning on pollutant and chemical transfer potential

K. Reilly, The University of Birmingham; J. Sadler, The University of Birmingham / Department of Geography and Environmental Science; I. Lynch, University of Birmingham / Geography Earth Environmental Science

The presence of microplastics in the environment has received increasing scientific and societal interest over recent years. Following this, there has been a range of scientific studies and discussions on impacts that microplastics are having in the environment and how we can mitigate this, leading to changes in legislation, although more is needed. Micro, and recently nano, plastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. Effects are typically dose-dependent and include 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 both freshwater and chemicals interact with the particle. In this study we considered the effect 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 17a ethynylestradiol and detergents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess the extent to which chemical interactions on microplastics may influence 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. Building on this data we could make recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU178 Exposure to conventional but non-biodegradable microplastics impacts fitness in Daphnia magna

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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 plastics. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; bioplastic) 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 effect at the level of the polymer type if using different microplastics. To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

TU179

Effects of polystyrene microplastics in different life stages of brown trout (Salmo trutta f. fario)

H. Schmie, Tübingen University / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology; E. Pechmann, University of Tübingen / Animal Physiological Ecology; A. S. Ruhl, T. Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. T. J. B. Koch, University of Tübingen / Animal Physiological Ecology. The widespread use of plastic products in our daily life has led to a constant increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for different 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, diameter < 100 µm, up to 10,000 particles/L) in combination with organic pollutants (pharmaceuticals, pesticides), 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 ion oxidation capability (FOC) assay (PMF-test). Furthermore, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larval or juvenile brown trout. Further analyses are still in progress. The present study part is the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WRS1378).

TU180

Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocerans

G. Jaku, M. C. L. Meaden University / CML Leiden University / CML Leiden University / Conservation Biology; B. Baas, Centre for Ecology & Hydrology / Centre for Ecology and Hydrology. Microplastics are formed by the environmental breakdown of large plastics. Information regarding effects of microplastics on freshwater ecosystems is limited. In the present study, the acute and chronic effects of microplastics on three Cladoceran species, Daphnia magna, Daphnia pulex, and Ceriodaphnia dubia, to both PMP and SMP was assessed. The acute toxicity was assessed at 180, 220, and 260 C, to determine the influence of temperature as an additional stressor on toxicity. The acute sensitivity of D. magna and D. pulex to both PMP and SMP, increased sharply with temperature, whereas that of C. dubia was stable across temperatures. C. dubia was the most sensitive species at 180, followed by D. pulex and D. magna, which were of comparable sensitivity, however, the trend was reversed at 260 C. In addition, secondary microplastics (SMP) had a similar toxic effect. There was a significant correlation between effects of both primary and secondary microplastics, which were more toxic to C. dubia. Both PMP and SMP showed adverse effects on all three species during chronic exposure. Further, C. dubia was the most sensitive species followed by D. pulex and D. magna. All species were more affected by PMP than SMP during chronic exposure. The results of the current study indicate that exposure to microplastics has adverse effects on health and reproductive output of the species studied, although at relatively high levels of exposure, and that temperature as an environmentally relevant additional stressor has a major influence on species sensitivity to microplastics.

TU181

Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels

S. Magni, University of Milan / Department of Biosciences; F. Gagne, Environment and Climate Change Canada; C. Delia Torre, State University of Milano / Biosciences; C. Andre, J. Auchair, H. Hanana, Environment and Climate Change Canada / Aquatic Contaminants Research Division; F. Bonasoro, University of Milan / Department of Environmental Science and Policy; A. Binelli, University of Milano / Department of Biosciences. Up to now, most studies investigating effects of microplastics have reported 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. The global plastic production produces 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 communities because their ability to be accumulating in the tissues of biota. MPs can reach the aquatic environment through the Wastewater Treatment Plants (WWTPs) or after the degradation of microplastics. 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 MP standards we choose two different beads of polystyrene, one of the most common MP classes detected in the environment, with a size of 1 and 10 μm. On the basis of the daily great release of MP 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 the control (C). To test the effects caused by food dilution and toxicity of MPs towards chemicals, or involved in metabolic pathways not detectable by our biomarkers. In addition, the prolongation 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

A. Weber, N. Geckel, C. Weil, S. Umbach, Goethe University Frankfurt am Main / Aquatic Ecotoxicology; N. Brenhoff, German Federal Institute of Hydrology / Biochemistry and Ecotoxicology; G. Reifferscheid, German Federal Institute of Hydrology; M. Wagner, Norwegian University of Science and Technology / Department of Biology. Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and therefore MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species is missing. Therefore, we analyzed the effects of irregular polystyrene MP (< 63 μm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve Dreissena polymorpha both in a single and multiple stressor exposure regime. We exposed D. polymorpha to polystyrene MP at concentrations between 6.4 and 100,000 pM L-1 over 6 weeks at 16 °C. After the exposure, the midgut gland tissues were analyzed for malondialdehyde concentrations as 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-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 (Technical University of Denmark) / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; M. Wagner, Norwegian University of Science and Technology / Department of Biology

The last decade has seen a surge in research investigating various aspects of micro- and nanoparticles 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 field of expertise, 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 – would be of particular relevance for other species that lack a gut lining. 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 fractoscope-based clearing followed by investigation through confocal laserscan microscopy. We additionally applied the lipophilic dye Nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoparticles. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microplastics studies is important, especially if these have a high impact on the body facing these new research areas in the realm of nanotoxicology.

TU184 Do terrestrial organisms, isopods Porcellio scaber and earthworms Eisenia Andrei, avoid microplastic contaminated soil?

A. Jemec Kokalj, University of Ljubljana, Biotechnical Fac. / Department of Biology; P. Zidar, University of Ljubljana / Department of Biology Biotechnical Faculty; G. Kalcikova, University of Ljubljana / Faculty of Chemistry and Chemical Technology

Microplastics (MP) can potentially enter the terrestrial environment via sewage sludge deposition on agricultural land. In some countries plastic bags are used as soil cover in home gardens and agricultural land to act as mulch. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in the terrestrial environment, data regarding the effect of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods Porcellio scaber and earthworms Eisenia andreii avoid soil contaminated with microplastics. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleanser was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 0.55 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/kg dry weight (0.4 % w/w). The isopods were exposed individually 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 for 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were isolated only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was divided when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil, which was not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behaviour of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.

TU185 Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study

I. Deerman, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; X. Chen, University College London; T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Besides their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported together into biota by the so called ‘Trojan horse effect’. In this study, we performed in a higher tier study with a complex ecosystem water phase. Exposure 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 polysulfe 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 2.5 μg/L (H) in the water phase before application. 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 fractoscope-based clearing followed by investigation through confocal laserscan microscopy. We additionally applied the lipophilic dye Nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoparticles. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microplastics studies is important, especially if these have a high impact on the body facing these new research areas in the realm of nanotoxicology.

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. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in the terrestrial environment, data regarding the effect of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods Porcellio scaber and earthworms Eisenia andreii avoid soil contaminated with microplastics. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleanser was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 0.55 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/kg dry weight (0.4 % w/w). The isopods were exposed individually 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 for 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were isolated only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was divided when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil, which was 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.
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. McIlroy, 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 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
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Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in various aquatic ecosystems worldwide. In recent years, the attention has been attracted to microplastics (MPs), small plastic particles (dimensional range Daphnia magna affecting food intake, growth and reproduction. First, we performed a 24 hours uptake and 48 hours release test to assess the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release was expected after 24 hours as D. magna is known to have a long-term retention capacity for MPs, being trapped in the crustacean after the consumption. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading to 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. SUIPIAN, 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 (Holliman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms 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 (2.5–3.8 mm) to D. galeata (1.3–2.0 mm) which spans a similar range of sizes as micro and nanoplastics, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10 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 dephar 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-Garca, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. Lorcé-Mahía, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muniategu, Universidade da Coruña / Analytical Chemistry
Plastic is one of the most used materials in the world and is one of the most common and persistent pollutants in the oceans. In fact, plastics constitute 60-80% of marine litter. A particular fraction of plastic debris are microplastics (5-500 μm diameters). 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 (Jemec, 2016). 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 method has been used to minimize damage to plastics [3]. An enzymatic digestion has been developed and optimized for digesting biological material without destroying microplastics. Different times and enzymes were tested to optimize the enzymatic protocol. In addition, a chemical protocol was compared with chemical digestion (KOH) for the treatment of mackerel stomachs. The optimized enzymatic protocol has been established in order 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 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 Science and Innovation. One fraction of plastic debris is microplastics. Effects of microplastics on ecosystems of the Weser Wadden Sea, thereby considering exemplarily major point (e.g. wastewater treatment plants, Danish estuaries) 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, Danish estuaries) 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, Danish estuaries) 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, Danish estuaries) 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, Danish estuaries) 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, Danish estuaries) 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, Danish estuaries) is going to conduct an interdisciplinary and ecosystem overarching analysis concerning the contamination with microplastics from the headstreams to the North Sea.
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 weathering of the material. This scenario is accompanied by a physical fragmentation into particles of increasingly smaller sizes, and a chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastic fragments (Polystyrene, Polypropylene and 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 hydrolysis is then determined by the liquid chromatography. The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acetic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients

J. Davies, Personal Care Products Council / Science

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (PCPs) contain a wide array of cosmetic ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and thus are likely to be the most significant contributors to terrestrial and marine litter. Tier I testing is that no section of the river currently 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 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.

TU194 Toxicalogical effects of irregularly-shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)

J. Park, Korea Institute of Toxicology; J. Choi, Korea Institute of Korea KIT; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus are typically irregular in shape. The objective of this study was to compare the effects of spherical or irregular shapes of microplastics on the changes in organ histology, ion, 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

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 relevant 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 sufficient representation 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-time passed in marine environment. None of significant differences were found across nine sample groups. This work provides the first dataset on the level of contamination in sediments from the French Atlantic Coast.

Derivation, Validation and Implementation of Environmental Quality Benchmarks (P)

TU196 Challenges in implementing legal frameworks for assessing water quality: the cases of the EU and Swiss approaches

N. Chévez, M. Milano, E. Bernard, University of Lausanne / Faculty of Geosciences and Environment

Human activities have a great impact on river quality. Monitoring programs show that multiple chemicals are present in water and that physico-chemical properties and 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 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 CPV 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 Environmental Quality Standards (EQS) of chlorpyrifos based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS decreased by more than one order of magnitude. The original AA-EQS was not derived based on available chronic ecotoxicity data but was set as MAC-EQS divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC from the EFSA authorisation dossier and a MAC-EQS of 0.1 mg/L. The aim of this study was to update the EQS of chlorpyrifos based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS decreased by more than one order of magnitude. The original AA-EQS was not derived based on available chronic ecotoxicity data but was set as MAC-EQS divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC from the EFSA authorisation dossier and a MAC-EQS of 0.1 mg/L. The aim of this study was to update the EQS of chlorpyrifos based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS decreased by more than one order of magnitude. The original AA-EQS was not derived based on available chronic ecotoxicity data but was set as MAC-EQS divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC from the EFSA authorisation dossier and a MAC-EQS of 0.1 mg/L.
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 set used for the chronic assessments contains data for sediments with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data state 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* for CPY of 0.32 µg/L 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* from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a *EQS*_sed,lp of 0.016 µg/kg dw. Without this AF, the *EQS*_sed,lp would be in the same order of magnitude as the calculated *EQS*_sed. 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 of the European Union. The environmental quality standard (EQS) 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. The lead application of this model includes an AF of 10 that covers uptake by ingestion resulting in a *EQS*ₕₚ,ₙₚ of 0.016 µg/kg dw. Without this AF, the *EQS*ₕₚ,ₙₚ would be in the same order of magnitude as the calculated *EQS*ₚₙₚ. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

**TU199 Assessing compliance of European freshwaters for copper: accounting for bioavailability**
A. Peters, I. Wilson, G. Merrington, wca; D. Heijerick, ARCHE; S. Baken, European Copper Institute
The importance of accounting for bioavailability in understanding the effects of metals has long been recognised in terms of setting environmentally relevant regulatory limit values. Attempts to deliver practical, routine methods to do so have been limited. For regulatory purposes in Europe an agreed Environmental Quality Standard (EQS) for copper is observed. The value of the level which will ensure protection of sensitive environments. The value of the threshold has important implications in terms of the financial costs of the compliance assessment. For copper, setting the thresholds at the same level for the whole of Europe (i.e. continental) would leave some countries with costly and unnecessary monitoring requirements. Deriving the threshold on a country specific basis enables effective use of resources without compromising on the level of protection. A very high level of compliance for copper is observed where bioavailability based thresholds are used for the implementation derived from regionally relevant water chemistry data (99.3%). Sites where elevated ambient background levels of copper are combined with very high bioavailability, principally when the waters have low DOC concentrations, are those most likely to be at risk due to copper exposures.

**TU200 Are lead exposures a risk in European freshwaters? A map of EQS compliance assessment accounting for bioavailability**
J. Chowdhury, International Lead Association / Senior Scientist -Environment; A. Peters, I. Wilson, G. Merrington, wca
Lead (Pb) is a priority substance for which the bioavailable Environmental Quality Standard (EQSbioavailable) of 1.2 µg L⁻¹ has been set under the European Commission Directive 2013/39/EU for application across all countries in Europe. In the present study, a tiered approach was applied to undertake a compliance assessment of the EQSbioavailable using the FOREGS database that includes paired data for water quality parameters and measured Pb concentrations from freshwater streams and rivers across Europe. In Tier 1 measured dissolved Pb concentrations were directly compared against the EQSbioavailable. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon concentration (DOC-WFD) approach. The outputs from both approaches were compared to the chronic Pb Biotic Ligand Model (Pb BLM), the final tier in the tiered approach. The maximum Pb concentration in FOREGS is approximately 11 µg L⁻¹. At Tier 1 screening, only 16 (2.0%) water samples of the whole dataset (n=797) have Pb concentrations that are greater than the EQS of 1.2 µg L⁻¹. The exceedances further decreased to 3 (0.4%) and 1 (0.1%) upon accounting for bioavailability at Tier 2 and 3 respectively. The map of site-specific PNECs (predicted no effect concentrations) as calculated by the Pb BLM identifies that the most sensitive waters in the database are all those with extremely low concentrations of DOC (< 0.5 mg L⁻¹). The greatest frequencies of such sites are found in the Alps and Norway. The lowest PNEC values for Pb are around 0.5 µg L⁻¹, and the WFD EQS value of 1.2 µg L⁻¹ is equivalent to approximately the 4th percentile of the dataset. The results indicate that the European freshwater bodies with low anthropogenic pressure are unlikely to fail the compliance with the EQS, with the exception of very local situations such as historic mining sites.

**Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)**

**TU201 Modelling survival under chemical stress. A comprehensive guide to the GUTS framework**
T. Jager, DEBTox Research / Dept of Theoretical Biology; R. Ashauer, University of York / Environment
Testing, analysing and predicting the lethal action of chemicals on organisms plays a central role in the fields of ecotoxicology and toxicology, both for scientific and regulatory purposes. The dominant approaches to deal with survival data are descriptive, focussing on standardised tests and simple summary statistics (such as the LC₅₀). Such descriptive methods ignore the fact that lethal effects develop over time, thereby leading to biased assessments and precluding useful predictions to untested exposure scenarios. Making sense of toxic effects over time requires mechanistic models, and, more specifically, the explicit consideration of toxicokinetics and toxicodynamics (TKTD). For the endpoint survival, almost all existing TKTD models can now be viewed as special cases of a more general framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field as it is expressly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatise on this model framework. In a CEFCI-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**
B. 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 extended 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 increases linearly with increasing concentration. In other areas 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 sigmoid shaped. This is investigated when the specific shape of a dose-response curve affects the outcome of an assessment and how the magnitude of predicted effects is affected.

TU203 Investigating toxicokinetics of emerging pollutants (PFASs) in the common sole (Solea solea) from in situ measurements and experimental data on PCBs within a DEB-based modelling approach.

F. Moumier, National Research Institute of Science and Technology for Environment and Agriculture - Irséa / UR EABX; V. Loizeau, IFREMER / UR Biogeochemistry and Ecotoxicology; L. Pecquerie, IRD / UMR LEMAR; P. Labadie, UMR CNRS / EPOC Université Bordeaux / UMR 5805 EPOC; G. Munoz, Université de Montpellier / Chemistry; H. Budzinski, CNRS / UMR 5805 EPOC; J. Lobry, Irséa / UR EABX

In the context of global change, developing mechanistic tools integrating the influence of environmental factors on xenobiotics 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 of sole life history and to investigate the influence of these factors on food availability, quality and consumption. Moreover, this modelling framework allows including adverse effects (DEB-tox), often based on internal concentration. However, for emerging compounds like PerfluoroAlkyl Substances (PFASs), toxicokinetics calibration is a challenge as their properties are not fully characterized yet and experiments are scarce. We here present the results of a research project at investigating toxicokinetics (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). In this paper entitled: "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", we evaluate how PFASs affect the physiology and health of juvenile common sole and the potential impacts on the food web dynamics and sustainability of marine ecosystems. This work highlights the importance of understanding the bioaccumulation of emerging contaminants in fish and the need for developing robust models to predict their effects on marine ecosystems.

TU204 Investigating metabolic acceleration in dynamic energy budget models of copepods using the ecotoxicological model organism Nitocra spinipes.

J. Koch, GhEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University / UGent / Applied Ecology and Environmental Biology

Copepods are 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. A recent publication in the Ecotoxicology and Environmental Safety journal highlights the potential of the Dynamic Energy Budget (DEB) theory to account for sublethal toxic effects in terms of effects on the energy household of an animal. Although DEB models for new species are usually easily parameterised, the copepod life history shows distinct deviations from the ‘standard DEB model’ requiring further investigation. While some authors presume metabolic acceleration from birth until puberty, others suggest a von Bertalanffy growth curve which is truncated at the reproductive age. As no high-quality data on growth and reproduction were available for N. spinipes, we performed a growth experiment over 28 days. Additional data from literature were used to aid the parameter estimation. Submodels for food (Holling’s type II functional response) and temperature dependency were calibrated on development time and reproduction data. While isomorphic growth is commonly assumed in DEB studies, it does not hold true for N. spinipes which grows more slender in the course of its development. Hence, we used the square root of the top view area as a length measure to scale with the cubic root of structural volume in length-to-volume conversions. Both models abp and sbp showed good fits to the given data. Overall, abp predicted the data slightly better compared to sbp with a mean relative error of 0.063 vs. 0.076 in sbp. However, we do not regard this difference clear enough to unequivocally confirm or reject metabolic acceleration in copepods. More detailed data on N. spinipes and other copepods are needed to reveal the most accurate model for the copepod life history. That said, both models are promising tools for the evaluation and extrapolation of toxicity data in N. spinipes.

TU205 Grey seal physiology and environmental change

J. Desorges, Aarhus University (AU) / bioscience; G.M. Marques, University of Lisbon; K. Kauhala, Natural Resources Institute Finland Luke; K. Harding, University of Gothenburg Sweden

Grey seals are marine mammals that are considered as sentinel species for marine ecosystem health. They are long-lived and the grey seal (Halichoerus grypus) is one of the largest marine mammals in the world. They are widely distributed in cold and temperate waters, and their populations are monitored as indicators of environmental changes. In the Baltic, grey seals have been shown to serve as sentinels for marine ecosystem health. They are considered as key species for understanding the impact of climate change on marine ecosystems. In the present study, we investigate the effects of temperature on grey seal physiology and lifehistory traits. We examined the influence of temperature on metabolic rate, growth, reproduction and body condition. An experimental approach was used to study the effects of temperature on grey seal physiology, and the data were compared with field observations. Our results showed that temperature had a significant impact on metabolic rate, growth, reproduction and body condition in grey seals. For example, higher temperatures were associated with increased metabolic rate and growth, and reduced reproduction. The results are important for understanding the impact of climate change on grey seal populations and for developing strategies to protect these valuable species.

TU206 Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters

H. JM, J. Na, J. Jung, Korea University / Environmental Science and Ecological Engineering

Daphnia magna is an important species in freshwater ecosystems and is extensively used in ecotoxicology studies. The present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history traits of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited higher growth and reproduction compared to animals kept at 20 °C. We measured oxidative stress markers such as glutathione peroxidase (GPx) activity and lipid peroxidation (LPO) level. An increase in GPx activity and a decrease in LPO level were observed in animals exposed to higher temperatures. Moreover, the lipid peroxidation level was significantly higher in animals exposed to 25 °C. These results suggest that higher temperatures may lead to increased oxidative stress in 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 Bioenvironmental Systems Engineering

The present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history traits of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited higher production of reactive oxygen species (ROS). In short term exposure, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. In contrast, daphnids showed significantly enhanced catalase (CAT) activity in response to increased environmental stress. The results suggest that temperature affects the antioxidant defense mechanisms of D. magna. 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 prolonged the onset of lipid peroxidation and reduced body length. However, induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature indicates that D. magna may have a more pronounced response to environmental stressors. The results suggest that temperature affects lipid metabolism and life-history traits, and the effects are more pronounced at higher temperatures.
significant higher than that of MOP 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 MOP 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 MOP. 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

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Discharges from metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Nevertheless, metals can also be detoxified by binding to nucleic acids designed to sequester them, limiting their toxicity. The objectives of this study were (i) to assess the subcellular distribution of metals and metalloids (Cd, Cu, Se and Zn) in layers of white suckers exposed to metal-mining effluents, and (ii) to investigate the links between the binding of specific metals to particular subcellular fractions and physiological effects. To this end, mature male and female fish were collected in three lakes downstream from a metal-mining effluent and one lake in a reference area. Subcellular partitioning among putative metal-sensitive fractions (MSF) and biologically detoxified fractions (BDM) in layers was determined after differential centrifugation and heat-denaturation steps. In parallel, a suite of biomarkers was investigated ranging from general indicators of energy accumulation to specific indicators of oxidative stress and metabolic or biosynthetic capacities. Total hepatic metal concentrations were only slightly higher in exposed fish than in reference fish, with Cd (x10) and Se (x10) being accumulated the most. No differences between sexes were observed. Subcellular partitioning of metals was similar among areas but specific to metals; over 70% of the Cd burden was found in the heat-stable cytosolic proteins fraction, which includes metallothioneins. In contrast, the largest contributors to the total Se liver burden were the potentially metal-sensitive heat-denaturable proteins fraction (~35%), and the organelles fraction (~30%). These results suggest that Cd was well detoxified and regulated by white suckers, whereas the presence of relatively high Se concentrations in the MSF suggests that exposed fish were likely subject to stress. Principal component analysis showed that increasing [Se] in all of the fractions was strongly correlated with lower fish condition and associated with higher Se concentrations in the heat-denaturable proteins fraction (ANOVA p<0.001). Finally, this work will contribute to advancing our understanding of the toxic modes of action of metals in aquatic organisms and our capacity to monitor the risk for fish inhabiting metal-contaminated environments.

TU209

Development of an adverse outcome pathway for acetylcholinesterase inhibition in zebrafish (Danio rerio)

K.H. Watanabe, A. Mikhail, Arizona State University / School of Mathematical and Natural Sciences; K. Conrow, Arizona State University; N. Vinas, Mississippi State University / Engineer Research and Development Center

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 Predictive Model for Lung Cancer

T. Hill, US EPA NHEERL/JSTD/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, less resource-intensive predictive modeling as well as the development of supplemental KE 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/nuclear acids adduks, diminished CC10 capacity and hyperplasia of CC10 deficient Clb cells, and culminating in the adverse outcome of mixed-cell tumor 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 characterizaton 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 of Fisheries Ecology; I. Dearing, National Research Council at U.S. Environmental Protection Agency; D. Działul, 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 panmictic stock of the European eel (Anguilla anguilla) has seen a dramatic decline over the past several decades, and declines in recruitment as a result of maternally transferred contaminants has been proposed as one of several potential causes. In particular, dioxin-like chemicals (DLCs) have been identified as a class of chemicals of great concern for both European and American eels (Anguilla rostrata). DLCs bioaccumulate, are highly embryotoxic in many species of fish, and maternally transferred in artificially matured eels. However, to date researchers have been unable to locate a relationship between DLC contamination in the natural spawning grounds in the Sargasso Sea. As a result, accurate embryotoxicity data to identify the potential causative chemicals are unavailable. Therefore, this study aimed to (a) parameterize a physiologically-based toxicokinetic (PBTK) model for European eels to account for the impact of changes in physiology that result from sexual maturation and migration on toxicokinetics, and (b) to couple this model with a quantitative adverse outcome pathway (qAOP) for activation of the aryl hydrocarbon receptor 2 (AHR2) of fishes to predict early life stage mortality of eels as a result of exposure to maternally transferred DLCs. The PBTK model was used to kinetically predict the redistribution of DLCs within the body of female eels during migration, and ultimately the concentration in gonads and eggs. A simple qAOP was described previously linking activation of species-specific AHR2 genes in vitro. In this study, we cloned AHR2 from European eel (Anguilla rostrata) and used it to predict expression of this gene in zebrafish embryos, with embryo lethality across nine species of fishes exposed to DLCs. To this end, AHR2 was cloned from European eel and used to predict eel-specific relative potencies of five DLCs representing congeners measured at among the greatest concentrations in gonads of eels. Using this data, mortality of early life stages of eels was estimated based on the internal concentrations predicted by the PBTK model. 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; I.R. Schultz, NOAA NWFSC / Marine Science Laboratory; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; P. Swanson, NOAA-NWFSC

The pituitary gland is a key endocrine organ, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17β-ethynylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fsbh) mRNA levels. These results motivated us to expand our studies by developing an in vitro test system for investigating how EDCs affect pituitary function. We hypothesized that an in vitro test system would allow us to sample pituitary cells and isolate RNA for transcriptomic analysis without the confounding effects of chemical bioavailability and metabolism. We cultured primary pituitary cells from Atlantic salmon (Salmo salar) to determine the optimal conditions for cell growth and viability, and the ability of the cells to respond to treatment with selected EDCs. The test system was used to determine the effects of exposure to EE2, bisphenol A (BPA) and hexachlorobutadiene (HCBD) on pituitary gene expression. Our findings support the potential use of this system for investigating EDCs' effects on the pituitary gland, with potential applications for identification of new EDCs and evaluation of existing EDCs' potency. This work highlights the need for further investigation into the effects of EDCs on the pituitary gland, with potential implications for conservation of salmonid populations.
 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-Gallego, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, Euromines

The EU Batteries Directive sets the minimum recycling efficiencies for waste batteries as a percentage of their average weight. In the light of the circular economy, it may be argued that, in addition to the quantity, it is important to consider the specific materials that are recycled, the quality of the recycled fractions and their potential use. The Public Waste Agency of Flanders (OVAM) asked VITO to assess the effect of these factors. In this study, the environmental impact of the end of life is compared for different battery recycling routes. Furthermore, the impact of the rest of the life cycle of disposable and rechargeable batteries is calculated to put the impact of the end of life into perspective. A number of potential improvement options, such as a higher collection rate, higher functional recycling and a shift to different types of batteries, are evaluated.

 TU215 The relevance of the end-of-life stage for the environmental impact of batteries

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Numerous LCA studies exist in the field of energy storage, especially batteries. However, the majority of these studies focus on the production and use phase, while the battery disposal or recycling is usually evaluated in separate studies that focus explicitly on this part of the life cycle. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LFP-LTO battery (round-mounted sealed cell), a hybrid aqueous ion battery (AHIB) and a redox flow battery (VRFB), all with the same final material composition. The results show that considering the end-of-life stage actually does change the outcomes of the results significantly and that cradle-to-gate assessments are not appropriate for comparing very different battery technologies. Highly integrated batteries like the LIB have advantages under a cradle-to-gate perspective (higher energy density and thus lower material demand per provided capacity), while less integrated systems can have significant advantages when it comes to recyclability. The AHIB and VRFB are easy to dismantle and all major components can be recovered by mechanical dismantling on a macro-scale. The highly integrated LIB require complex processes and obtain a commingled fraction of micro-size particles that are difficult to separate and require significant process inputs while only recovering a fraction of the materials originally contained in the batteries. This can change the picture fundamentally towards an advantage of technologies easy to dismantle on macro-scale (AHIB and VRFB) in comparison with highly integrated cells (LIB). Thus, design for recyclability is highly important in terms of future circular economy and might easily outweigh the possibly reduced energy density or lower performance.

TU216 Battery recycling efficiencies and their influence on the life cycle impacts of batteries

K. Boonen, A. Van der Linden, VITO

The EU Batteries Directive sets the minimum recycling efficiencies for waste batteries as a percentage of their average weight. In the light of the circular economy, it may be argued that, in addition to the quantity, it is important to consider the specific materials that are recycled, the quality of the recycled fractions and their potential use. The Public Waste Agency of Flanders (OVAM) asked VITO to assess the effect of these factors. In this study, the environmental impact of the end of life is compared for different battery recycling routes. Furthermore, the impact of the rest of the life cycle of disposable and rechargeable batteries is calculated to put the impact of the end of life into perspective. A number of potential improvement options, such as a higher collection rate, higher functional recycling and a shift to different types of batteries, are evaluated.

TU217 New and Reconditioned Electrical and Electronic Equipment. How does it change the environmental performance?

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The scope of this study, carried out within the LIFE12 ENV/IT001058 WEEE models, 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 complemented each other in order to be compared to each other. Both methods have been considered for each WEEE group, assuming that it generates the same environmental damage of the other products belonging to the same category. In particular, the following representative products have been selected: refrigerator (R1), washing machine (R2), cathode ray tube (CRT) (R3), laptop (R4) and fluorescent lamp (R5). In addition, lower performance of reconditioned EEE has been taken into account. Different set of replaced components have been evaluated in order to understand which determines the best solution. Scenario A represents the set of replaced components, which damage more frequently. Scenario B is just an alternative set of replaced components. The environmental comparison between new and reused EEE, adopting attributional LCI modelling, showed that Scenario B presents a damage decrease for all WEEE categories. Moving on to the consequential LCI modelling, the environmental comparison highlighted for both scenarios a considerable damage reduction for the reused EEE respect the new one. Furthermore, for the reused R1, R2, R3 the analysis of results carried out environmental credits. This is due to the avoided burdens associated to the manufacturing of the new EEE, since the system boundaries have been enlarged understanding the avoided production of the new 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 are local administrations. Generally, they wants a snapshot of the real effects that waste management policies provoke on human health and environment. For this reason, attributional LCI modelling would be the proper LCI modelling to achieve this scope. Considering this LCI modelling the Scenario B determines the
TU219 The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends

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Household appliances are an important contributor to the overall impact generated by European citizens’ consumption of products. In 2010 the energy-related products covered by the Ecodesign directive responsible for 53% of total EU-28 greenhouse gas emissions. The aim of this study is to provide insights from the Life Cycle Assessment (LCA) of future scenarios of the European consumption of household appliances in the residential sector. The consumption is a Basket of Products (BoP) owned by an average European citizen. The BoP baseline consists of a process-based LCI model for a BoP that represents the most relevant household appliances in terms of energy consumption and market share: dishwasher, washing machine, drying machine, air conditioner, refrigerator, TV screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overview 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 generation (with ECD impact assessment methodology) confirmed the well-known relevance of the use phase of energy-related products, where the efficiency of products and consumer behaviour appear to be the two factors determining the BoP impact. Results of the scenarios assessed show for most of the categories a reduction of the overall impact compared to the baseline scenario. The reduction is more important for categories like e.g. GWP (due to the improved energy efficiency of a future phase-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 HTPc, FETP, LUC and FRD – show a higher potential impact in the scenarios than it is in the baseline. Obtained results show clearly that just heading for more efficient devices is a necessary, but not yet a sufficient condition towards more sustainability; we as a society have also to re-evaluate the way we acquire (more and more) such devices and are spending more and more time behind them – here some limitations may would make sense.

TU220 Assessing economic and environmental effects of product replacement program using dynamic discrete choice model: As a case study of “home appliance eco-point system” in Japan

D. Nishihiroma, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies In this study, we evaluated the impact on the economic and environmental burdens from consumer durables, product lifetime is a key factor and most of the previous studies used average lifetime or lifetime distribution with a focus of engineering durability ( Müller 2006; Kagawa et al., 2011; Nishihiroma, 2016). These product lifetime modelling techniques did not explicitly treat a relationship between product replacement and consumer’s behavior. Whereas, the product replacement modelling techniques based on the economic maximum utility theory have been developed in economics and marketing fields (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic product replacement models to environmental research. This study attempts to use the product replacement model for evaluating economic and environmental effect of polices for consumer durables. As a case study, we focused on air conditioners and analyzed the economic and environmental impacts of “home appliance eco-point system” in Japan which was conducted during a period from May 2009 to March 2011 for encouraging consumers to replace their own products with new ones. Following the proceeding studies (Rust, 1987; Gordon, 2009;), we constructed the product replacement model of air conditioners in Japan by Bellman equation and a dynamic discrete choice model. We also estimated the logit parameters by the maximum likelihood estimation. We used the annual sales and replacement data of air conditioners during 1993 to 2015 (The Japan Refrigeration and Air Conditioning Industry Association; The Japan Electrical Manufacturers’ Association) and replacement and running cost data during the same period (Agency for Natural Resources and Energy of Japan; The Japan Refrigeration and Air Conditioning Industry Association). Using the estimated product replacement model, we analyzed the impact of “Home appliance eco-point system” on the CO2 emissions and economic output by input-output framework. Through the results, we not only evaluated how effective the system was for reducing CO2 emissions and stimulating economy in Japan, but discuss how we could improve the system for obtaining more economic and environmental benefits.

TU221 Economic lifetime, hazard functions, and car inspection system Y. NAKAMOTO, S. Kagawa, Kyushu University

Under the Paris Agreement adopted at COP21, Japan set itself a target of reducing its territorial greenhouse gas emissions by 26% (relative to the 2013 level) by 2030. To further reduce emissions in the transport sector, the government has set up both a technology policy and a demand policy, to try to improve the fuel economy of new vehicles and increase sales of next-generation motor vehicles as a proportion of new vehicle sales, respectively [Ministry of Land, Infrastructure, Transport and Tourism, 2017]. In by assessing and estimating the economic lifetime of vehicles, it is important to examine consumer behavior that maximizes utility level over time, where we were able not only to specify the replacement purchase rates on a dynamic economic choice model but also to quantitatively analyze the environmental impact of changes in consumer behavior due to the adoption of policies because a motor vehicle inspection dummy, maintenance and repair costs, and new vehicle replacement purchase costs are explicitly included in the utility functions at the time of vehicle purchase and in the decision to replace a vehicle. We 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. In the results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in the environmental impacts of car-related emissions, contributing to cutting CO2 emissions. However, in practice, completely scrapping the current car inspection system would be very difficult. This is because, although abolishing inspections would relieve car owners of a painful cost burden, it would also put the safety of car operation at risk, due to the failure to detect problems that a car inspection would ordinarily detect.

TU222 Li-S batteries for electric vehicles, challenges for circular economy objectives H. benveniste, C. Corcho, IREC; B. Amante, Universitat Politècnica de Catalunya UPB

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 field of economical batteries and in 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.

TU223 ASITOSOL C2C - Life cycle assessment as a tool for the ecodesign of a “vapour and air barrier membrane - insulator” system, in a cradle to cradle approach looking perspective. In the design of the system, the unique combination of water retention, vapour and thermal insulation was achieved through the use of technical engineering - PEPs; M. Getlicheren, Derbigum; B. Colson, Sioen Fuel & Filtration; I. De Vilder, Centrebel; A. Timlans, Belgian Building Research Institute (BBRI); A. Léard, Liège Université / Chemical Engineering - PEPs The European directive on the energy efficiency of buildings requires the members}
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 duration in time (stability of tapes of junction, adherence to the existing walls, punching resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + renewable vapor barrier), with the lowest environmental impact on its whole life cycle. The solution can be used in both new construction and renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spunbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on different wall covers but can be also used as a bonding. 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 Herbizkin®. 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. Jiménez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; M. Plociennik, TU224 Dynamic vs static LCA to explore the sustainability of industrial waste recycling A. Di Maria, KU Leuven / MTM; A. Levassuer, École de technologie supérieure / Construction engineering; K. Van Acker, KU Leuven / Materials Engineering LCA methodology is often used to promote the circular economy in the construction sector. However, it is often carried out in a misleading way to the practitioners when assessing the environmental impacts of building and construction materials. Construction materials can accumulate in buildings and infrastructures for several decades, with considerable stocks of materials along the life cycle. Due to the long life of construction materials, LCA should take into consideration also time related aspects. However, in the current LCA, any temporal information is lost, making many LCA results more suitable for prescriptive assessment rather than forecasting purposes. To fill this gap, this study proposes a time-dependent LCIA on climate change, to assess the carbon footprint of two newly developed construction materials, produced through the recycling of industrial residues (stainless steel slag and industrial goethite). The results of the dynamic LCA are compared to the results of traditional static LCA, to see how the methodological development of dynamic LCA may have an influence on the final environmental evaluation for construction materials. Both dynamic and static LCA results show that the recycling of industrial residues to produce new construction materials has the potential to mitigate the climate change impacts of construction blocks, by substituting traditional OPC concrete. Although the dynamic LCA did not result in a shift in the ranking between the three materials compared with static LCA, it provides a clearer picture on emission flows and their effect on climate change over time.

TU226 Supporting 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 the process in their quest of moving 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 data. 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), environmental performance analysis (EPA), and eco-efficiency analysis. However, the preliminary results showed that there are many research gaps regarding the impacts of new strategies and a structured evaluation is needed. While research and practice are both interested in the implementation and evaluation of waste management practices, cities are engaged in a variety of initiatives that research has not explored yet, such as urban planning issues. This might put cities at a disadvantage if they are not able to select the most environmentally friendly initiatives that help them achieve their local sustainability goals while approaching circular economy.

TU227 Taking stock of a circular economy within planetary boundaries: A multi-scale analysis of the specific consequential LCA
H. Helander, 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 and is expected to significantly contribute to the achievement of the earth’s safe operating space. For this reason, consequential life cycle assessment (CLCA) provides suitable tools for understanding these changes. Our main goal is to create a methodological framework that enables the assessment of CE strategies across scales within the planetary boundaries. Two assessment levels will be considered, i.e., cities and products/sectors. The framework will be applied and tested through an analysis of one city and one sector, currently under development. At the city level, CLCA will be combined with territorial LCA to provide information on the environmental variations associated with local CE strategies. Thus, we might be able to determine the impacts of production and consumption activities that meet the needs of a city before and after the application of CE strategies. At the product level, case studies will examine different CE strategies such as eco-design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector, to interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability, progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.

TU228 Opportunities and threats in water treatment options as investigated by LCA
S. Kools, KWR Watercycle Research Institute / Chemical Water Quality and Health; R. Hofman, KWR Watercycle Research Institute / Water systems and technology; H. Helander, KWR Watercycle Research Institute / Water systems and technology; R. Hofman-Cardis, KWR Watercycle Research Institute; A. Butkovskyi, Wageningen University WUR; B. Hofs, Evides Waterbedrijf; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Koole, KWR Watercycle Research Institute ATISOL C2C project aims to develop a complete solution (ecological insulation + renewable vapor barrier), with the lowest environmental impact on its whole life cycle. The solution can be used in both new construction and renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spunbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on different wall covers but can be also used as a bonding. 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 Herbizkin®. 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).
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, biocatalysts are used to reduce particulate, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new biocatalysts. Our LCA study showed that biocatalysts obtained from iron sludge after HCl digestion have a significant lower energy demand in their production than commercial alternatives. Results for the use of biocatalysts in iron sludge treatment looks promising and this LCA study underlined that technical research into the quality of the biocatalysts is proposed. The assessment incorporates common LCAs of the biocatalysts into the efficiency of the VCD, to optimize compound removal from waste water, is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the 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, CETqua / MASE; M. Amores Barrero, CETqua, Water Technology Centre; D. Marin, CETqua, Water Technology Centre / Environment and Socioeconomics; M. Issa, CETqua Water Technology Centre / MASE; M. Termes, CETqua / MASE; M. Ruiz Mateo, CETqua 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 solution to develop etc. Local authorities, municipalities and wider geographical areas, act as accumulators of resources that in the current linear model create negative externalities. However, these waste, energy and waste 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 Felini de Lohe and Cabau in the Comunidad Valencia Region) 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. Birks, Technical University of Denmark / QSA Dept of Management Engg

A truly environmentally sustainable bioeconomy requires integrative approaches for waste management and the food industry to produce food waste. 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 ecoscenario that would incorporate emerging biotechnologies and cascading products. Among these technologies, six pathways for anaerobic digestion (AD) and three different pathways to extract polyphenols will be assessed at the product level. At the territorial level a two-pronged approach will be used to achieve a representative data set for the territories, which will consist of material flow data from national and regional sources scaled down to the territory and individual producer data (primary production), which will be added up to the territory level. A feedback loop will be established between the modules of biotechnology assessment and the foreground system at the level of the territory, in order to observe the effects of waste optimization on the territory. Results: The performance of the biotechnologies will very likely depend largely on energy consumption and the intended use of the new products viz. how the residual resources from wine production are used. At the territorial level the authors posit that local managerial practices, in terms of wine production will be greatly influential for global warming, eutrophication and resource depletion potentials. Fertilizer inputs, both mineral and organic, and pesticide use will very likely differ from territory to territory and will impact the above mentioned categories as well as toxicity related impact categories. Another important aspect will be the energy consumption of the territories and the influence of future energy grid greening on the future impacts of the technologies proposed today.

TU231
Environmental Benefits of a Circular Economy: Connecting Waste Type and Geographic Proximity

R. Itten, K. Kelley, M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

The aim of a circular economy is to transform waste into resources. There is a plethora of waste and by-products that remain unused in the traditional linear industrial system. However, transformation from a linear to a circular system is challenging, limited by several constraints such as the availability of information on the specific composition of the waste, the availability in time and space of quality of waste as well as limited knowledge of the usability of such waste products. The goal of the SHAREBOX Horizon 2020 project is the development of a platform for the facilitation of synergies within the industry to enable a more circular flow of resources within the European processing industries. The SHAREBOX platform is a database of available waste and resources required by companies, enabling the transformation of waste to resources by matching supply and demand. The platform also serves as the first point of contact between different partners in a circular system. Furthermore, the platform enables the identification of new synergies overarching the different subsectors of the industries as well as optimal matching from the perspective of a circular economy. We analysed the implications of the transformation of different types of waste to resources when the industries are located in different geographic locations under consideration of the life cycle stage of transformation. Waste PET can be transported up to 10 000 km by lorry and still provide a net benefit regarding greenhouse gas emissions due to circular use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reuse of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232
Evaluation of nutrients and energy recovery technologies through Life Cycle approaches

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Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTPs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the fermentation industry to produce biofuels and biomolecules from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE NECROPHY project aims at demonstrating, by means of a prototype, the feasibility of a new wastewater treatment approach, based on energy and nutrients recovery. The process tested in the project is based on an initial pre-concentration step that promotes the biosorption process maximizing the biogas production. The effluent of the pre-concentration unit is the influent of a nutrient recovery unit based on adsorption in zeolites. The LIFE ENRICH project (Enhanced Nitrogen and Phosphorus Recovery from wastewater and Integration in the value CHain) goes a step further and aims at demonstrating the whole value chain for nutrient recovery
in wastewater treatment plants and their valorisation in agriculture through different approaches boosting a model based on circular economy. This study intends to evaluate environmentally and economically the innovative processes tested in the LIFE RECOVERY and LIFE ENRICH projects by comparing them to conventional schemes of wastewater treatment. To do so, Life Cycle Assessment (LCA) has been the selected methodology to quantify the environmental burdens of these innovative processes relative to traditional conventional ones that are found in the literature. Several hotspots of the latter 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. This will generate cost incurred information (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 from waste and by-products from wine industry value chain A. Novi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; L. Vogli, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Righi, University of Bologna / Physics; S. Macrelli, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; C. Samori, C. Torri, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; D. Rey, Emilia Romagna Region (Italy) which aims to valorize wine industry by-products. Its focus is the development of an integrated strategy for the transformation of waste from the whole oenological supply chain into high added-value products such as polymers, base chemicals, and molecules for the nutraceutical, cosmetic and agrochemical industries. In this framework, a novel experimental process for the valorization of wine lees and sewage sludge is carried out. These wine residues are subject to anaerobic acidogenic fermentation in order to produce volatile fatty acids (VFAs), which in turn are used to feed a mixed microbial community (MMC) able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The last step consists of PHAs extraction using dimethyl carbonate (DMC). Life cycle assessment is applied in order to calculate and compare the environmental impacts related to the production of one kg of PHAs according to the model proposed by the European environmental impact method and SimaPro 8.4 software. The present study demonstrates that the generation of electricity from biogas plant stages. 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 a major non-food agricultural commodity for the economy due to its market abroad. The volume of production places 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 the circular economy approach in the Colombian palm oil industry, to account for the agricultural 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 Uledge for future decision making towards the sustainability of resources and the optimization of processes carried out by palm-cultivation companies as part of their policy of environmental responsibility.

TU256 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILL EFFLUENT N. Abdul Aziz, M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science Exploring renewable energy sources is becoming increasingly important due to its low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be a suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle assessment (LCA) performed using ReCiPe 2016 environmental impact method and SimaPro 8.4 software. The present study demonstrates that the generation of electricity from biogas is an advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.
Ecoinnovazione / LCA and Ecodesign Laboratory; D. Tonon, Ecoinnovazione srl Circular Economy has become a concept quite known also within the public domain. It is a catchy term that puts together two words easily understood by everybody with a positive meaning. Moreover, it can be easily translated into simple rules/guidelines to follow to claim an improvement of our economy and its relation with the environment, such as: recycle, avoid dangerous substances, extend the life of the products. However, the reality is more complex, and the current consumption patterns towards circularity are not always feasible. For example, burden shifts from resource depletion to other environmental impacts are common and consequent. 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 discuses 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 polyphenol 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 boundaries and to the fact that the same technology can provide different functions according to the selected perspective. The oral presentation will detail how the main difficulties have been considered and addressed, such as the 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 consumption say? R. Dagilute, Vytautas Magnus University / Environmental Science Department; A. Muteikytė, Vytautas Magnus University Around 88 million t. of food is annually wasted in the European Union. According to FAO (2013), 31–39% of food is wasted at consumption level in developed regions. This wastage has an enormous negative impact on the global economy and food security, leading to the major environmental impacts. EU framework “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 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’ flow and food waste generated. To find out consumers’ opinion about their food, the restaurant was examined during 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 respondents do not indicate any opinion to take food 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 encouraging food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU239 Assessment of Carbon Footprint of a typical Spanish dietary pattern: The Atlantic diet X. Esteve Llorens, Universidade de Santiago de Compostela / Chemical Engineering; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; J. Garrido, Universidad de Santiago de Compostela; L. González-García, University of Santiago de Compostela CIF Q1518001A Chemical Engineering Access to adequate nutrition is a basic human need that depends on numerous social, political and economic factors. Similarly, food patterns affect not only to food consumption but also its production, which cause health, social and environmental impacts. In particular, food chains that support diets are linked to environmental issues such as greenhouse gas (GHG) emissions, fossil energy requirements and land use. According to Garnett (2011) and Irz et al. (2016), 15-30% of total GHG emissions in developed countries are derived from food production, distribution and consumption. Therefore, environmental pressures from food systems are on the top of public health agendas, and sustainable food production and dietary patterns are considered of major interest. Consumption patterns vary significantly across Europe. In the southern countries, healthier diets richer in fruits and vegetables have been identified. In this sense, the traditional Atlantic diet is a common dietary pattern in Northern Portugal and Galicia (Northwest of Spain), culturally and climatic similar areas. The Atlantic diet is characterised by an abundant consumption of vegetables, fish and meat, mainly local and fresh products (seasonal food), cooked to maintain its characteristic flavour and taste. For this reason, it has been 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 detailat 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 valuable for food producers and retailers to develop a sustainable Atlantic diet. Moreover and in line with the literature (Pernellet 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 (RVC-2014-14084).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes? N.A. Chapman, KU Leuven / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering; J. Eyckmans, KU Leuven / Faculty of Economics and Business The sharing economy, facilitated by digital platforms, is expanding in to more and more areas of the economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from preventions of the wider access to goods and services, and a more intensive use of goods and consumer goods produced overall. Thus, in order to account for the impacts, goods must be assessed over their entire lifetime, particularly the manufacture and use phases. Life cycle assessment (LCA) is a tool that can be used to estimate such environmental impacts, but a comprehensive assessment should also include the various responses and behavioural changes of consumers to this new sharing marketplace. For example, the use of goods may expand in to more and many ways, with corresponding changes to market dynamics. This research consists of a review of studies into the sharing economy, and suggests how consequential LCA can be used to give a more detailed assessment of the environmental impacts. Particular attention is paid to how the behavioural changes in consumption should be accounted for in an LCA applied to the sharing economy.

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

TU241 Effects of plant growth and organic carbon addition on DDE degradation in soil M. Cardoni, National Research Council of Italy / Water Research Institute; F. Mitton, University of Mar Del Plata; M. Di Lenola, National Research Council of Italy / Water Research Institute; L. Patrolecco, Water Research Institute-National Research Council / Water Research Institute; N. Ademollo, F. Spataro, National Research Council of Italy / Water Research Institute; K.S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicologia y Contaminacion Ambiental; L. Patrolecco, Water Research Institute, University of Mar Del Plata; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute Although the use of DDT was banned in numerous Countries several years ago, owing to its high lipophilicity and persistence, this pesticide and its metabolites (p’‘-DDE and p’‘-DDD) are frequently found in the environment. Plant-assisted bioremediation can be a promising clean-up technology to contaminated soil remediation; it relies on the synergistic action between plant rhizosphere and microorganisms to remove toxic substances. In this work, Solanum lycopersicum together with dissolved organic carbon were added to DDE-contaminated soil for bioremediation purposes in greenhouse microcosms. The experimental set was 290
performed to assess the effectiveness on DDE biodegradation of tomato plant presence with and without the addition of two different DOC (with different humic substance composition). The pots were filled with contaminated soil (1 ppm of DDE) in presence/absence of tomato plants and watered with different kinds of DOC solutions; control soils (with/without plant and/or DDE) were also implemented. The plots were sampled after 40 days from DDE exposure. The effects of the different treatments on the soil microbial community and on DDE biodegradation ability were evaluated in terms of microbial abundance, viability, structure, dehydrogenase activity and DDE residual concentration. The results showed that the plant presence stimulated the overall soil microbial community activity but did not increase significantly the DDE biodegradation. The quality of the organic carbon in terms of fulvic and humic acids presence influenced differently both DDE degradation and microbial activity.

TU242 Soil microbial community associated to a poplar-assisted bioremediation study


A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area a little more than one year after planting. In fact, the systematic sampling of the poplar and the sterilized soil performed promoted a reduction of overall PCBs concentration under the Italian legal limit (D.Lgs. 152/2006) of 60 ng/g soil (Ancona et al., 2018). A further sampling was performed four year later in order to assess the PCB residual concentrations at different depths and distance from poplar tree trunks inside the planting area. At the same time, microbial analyses were carried out to measure the total microbial abundance, cell viability and dehydrogenase activity. Moreover, nucleic acids were extracted from soil. The hypervariable regions V4-V5 of the 16S rRNA gene were amplified and sequenced by MiSeq (Illumina). The structure of the microbial community in the planted and un-planted (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


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 stimulte 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, which can grow in different environments and it is among the fastest growing trees. Furthermore, poplar demonstrates the capability to absorb organic contaminants (i.e. heavy metals) from the soil in which it is cultivated. For these reasons this poplar clone for synergistic acting, 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

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Greenhouse experiments have been performed to test the capacity of the Populus clone (clone Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-planted soil was used as control. PCB concentrations in soil samples and plant roots were analysed at 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 a better uptake of organic contaminants and ability to produce biomass under flooding conditions. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation study.

TU245 Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments

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In experimental design and suggested guidelines for conducting the experiments

F. Terzaghi, University of Insurbia (Como) / Department of Science and High Technology; E. Conno, University of Insubria (Como); E. Guerriero, C. Morosini, University of Florence / DIST; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; S. Borin, University of Milan / DeFENs; F. Mappelli, University of Milan; L. Vagnani, University of Milan / Department of Food, Environmental and Nutritional Sciences; A. Di Guardo, University of Insurbia / Department of Science and High Technology

Effects of the different treatments on the natural microbial community and on DDE biodegradation in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation study.

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

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 9.0±10³ and 30±10⁶ CFU/g compared to unamended control soil throughout the 4 weeks of study. Oil-contaminated soil amended with a combination of poultry manure and NPK fertilizer showed the highest reduction in total petroleum hydrocarbons with loss of 80% in the 4th week compared to other treatments. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPK > Poultry Manure > NPK.

TU247

- Soil pollution and physico-chemical properties steer the bacterial community structure in the uneven highly polluted SIN Brescia-Caffaro site.
- E. Mapelli, University of Milano - DeFENS; Department of Food, Environmental and Nutritional Sciences; L. Vergani, University of Milano - DeFENS; E. Terzaghi, University of Insubria (Como) - Department of Science and High Technology, Como; G. Rasp, Sapienza University of Rome - Department of Chemical Engineering Materials and Environment; E. Zanardini, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Barin, University of Milano / DeFENS

- Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity 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 SIN Brescia-Caffaro Site (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 Brescia along a tridimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolitic activity, the physico-chemical features and the concentration of metals and 79 PCB congeners. A cultivation-independent approach led to unravel the phylogenetic structure of the residing bacterial communities. By means of statistical analyses, we showed that significantly different bacterial communities were selected in the investigated areas within the SIN Brescia-Caffaro. Spatial distribution of bacterial populations within each site was significantly correlated with physico-chemical soil parameters and pollutant concentrations. Soil physico-chemical properties were also significantly correlated to the hydrolitic activity of the soil microbiome, a relevant indicator of soil quality and pollutant availability.

TU248

- Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.
- E. Diana, University of Milano - Bicocca; T. Stella, University of Milano-Bicocca / DISAT; M. Daghio, University of Milano - Bicocca / Department of Earth and Environmental Sciences; F. Pittino, University of Milano - Bicocca; R. Ferrari, A. Francioli, HPC Italia S.r.l; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences

- Recalcitrant hydrocarbons often persist in contaminated environments. Bioremediation 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 biopolymers. The site is contaminated by light and heavy hydrocarbons, the latter ones representing the most recalcitrant fraction. Biocatalysis of hydrocarbons is related to dissolved oxygen concentrations both in the size of the area and the economic/environmental costs of other technologies such as Di&G Dump. Biopolymers 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 (SD) and 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 to 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 microbological/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 SD (K=0.011 d⁻¹) in the first 60 days of incubation. However, a residual TPH concentration of 990 ppm was reach in all bioreactors after 180 days starting from an initial concentration of 2600 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 bacteria growing 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 vanhaelenii 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

- Polymeric 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 effects of Brij-35 biosurfactant and rhizomucil biobuffer surfactant at three concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanhaelenii PYR-1 in PAH-contaminated soil using 14C-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 structure at tree (PICRUSt). Results showed that Brij-35 surfactant at all three concentrations resulted in increased PAH mineralization after 50 days incubation by indigenous microbe populations in the sandy loam and clay soil compared to the unamended and rhomulip-amended soil treatments. The bioaugmentation of M. vanhaelenii PYR-1 had an immediate impact on PAH mineralization in both soils, resulting in 29% reduction in total petroleum hydrocarbon with loss of 80% in the 4th week compared to other treatments. The bioaugmentation of M. vanhaelenii PYR-1 with Brij-35 showed the highest decrease in total petroleum hydrocarbons. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPK > Poultry Manure > NPK.

TU250

- Italian field results of Emulsified Lecithin 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 convert inorganic carbon (inorganic carbon) into organic carbon (organic carbon) and produce the electrons needed for the redox potential in groundwater. As bacteria ferment the ELS, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators. Lecithin itself is composed primarily of phospholipids, which have both hydrophilic and hydrophobic regions in their molecular structure. As a result, ELS tend to be stable emulsions, expectedly more aerobic and less likely to volatilize. The results of this study provide beneficial insights towards the abiotic and biotic processes as well as their complex interactions in the bioremediation of PAH-contaminated soils.
buffering capacity presented the best conditions for dehalorespiring bacteria. The authors acknowledge the assistance provided by the project No. TF02000064 supported by TACR.

TU253 Mechanistic insight into microbial reductive dehalogenation
S. Zhang, E. Helmholdt, Centre for Environmental Research / Department of Ecological Chemistry; G. Schüürmann, Helmholz Centre for environmental research - UFZ / Department of Ecological Chemistry
Microbiologically 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 CD1 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).[1] The latter was unraveled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational analysis of the molecular initiating event triggering the reductive dehalogenation. Application to 93 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibeno-p-dioxins, and brominated benzenes reveals that the lowest symmetry-compatible G or ferrocene located at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CD1B1-active from non-active substrates to 92%. In future, we are planning to develop new experimental 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, H. S.; Schüürmann, G.; Adrian, L. 2017. Anaerobic Dehalogenation of Chloroaromatics 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
M. Stylianou, Orebro University / The Life Science Centre-Biology; I. Jönsson, Orebro University / MTM Research centre; P. Olsson, Orebro University / The Life Science Center-Biology; J. Jass, Orebro University / SCHOOL OF SCIENCE AND TECHNOLOGY
Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for commercial and industrial products since the mid-1960s. While they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009). Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contain 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 develop new strategies 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 OPS0 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed for PFOS by UPLC-MS/MS. The dead bacteria were found to have high adsorption (286-5324 g/g of bacterial pellet) whereas live cells showed only low adsorption (0.006-0.496 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.
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed at the initial, during the experiment and final time by spectrophotometric method, while the dissolved total chromium was analyzed by ICP-MS. During the whole test, the current intensity was monitored. At the end of the experiment, the microbial characterization of the communities enriched on the biocathode and in the cathodic sediment was analyzed by 16S rRNA gene sequencing. The acclimatization phase in the MFC allowed the formation of an electroactive microfilm 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 values 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.

TI/256 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. In injection wells, non-return valves are corresponding to thirty. Contaminant is present in shallow aquifer and was higher than 10 mg/l. The efficiency of the remediation is currently about 99%, 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, approximating 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 (Phase 1) 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 PCE bioremediation we have production of daughter products to prevent the accumulation of these by producing an air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methane gas reaction, CH2M has decided to install a biofiltration plant, to prevent any dangers for the residential areas nearby. The challenge this complex ecological has been solved by using fixed patented valves corresponding to thirty. Contaminant is present in each aquifer. 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.

TI/257 Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments

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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 surrogate 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) ones, to increase the percentage of EAM in order to improve the MFCs performances. A freshwater sediment (Fw) sample was chosen as inoculum source. The effect of the enrichment procedures was compared in term of both electrochemical performance and biological characterization. The microbial community was subjected to three sequential enrichments and then used as inoculum for the MFCs. Anodic potential and voltage were continuously monitored. DGGE, sequencing and qPCR techniques were used to investigate the EAM community. Moreover microbial α-diversity was calculated. The enrichment effect was evaluated both for the 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 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 population 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.

TI/259 Integration of molecular and isotopic analyses to investigate the potential of aerobic biodegradation at a site contaminated by Monochlorobenzene (MCB) at the Kennedy Space Center

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Biodegradation of contaminants at hydrocarbon 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 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 and analyses during the biodegradation showed a completely depleted signal of acetate and CSIA results revealed negligible C isotope fractionation under oxidative conditions. The catalytic toxC gene, encoding for tolune 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 microbial communities living in contaminated areas with multiple pollutant sources and different environmental conditions represent a big challenge to site owners. Therefore, a detailed chemical, isotopic and microbiological 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 biology data from a contaminated industrial area to quantify the complex mixtures of contaminants, to provide information about the sources of contamination and to assess the presence of potential degraders and, thus, to enhance the on-going biodegradation processes. Contaminated groundwater was collected from 19 piezometers in a restricted area of the site. Chemical analyses of chlorinated ethenes, 1,1,2-trichloroethane (1,1,2-TCA), 1,2-dichloroethane (1,2-DCA), benzene, toluene, xylene isomers, ethylbenzene and chlorinated benzenes were performed following the standard protocols. Compound-Specific Carbon Isotope Analysis (C-CSIA) were carried out to define the isotopic signatures of 1,1,2-TCA, 1,2-DCA and chlorinated solvents (PCE, TCE, 1,2-cis-DCE, VC). The structure of the microbial community was determined by Illumina High Throughput Sequencing, whereas its functional profile was assessed by quantitative PCR of key genes encoding for enzymes involved in specific metabolisms. Trichloroethylene and 1,2-dichloroethane (1,2-DCA) were found in most of the water samples at high concentration as well as 1,2-cis-DCE. Illumina sequencing data showed a great bacterial diversity probably due to contamination heterogeneity. However, species belonging to Burkholderiales - VC and 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PceA, TceA, VcrA, BvCA) and oxidative enzymes (emC, emE) will be accomplished (on-going analysis) as well as isotopic analyses.

TU261
Microbial ecology and ecosystem services: a key role for biotechnological applications
The microbial communities living in contaminated areas with multiple pollutant sources and different environmental conditions represent a big challenge to site owners. Therefore, a detailed chemical, isotopic and microbiological 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 biology data from a contaminated industrial area to quantify the complex mixtures of contaminants, to provide information about the sources of contamination and to assess the presence of potential degraders and, thus, to enhance the on-going biodegradation processes. Contaminated groundwater was collected from 19 piezometers in a restricted area of the site. Chemical analyses of chlorinated ethenes, 1,1,2-trichloroethane (1,1,2-TCA), 1,2-dichloroethane (1,2-DCA), benzene, toluene, xylene isomers, ethylbenzene and chlorinated benzenes were performed following the standard protocols. Compound-Specific Carbon Isotope Analysis (C-CSIA) were carried out to define the isotopic signatures of 1,1,2-TCA, 1,2-DCA and chlorinated solvents (PCE, TCE, 1,2-cis-DCE, VC). The structure of the microbial community was determined by Illumina High Throughput Sequencing, whereas its functional profile was assessed by quantitative PCR of key genes encoding for enzymes involved in specific metabolisms. Trichloroethylene and 1,2-dichloroethane (1,2-DCA) were found in most of the water samples at high concentration as well as 1,2-cis-DCE. Illumina sequencing data showed a great bacterial diversity probably due to contamination heterogeneity. However, species belonging to Burkholderiales - VC and 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PceA, TceA, VcrA, BvCA) and oxidative enzymes (emC, emE) will be accomplished (on-going analysis) as well as isotopic analyses.

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, physiochemical, 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 Bydlov 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
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Introduction: Despite the scenario of excess phosphorus in some aquatic environments, there has been concern with the development of algal blooms and eutrophication process, 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 microwave 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 using inductively coupled plasma mass spectrometry. Results: Dissolved oxygen values in the control microcosms were significantly higher (p < 0.05) in comparison to the treatment microcosms, as a consequence of the organic matter oxidation present inside the bags. The lowest concentration of Fe(II) found in the water column of the control microcosms causes the oxidation of the superficial sediment and this oxidized layer was responsible for the reduction of internal flow of P. In the interstitial water the Fe(II) concentration is much higher than in the water column due to the large amount of Fe present in the sediment. The concentration of orthophosphate in the water column varied during the experiment, in the treatment microcosm the decrease was indicative of phosphorus adsorption. It was observed that the adsorption of phosphorus on sawdust began after 57 days. The maximum adsorption was at 214 days (41.4 μg P g−1 sawdust). The investigation of the microbial community and to identify functional biomarker 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.
Formulation potential of trifluoroacetate and its estimation by means of the TOP assay

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Trifluoroacetic acid is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pK_a < 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 anthropogenic source of TFA. However, its formation in the environment has also been shown for other substances containing trifluoromethyl moieties. Hence, a large number of active substances in modern crop protection agents, pharmaceuticals or industrial chemicals have to be regarded as potential TFA precursors. In the present study, the TFA formation potential of environmentally relevant substances was determined using the so-called total oxidizable precursor assay (TOP assay). In order to analyze the resulting concentrations of TFA, a method for quantitative extraction of the analyte from the highly alkaline and saline digestion solutions was developed. The subsequent measurement was performed using liquid chromatography coupled to tandem mass spectrometric detection (LC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, flupyradifenox, flubromatin and tembotrione; pharmaceuticals: fluoxetine and sitaglitin; industry chemicals: 4:2 FTSA and 6:2 FTSA) led to substance-specific molar yields between 7.1% (6:2 FTSA) and 96% (sitaglitin). It is known from previous studies that TFA can be formed during wastewater treatment of samples from six treatment plants (WWTPs) was investigated. As expected, more TFA was formed after oxidation of the influents (up to 180% increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140%). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

A Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

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The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of 1,2,4-triazol after application of these substances are below the limit value of 0.1 μg/L. In plant protection regulation, this limit value has to be applied for 1,2,4-triazol due its toxicological relevance according to the regulation (EC) 1107/2009. Exceedance of this trigger has been questioned considering that several fungicidal active substances forming 1,2,4-triazol may be used consecutively. In addition, plant protection products are not the only source of 1,2,4-triazol. It can also originate from animal feed use. In addition polymer inhibitors as additive to fertilizers, or even be formed naturally in forest soils. Consequently leaning of 1,2,4-triazol from these different sources might lead to exceedance of the limit value for groundwater in agricultural catchments. Therefore, the competent authorities of Germany, Denmark and France have initiated monitoring programs and incidence reporting. If entries above 0.1 μg/L in groundwater are found and entry via pesticide application is considered likely, authorities may have to decide on further risk management actions. Possible mitigation measures are discussed and the difficulties in dealing with different sources and regulatory frameworks are highlighted.

PPPs on the basis of natural compounds: nature challenges analytics

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For many plant protection products (PPP) using natural compounds as an active ingredient, considerable background levels are frequently observed in untreated control material. These contaminations originate from both, natural and anthropogenic sources. Applying the method described in the paper above, the analysis mostly undergoing chromatography and residue analysis more challenging. There are different routes for natural background contaminations resulting from natural sources as amongst which are: physicochemical degradation from higher compounds (e.g. degradation of triacylglycerides to fatty acids), microbiological activity or the use of a plant product as active ingredients (e.g. rapeseed oil). Besides the natural occurrence of the active ingredient or parts of it, anthropogenic routes of contaminations are also diverse; some active ingredients of PPPs were used in industrial production processes (e.g. short-chained fatty acids as softener for plastic materials), other compounds are incorporated in materials used for solvent production. Both may lead to high background levels. Both routes, the anthropogenic as well as the natural, can lead to background level contaminations of the active ingredients, making it hard or in some cases impossible to find contaminant-free control material and/or to determine these active ingredients at low concentration levels. Furthermore, natural compounds used as active ingredients in PPPs or their derivatives are of low molecular weight and thus leading to fragments < 100 Da in LC-MS/MS analysis. These are more difficult to analyse as the signals of these mass transitions are often disturbed.

Persistence & Biodegradation Assessment (P)

Implication of microbial adaptation for the persistence of emerging pollutants

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Regulatory determination of the persistence of organic chemicals is mostly done using OECD ready biodegradability tests (RTBs). RTBs, 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 RTB’s change over 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 RTBs. We, therefore, used chemostat systems to expose activated sludge microbial communities to 4 chloro-5,6-dihydro-5-methylpiperazine or metformin. Two of these chemicals are considered as emerging contaminants and are persistent according to RTBs. 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 CO_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 showed enhanced biodegradation capacity for 5-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, guanlyurea, 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 RTBs using adapted inocula.

Prioritization of organic compounds based on their persistence in dissolved phase

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When considering the large number of chemicals potentially present in the environment, the scientific community seeks to establish a pertinent list of priority compounds. Assessing the persistence of chemicals such as pharmaceuticals or polar pesticides represent a need in order to realize a better prioritization of compounds of concern. Persistence in dissolved phase is widely dependent on intrinsic properties of compounds but also on environmental conditions such as temperature, salinity, or presence of microorganisms. Estuaries are characterized by gradient and high variability of salinity and suspended solids (SS). The environmental risk assessment need to be adapted to dynamic conditions as those prevailing in transitional areas. This study focuses on the persistence of polar pesticides and pharmaceuticals into turbidity maximum zone of the macrotidal Seine estuary. Laboratory batch experiments simulating mixing conditions of the discharge of wastewater into estuarine water were performed. The influence of SS concentration, salinity and abiotic control was assessed on a selection of 60 polar pesticides and 51 pharmaceuticals. In order to compare relative compound persistence in dissolved phase, a persistence index based on the half-lives of the compounds was calculated. Briefly, marks depend on half-life values of each condition, and the average mark gives the persistence index. Risk 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
TU269
OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers
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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, notably 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-anerobic 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, flunoxamone, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Grindelch, 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 is slower than in water, which is more relevant than the possible sorption cannot be completely excluded, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU270
Compartment-Specific Screening Tools - Development and Application to Assess Potential Persistence of Organic Compounds in Water, Sediment and Soil
T. Junker, ECT Oekotoxikologische GmbH; A. Coors, ECT Oekotoxikologische GmbH; G. Seidmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The persistence assessment under REACH ideally relies on compartment-specific degradation half-lives that are generally derived from aerobic laboratory simulation studies for surface, aquatic sediments or soil. Albeit these data are given top priority, they are not available for most of the compounds since simulation tests are time-consuming and expensive, and they are required only for compounds with a production volume of 100 or more tons per year. Thus, screening information (e.g. results from ready biodegradability tests (RBTs) or quantitative structure-activity relationship (QSAR) models) are used in the absence of simulation test data to decide whether a substance is considered as “not persistent” or “potentially persistent” according to screening criteria. However, RBTs only model the water compartment, while QSAR models were only developed based on qualitative experimental biodegradation data related to water-only test systems. Therefore, half-lives for soil and sediment are calculated by multiplying the half-life in water by constant factors. However, this extrapolation is questionable due to different conditions in the compartments, which might affect biodegradation in connection with the physico-chemical properties of the compounds. Consequently, there is a lack of experimental quantitative biodegradation data for soil and sediment at the screening test level. In the present work compartment-specific screening tools for water-sediment (Water-Sediment Screening Tool, WST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WST and SST were applied to determine degradation data for a set of fifteen test compounds. The results demonstrate that the WST 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∞).
Levan was isolated after fermentation of *Bacillus licheniformis* strain. Syntheses of copolymers were performed by the free radical reaction using potassium persulfate as initiator. Verification of the synthesis was recorded by 13C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O2 consumption of samples mixed with soil was measured in period of 28 days. The 13C NMR spectrum of copolymer showed significant difference to both monomers. Monomer O2 in copolymer sample (705.0 L) compared to control (350.9 L) and polystyrene (499.5 L) after 673 h. The formation of levan and polystyrene graft copolymer was confirmed by 13C NMR analysis. Results after 28 days in aerobic biodegradation in soil shows that obtained novel copolymer has biodegradation potential, however additional tests for biodegradation are needed.

TU274 Aerobic degradation of styrenated polyl in soil: influence of the temperature and of the characteristics of the soils

M. Enrici, SOLVAY / HSE - PRA PS; P. Chagnon, SOLVAY / Research and Innovation

The persistence of chemicals is assessed through their kinetic of degradation in the environment. Several simulation tests are available to evaluate the half-life of the chemicals in different environmental compartments. The half-life is then compared to the Annex XIII criteria of REACH to decide if the substance is be considered as Persistent (P) or very Persistent (vP). Nevertheless, the interpretation of those tests is complex. Degradation of styrenated polyl was studied in aerobic conditions, despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated polyl 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, transformation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

TU275 Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests

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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, as such 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 of 1,4,2,6-TDA was studied under aerobic conditions in the OECD Guideline Nos. 301B and 301C, whereas their disappearance, formation of degradation products, and evolution of 13CO2 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 301C test used water/sediment collected from two diverse environments. Statistical analysis was performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the parent compound, 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 polybrominated diphenyl ethers (PBDEs) is an important transformation and detoxification route in the environment. To better understand the in-situ microbial degradation of PCB and PBDE in anaerobic sediment, three sediment cores from an e-waste dismantling site, Shenzhen, China, were collected (named #1, #2, and #3, respectively). Positron emission tomography (PET), compound specific isotope analysis (CIA), and microorganism analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g dw) and PBDE (62-792000ng/g dw) were found in all the samples and the concentrations were general increased from bottom to the top layers. PMAF analysis indicated that the technical mixtures are the dominant PCB and PBDE input and dehalogenation take place in the sediment cores, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Dehalococcoidetes were found in the sediment cores. The range of the relative abundance of Dehalococcoidetes for three sediment cores (#1, #2, #3) was 1.50-9.01%, 1.47-5.24%, and 0.20-2.55%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) PCBDEs (with values of 0.02, 0.05 and 0.01, respectively) as for CIA analysis, only the stable carbon rations (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the 3rd sediment cores were obtained. An increase in the δ13C values for BDE 28 and a slightly decrease in the δ13C values for BDE 85 were found with the increase of the depth sediment cores, indicating a potential biotransformation of these compounds in the cores. No significant differences in the δ13C values of BDE 47 and BDE 99 were obtained 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 demobilisation processes.

TU277 Transformation and degradation mechanisms of flame retardant triphenyl phosphate in aquatic environment

Y. Choi, Gwangju Institute of Science and Technology; S. Kim, Gwangju 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 TPH and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, *Daphnia magna* was exposed to single concentrations due to its sensitivity in aquatic environment. TPHF was exposed to individual *Daphnia magna* and each sample was separated by biota and remaining medium. *Daphnia magna* was 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 high-resolution tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase 1 & 2 biotransformation mechanisms. Diphenyl phosphate (DPPH), 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 (TPHF) and hydrolysis products (DPPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHF and DPPH; as TPHF showed decreased, degradation product (DPPH) ratios increased. In conclusion, hydrolysis and sulfoxidation were major mechanisms for biotransformation products of TPHF in environment. As a result, the risk to aqueous organism 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 exclusively new synthesized silicon organic compounds (p-MeOC6H4SiMe2, o-MeOC6H4SiMe2, p-MeOC6H4H2SiMe2, o-MeNC6H4SiMe2, p-MeNC6H4H2SiMe2) 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. The processes of photolytic biodegradation and photolysis were carried out at a certain degree. After 6 hours, 99% of the substances with CO\textsubscript{2}, NH\textsubscript{3}, H\textsubscript{2}SMe\textsubscript{2} was also 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 were in the range of 0.01 to 7.06 mg/L for each compound on 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

Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)

Microbial degradation (biodegradation) is an important mechanism for removal of organic pollutants in natural water systems. The biodegradability of a compound is a fundamental determinant of the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most important tests for providing kinetic biodegradation data in surface waters for use in persistence assessment and risk assessment. The OECD 309 simulation test measures biodegradation in aerobic natural waters that have been spiked with test compounds and in situ analyses have been carried out at a certain degree. After 6 hours, 99% of the substances with CO\textsubscript{2}, NH\textsubscript{3}, H\textsubcript{2}SMe\textsubscript{2} was also 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 were in the range of 0.01 to 7.06 mg/L for each compound on our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

TU280 Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters

Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)

Microbial degradation (biodegradation) is an important mechanism for removal of organic pollutants in natural water systems. The biodegradability of a compound is a fundamental determinant of the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most important tests for providing kinetic biodegradation data in surface waters for use in persistence assessment and risk assessment. The OECD 309 simulation test measures biodegradation in aerobic natural waters that have been spiked with test compounds and in situ analyses have been carried out at a certain degree. After 6 hours, 99% of the substances with CO\textsubscript{2}, NH\textsubscript{3}, H\textsubcript{2}SMe\textsubscript{2} was also 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 were in the range of 0.01 to 7.06 mg/L for each compound on our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

TU281 A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals

M. Crespe, Frilet, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; C. Sweetlove, IOREAL SA / Research and Innovation; J. Chénélle, L’Oreal Research / Research and Innovation; J. Lharridon, L’Oréal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology

According to the United Nations (UN), a substance is the “chemical elements and their compounds in the natural state or obtained by any production process”. This definition has evolved according to different acts of regulation. Another category of substances is UVCB: Unknown or Variable composition, Complex reaction products or Biological materials” such as crude oils or vegetal extracts. In addition, there are “mixtures or solutions composed of two or more substances in which they do not react”. The assessment of complex mixture biodegradability can be limited by technical issues and/or difficulties in determining inherent biodegradability. This work is composed of three different studies to introduce and improve Ultimately Transformed Organic Carbon (UTOC) as a quantification tool for biodegradation. The UTOC includes the inorganic carbon resulting from respiration and the carbon assimilated by microorganisms. This measurement strategy was initially compared to a DOC D/E/A 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 aimed to reinforce safety in the assessment for substances of unknown composition. Based on the principle of reducing the probability of persistent parent products or generation of toxic by-products during biodegradation, the UTOC approach was reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assessed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture. The results showed 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.

TU282 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 and in situ assessment of a complex mixture of pollutants cannot be filtered according to their biodegradability. 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 \( \text{O}_2\), \( \text{CO}_2\), pH, T°C, Pressure and Biomass. These technological investigations will be used to create an unique automated device enabling the evaluation of biodegradation of a chemical whatever its physicochemical characteristics.

**TI283**

**Investigations on key parameters of an innovative biodegradation test based on cell proliferation**

S. Rey, Firmenich / Biotechnology; B. Özel 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 \( \text{CO}_2\) formation or oxygen consumption, and usually neglect biomass formation. Our research attempts to fill a gap in the knowledge on bacterial physiology in tests conducted 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 cell counting. As test compounds, selected reference chemicals were chosen from the ECETOC MCC/007 list suggested for method development for readily and non-biodegradable compounds. Alongside cell counting, several test compounds were analyzed in parallel for \( \text{CO}_2\); and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

**TI284**

**Challenges and Solutions of Ready Biodegradation Study with Difficult Substances**

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tsumayama, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morita, Kao Corporation / Safety Science Research

Ready biodegradation studies (OECD TG 301) are required for registrations and the development of chemicals for various applications. Current test systems work well for many substances, but some substances, called “difficult substances” sometimes fail due to problems with these test systems. Here challenges and solutions in ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylhentriacontane, is insoluble in water and tends to stay on the water surface. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface. To overcome this challenge, the test substance was wrapped in a nylon sheet so that it could stay in the water for access by the microorganisms. With this test system, the biodegradability was remarkably improved and it was regarded as ready biodegradable. This method and result were accepted by the Japanese authority. An aroma chemical, 3,5,5-trimethylhexanoic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the test substance disappeared from the test system by volatilization. To elucidate this hypothesis, the concentration of the test substance and a possible hydrolyzed metabolite were monitored by chemical analysis in the water phase. The result indicated that the test substance volatilized within 48 hours. This result strongly suggested that the low biodegradation result was due to the rapid volatilization and disappearance of the test substance from the test system. The possible solutions to this challenge will be discussed in the presentation.

**TI285**

**Influence of inoculum origin and adaptation on biodegradation of emerging contaminants**

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Assessment of microbial biodegradation is a key parameter for estimating the environmental risk of new organic chemicals. Commonly used tests for the assessment of ready biodegradability (RBTs) have been designed as simple and inexpensive methods to identify chemicals that are not expected to be environmentally persistent in most of the ecosystems. However, RBTs suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. These tests are low throughput, space consuming and poorly reproducible. Moreover, the origin of the inoculum is also a cause of variability in RBTs results. Pre-exposure of the inoculum to the tested chemical prior to any test has been proposed as a method to improve biodegradability testing. Pre-exposure could allow a better persistence prediction of chemicals present at low levels in wastewater or of newly produced chemicals by including the natural adaptation ability of microbial communities. Therefore, in order to assess the influence of the inoculum origin and of pre-exposure on RBTs, we compare the biodegradation capacity of activated sludge from different Dutch wastewater treatment plants before and after pre-exposure to five different chemicals. Carbamazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-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 method. We present here a summary of the results obtained using 386 well plates pre-used for the incubation and elimination is measured by following the CO\(_2\) production (OECD 310) and the compound concentration by LC-MS/MS. The results of these experiments are expected to show differences between responses of inocula that are not pre-exposed. After pre-exposure we expect to reduce the risks of errors of test results and to enhance biodegradation. Different responses between the different inocula will give valuable information about the future environmental fate of the tested compound. Finally, this knowledge will develop more accurate ready biodegradation testing and lead to a more comprehensive environmental risk assessment of persistent chemicals.

**TI286**

**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 OECD Guidance on Screen and Testing) the regulatory environment has changed. Adapting is explicitly excluded in this Guidance. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessments and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of these families was subsequently used for a detailed evaluation about the potential 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.

**TI287**

**Use of Chemical Analysis to Enhance Biodegradability Testing: A Case Study with Two Gas-to-Liquid (GtL) Products**

J. Dawick, G. Whale, C. Hughes, Shell Health / Risk Science Team

The Oslo Paris (OSPAR) Commission, which oversees the OSPAR Convention, currently implements the harmonised mandatory control system (HMCS) for use and reduction of discharges of chemicals in the exploration and production of oil and gas offshore in the North Sea, the Celtic Sea, the Irish Sea and the English Channel. The HMCS requires that any 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 BSTs demonstrates that disappearance of test substances from the test system is often far greater than is suggested by the results of standard biodegradation testing. 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.

biodegradability of various hydrocarbon solvents. SETAC Europe annual meeting 2015, Barcelona, Spain.

TU288 Organising an international ring test to improve the marine biodegradation screening test
A. Gracio, T. Marshall, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering
A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradation screening tests (BSTs) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, there have resulted in major enhancements also address a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these in-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 led to the accumulation of these compounds in environmental systems such as fish. The study of organotin accumulation in fish tissues is very important as the concentrations of these compounds can differ considerably among species. This difference is influenced by various factors such as diet, age, size and location of the fish. Our previous studies have found that the accumulation of organotins is highly species specific and that it is affected by many factors. This is significant because the accumulation of organotins in fish tissues can affect their toxicity and bioaccumulation. Therefore, studying the tissue-specific accumulation of organotins in marine fishes is important to understand their toxicity and bioaccumulation in the environment. Our study aims to investigate the tissue-specific accumulation of organotins in marine fishes in southern Hong Kong.

TU290 POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
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We present preliminary results on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, water] of Schirmacher Hills, Dronning Maud Land, Antarctica, α-HCH concentrations (4.48 ng/g dw) are higher than those observed by 5 times or more. Out of the tested 28 polychlorinated biphenyl (PCB) congeners, only 6 PCBs were detected. Σ6PCBs in moss (122 ± 115 ng/g dw, n = 5) and water (30 ng/L and 165 ng/L, n = 2) are higher by up to 10 times compared to other studies around the continent. Heavier congeners (hexa through nona) in both moss and water samples contain high proportions of PCBs. This suggests that some localized sources of PCBs may still exist in the Schirmacher Hills region. It is possible that the old research stations, or tourism base, in the area may be one of those sources. While the observed congener distribution can be explained using congener distributions in known commercial PCB mixtures (Aroclors, Soolv and Clophen) in some samples, a post-deposition transformation in snowflakes (in glaciers) is required to explain the remaining observations. Box modeling exercise to reproduce congener distribution in our environmental samples suggests that degradation half-lives of PCB congers in snow should differ by at least 20 times between penta-hexa-hepta-(1750 h) and octa-(35000 h) congeners, as against the uniform value of one year (8760 h) suggested previously. Different half-lives could be possible, either if the rate of actual photodegradative-dechlorination process is different for congeners other than COC.

TU291 Degradation of crop protection products in Brazilian soils
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Recent CPPs become commercially available they are subjected to rigorous testing according to strict regulatory guidelines, including understanding the fate of these compounds in the soil environment. The global use of CPPs requires an understanding of their behaviour in a range of soils, including those from both temperate and tropical regions. Moreover, results from previous CPPs fate studies have shown fundamental differences in Brazilian soils compared to temperate soils. The study aim of this project is to determine the major physico-chemical and biological properties controlling the degradation of pesticides in Brazilian soils. A set of 4 different soils, prescribed for regulatory testing to encompass the typical range of properties, such as pH, organic matter, clay content and cation exchange capacity (CEC), including an on crop version and a pristine version of these soils, was used in my study. My first experiment focussed on the rate of degradation and mobility of O,p′-trifluoro thiabendazole in four different Brazilian soils and one temperate soil. Thiabendazole exhibited slow degradation due to its adsorption onto the soil solid surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT50) and distribution coefficients (KOC) were higher in some Brazilian soils compared to the temperate soil due differences in their physico-chemical properties. Further pesticides will be tested to determine which key physicochemical and biological properties are the driving force for a compounds fate in tropical soils.

TU292 Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD
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Bisphenol A (BPA) is a compound widely used in plastic materials such as polycarbonates and resins. Its use has been increasing in the last years and researches point that it may be detected in the environment in great concentrations. Moreover, this substance is classified as a pollutant of emerging concern because of its persistence in the environmental systems and its uncertain damages to both human and animal health. Some studies connect the exposition to this compound with cancer and other diseases. In this work, it was evaluated the ability of the fungus specie 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 powder 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 persistency in the culture medium.

TU/203 Soil dissipation of paraffin oils: Improvement of the microbial degradation and impact on soil dissipation.

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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/DISS 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 50% of the original concentration over a 17-day period after the initial treatment (DAT) in all four soils evaluated in the study. From 122 DAT through 300 DAT there was no substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids. Dissipation was not significant for all treatments from 17 to 300 DAT. However, dust emissions may pose a potential risk for longer periods.

After 250 years coal mining stopped 2012 in the Saarland, Germany. Ca. 80 mining heaps were investigated at each of the five locations. The average size of 15 samples (top 10 cm) from heaps of Shilen, Gotthlenborn, Lydica, Reden, Viktoria and 2 coal samples, were extracted and used in batch experiments. Leaching experiments with an automatic extraction unit (Dionex300) were executed, using acetone (potential leaching) and water at different temperatures (40°C and 80°C, “real” leaching). Additionally, batch experiments were conducted to investigate leaching under near equilibrium conditions (40°C) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, the transfer of Hg to higher trophic levels in freshwater ecosystems. By taking this into account, we can better predict effects of Hg in these ecosystems. Therefore, we conducted an experiment where single Daphnia magna clones were exposed at 20±2°C and 2±1 g/L Hg (HgCl₂) in the presence and absence of biofilm. Our objective was to test for a significant effect of Hg accumulation in biofilm on Hg uptake in Daphnia. 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 to freshwater food web and in decreasing the risk from Hg toxicity in Daphnia.
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.

TU302 Analysis of anticoagulant rodenticides, neonicotinoids and fipronil in liver of predatory birds

Pesticides in predatory birds have been drawing much attention worldwide in regard to species declining and protection. Pesticides are used for pest management of animal species such as commensal rodents and sap-sucking insects. However, pesticides can lead to secondary poisoning, when predatory birds take 3–5% of rodent P levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 μg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animal. The implemented supplements could not change what wildlife and livestock feeding 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.

TU303 Trophic Magnification of POPs including PFCs Within A Terrestrial Food-Web Of An Avian Top Predator, the Cooper’s Hawk (Accipiter cooperii)

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Lead (Pb) mining has contributed to the extensive release of Pb into natural environments for centuries. In former mining districts, now on the Iberian Peninsula mainly livestock and hunting estates, Pb persisting in the soils and vegetation of affected areas may constitute an environmental and health risk due to Pb bioavailability and high P:HAF for final statements.

TU301 Effects of mineral supplements on lead exposure in free-ranging herbivores
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Inhabiting mining areas and thus reduce the possibility exposure route to people. In our ongoing 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 2-fold higher than in non-supplemented animals (0.012 vs. 0.006 μg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animal. The implemented supplements could not change what wildlife and livestock feeding 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.
Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban river basin

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Trophic magnification factors (TMFs) have been extensively used to assess the biomagnification potential of organohalogenes in numerous aquatic and terrestrial ecosystems. While the trophodynamics of legacy persistent organic pollutants is relatively well known, that of emerging halogenated contaminants remains scarce and understudied. This is partly because TPT (triptyphenyltin) 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).

Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban river basin

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 biota quality

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 is moderately lipophilic (log Kow = 3.5), are commonly used in antifouling paints on sea-going ship hulls and superstructures in the South China Sea, 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 triphenyltin (TPT) can be biomagnified 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 western waters to the less-contaminated southern waters of Hong Kong. We have divided the western and southern waters into four sites, namely inner estuary (WI), outer estuary (WO), south of Lantau Island (SL), and southeast of Hong Kong Island (SE). Environmental (seawater and sediments) and biota samples (including molluscs, crustaceans, fishes and marine mammals) collected from the respective sites were analysed using gas-chromatography mass-spectrometry to examine the concentrations of six organotin compounds (i.e., mono-, di- and tri-butyltin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had higher concentrations. This is partly because TPT (\(F_0 = 21.38, p < 0.001\)) was 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 chlorinated compounds, to determine whether these findings were transferable to other environmental contexts. For this purpose, PCBs ranging from primary producers to piscivorous fish (n=85), were collected in this systems 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 (lme) accounting for the difference of samples between taxa. Our results showed 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.
standards of several heavy metals, to contribute to water quality management to take forward the conservation of macroinvertebrate communities. The specific objectives of the study were: first, to model the relationships between 4 macroinvertebrate community metrics (number of families and abundance of EPT and PT), one multimetric (METI) and a predictive model (NORTI), using the Cu and Hg body residues as predictor variables; second, to assess Cu and Hg toxicity to benthic invertebrates through the estimation of effective body residues (ER); and third, to investigate the taxa-specific differences in metal ERs in relation to their feeding styles. The ERs were estimated for each taxon and metal from the best non-linear models, selected using Akaike's Information Criteria, and compared with the 90\% percentiles (P90) of the data distribution in the reference sites of the study area, considered an approach to threshold (no-effect) concentrations. These models were fitted for Cu only in a few instances for Hg. Results showed that Cu-ERs and Cu-ERs, in 4 taxa (Baetidae, Hydropsychidae, Epheremellidae and Microdrilii oligochaetae) were usually less than 2 times above the P90, calculated for the same taxa. These ERs in other 3 taxa (Heptageniidae, Ephemeriidae, Rhyacophilidae) were mostly within the range of 2.1 to 5.0 times the P90. The largest ratios were found in ERs for Lumbricidae and Perlamidae, which reached 12 to 15 times the P90 values. In the case of Hg, the predator taxa (Rhyacophilidae and Perlamidae) and some of their potential prey, e.g. mayflies and simulids, showed ERs that were typically within the range of 1 to 3 times their respective P90s.

TU308
Trophic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton Aurelia sp. and Sanderia malayensis on crustacean Artemia sp.

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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 metazooplankton and as prey of apex predators, inducing 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. Perform experiments consisted in feeding ephyrae, every 24 hours for 5 days, with nauplii of Artemia sp, previously exposed, for 6 hours, to different concentrations (0.1-0.5-1-2.4 mg/L) of Cadmium nitrate; this range was selected through preliminary trials aimed to define the cadmium LC50 value for crustacean larvae. At the end of feeding experiment (5 days), the effect of Cadmium nitrate treated crustaceans on ephyrae jellyfish was investigated by the “digestion 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 (groundwater, surface water and wastewater). Almost 200 substances were 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, lethal effects derived from cadmium exposure, a non-essential metal, in more than 50% of organisms could be observed on day 10 and those associated with more than 50% in animals in co-op exposure were deferred to day 15. The presence of Chlorella sp. in the digestive tract made possible to associate the injuries within trophic metal poisoning, and the prevalence of lesions with metal and exposure time.

TU310
Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web

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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).

Thus, cryogenically grounded microplastic particles, made of poly styrene (PS) and polyethylene (PE) were applied in environmental remediation that the potential impacts on the ecological dynamics and soil ecosystem health are of great concern.

OBJECTIVE: The primary objective of this study was to simulate dynamic models linking bioinert and consumer-resource dynamics in the Caenohabditis elegans (C. elegans)-Escherichia coli (E. coli) OPES ecosystem. METHODS: The bioinert parameters, uptake and degradation rate constants of bacteria and worms were obtained from toxico kinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamic of Fe/NPs accumulations, bioconcentration factors (BCFs), biomagnification factors (BMFs) were simulated based on the consumer-resource dynamics. A sensitivity analysis was also performed to characterize the influence of consumer-resource-related physiological parameters.

RESULTS: Results showed that biomass of worms increased steadily from 22.25-51.61 g L-1, whereas the biomass of bacteria decreased rapidly from 17.17-2.9 g L-1 and attained a steady-state after 2 h of the simulation in the scenario of 100 mg L-1 Fe/NPs exposure. We also observed that internal concentrations of Fe/NPs were estimated to be 67 and 1768.85 µg L-1 in worms and bacteria, respectively. In addition, the BCF of bacteria was found to be 17.69, close to the experimental results. Moreover, the BMFs of worms were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of Fe/NPs in worms were mainly influenced by biomass conversion rate for bacteria ingested by worms, whereas parameter of death of worms had the smallest effect on worm internal concentrations. CONCLUSIONS: Model application to toxico kinetic results confirm the hypothesis that the consumer-resource dynamics are effectively associated with Fe/NPs accumulations in bacteria and worms that the bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

Use of Effect Based Methods in the context of the national and european legislative framework for the protection of aquatic ecosystems (P)

TU312
INTEREST OF IN VITRO BIOASSAYS (YES/YAS) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WOLLONIA (BELGIUM)

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This study is part of the BIODIEN project. This project aimed at conducting, for the first time, a screening campaign of endocrine disruptors (ED) in waters of Wallonia (groundwater, surface water and wastewater). Almost 200 substances were screened, including hormone estrogen, alkylphenols, phthalates, chlorophenols,
perfluorates, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2eq/l (mean: 2.1±1.6 ng E2eq/l). Androgenic activity was also detected. 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 estrene concentration but also with other ED (e.g. biphenol A, perfluorates). This study is, in a way, the first attempt in Wallonia to follow the recommendations for the use of effect-based methods (EBM) for monitoring of estrogens in surface waters emanating from the Science to Policy Interface (SPI) Estrogen monitoring project. These recommendations were presented at the last EU-WG chemicals held in October 2017 and this would possibly lead to the introduction of EBM in regulatory monitoring under the Water Framework Directive (WFD), especially for estrogens.

TU313
Ecotoxicological tools to assess the impact pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

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Degradation of surface waters and biodiversity loss at different spatial and temporal scales occurs through multiple stressors whose effects are difficult to separate and identify. Efficient management of water bodies depends on the development and selection of robust, sensitive and easily applicable tools that allow prioritizing the pressures and stressors that act in a basin, and mitigate their effects. The Alqueva reservoir constitutes the most important water supply source in southern Portugal, a semi-arid region with high levels of water scarcity and where agriculture is one of the main activities. The aim of the present study was to assess the use of an ecotoxicological tool-box in tributaries of the Alqueva reservoir for detecting chemical alterations that may influence the water quality of the reservoir. Water samples were collected along 2017 at four tributaries of Alqueva (streams of Zebro, Alamos, Almeira and Lucefécit) and analyzed for: (i) physical chemical support elements (pH, temperature, dissolved oxygen, conductivity, chloride, total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD), (ii) hormone-like compounds in water samples, and (iii) endocrine disruptors, using biomarkers indicating different trophic levels (Vibrio fischeri, Daphnia magna). In general, Zebro and Lucefécit presented concentrations of BOD (Zebro: 4.0-35.5 mg L−1, Lucefécit: 2.3-7.5 mg L−1) and total phosphorus (Zebro: 0.18-6.23 mg L−1, Lucefécit: 0.02-1.92 mg L−1) that compromise the biological life, with regard to nutrient over-enrichment concerning the concentrations detected. In Zebro the concentrations were low, being benzoate the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzoate of 1.94 μg L−1), probably due to the intensive agriculture crops around it. Concerning to ecotoxicological analysis, the results highlighted the toxicity in sublethal parameters (reproduction, feed inhibition or growth inhibition) induced, mainly, by samples from Zebro and Lucefécit streams. So, the results from the ecotoxicological tool-box allowed identifyin the streams that promote a higher chemical impact to the reservoir, which is essential to delineate management actions to improve the water quality of the reservoir.

TU314
Effects based tools for use in conjunction with passive samplers

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As part of an ongoing review of the Water Framework Directive (WFD), the European Commission (EC) is considering “effects based tools” (EBTs) for use as an “add-on” to the適用 to the monitoring of surface water concentrations. There are several ways in which EBTs may be integrated into regulatory monitoring for the purpose of achieving good quality and quantitative status of all water bodies. Despite the efforts to reduce the release of chemicals into the aquatic environments, pollution is still widespread across Europe, and new emerging substances should be assessed and managed. The general goal of this project (realised in the framework of the ‘Torno subito Lazio Operational Programme European Social Funding 2014-2020) is to select and define innovative methods to assess the toxicity due to the exposure to different pollutants, especially the emerging substances and respective mixtures, with a focus on aquatic ecosystems and human health. This goal has been achieved, in a first step, by making a literature review on the priority and emerging substances widespread in the aquatic environment, to investigate their effects on the development of zebrafish (Danio rerio) embryos. Then, a few toxic substances that are relevant for our goals have been selected and analysed through the fish embryo acute toxicity test (FET) and other assays; particular attention has been given to the sub-lethal effects. Afterwards, environmental samples from different aquatic ecosystems in Italy will be analysed to detect the chemicals present in these sites as well as their toxic effects. In order to reach a better comprehension of the effects of such substances on the ecosystem, a comparison of the effects of different trophic levels (bacteria algae, daphnids) will also be performed. The study will ultimately aim to provide recommendations for the implementation and the update of the monitoring strategies of the WFD, as well as to enhance the current EU activity on Effect-Based Methods.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD)

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The Water Framework Directive (WFD, 2000/60/EC) regulates the European water policy and addresses the EU member states to achieve good qualitative and quantitative status of all water bodies. Despite the efforts to reduce the release of chemicals into the aquatic environments, pollution is still widespread across Europe, and new emerging substances should be assessed and managed. The general goal of this project (realised in the framework of the ‘Torno subito Lazio Operational Programme European Social Funding 2014-2020) is to select and define innovative methods to assess the toxicity due to the exposure to different pollutants, especially the emerging substances and respective mixtures, with a focus on aquatic ecosystems and human health. This goal has been achieved, in a first step, by making a literature review on the priority and emerging substances widespread in the aquatic environment, to investigate their effects on the development of zebrafish (Danio rerio) embryos. Then, a few toxic substances that are relevant for our goals have been selected and analysed through the fish embryo acute toxicity test (FET) and other assays; particular attention has been given to the sub-lethal effects. Afterwards, environmental samples from different aquatic ecosystems in Italy will be analysed to detect the chemicals present in these sites as well as their toxic effects. In order to reach a better comprehension of the effects of such substances on the ecosystem, a comparison of the effects of different trophic levels (bacteria algae, daphnids) will also be performed. The study will ultimately aim to provide recommendations for the implementation and the update of the monitoring strategies of the WFD, as well as to enhance the current EU activity on Effect-Based Methods.
(predicted no effect concentration). Ecotoxicological effects have been detected with the algae and could be related to the substances detected (e.g. heavy metals) or other substances released in the area (transitional waterbody). In general the results show a situation in which the quality of the sediments is not in a good status, although the level of concentrations should not cause a high risk for the aquatic ecosystems; the chemical contaminants can derive from different sources of pollution (industrial, urban, agricultural, atmospheric deposition) and may result in the need to reinforce measures to achieve the good quality status required by the water framework directive. The presence of Uranium in the marine coastal area should be further investigated to understand the possible role of the Coal fired power station.

TU317 USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSOME ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER
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The Salmonella/microsome mutagenicity assay uses the genetically modified Salmonella enterica serovar Typhimurium bacterium, and the exploration of these different genetic characteristics allows the detection of various classes of mutagenic compounds. The objective of this study was to use different strains for the identification of mutagenic profiles and hitting at the class of compounds responsible for the detected mutagenicity. The research was performed with organic extracts of surface water and suspended particulate matter (SPM) collected in 13 different sites along the Danube River during the Joint Danube Survey 3 (JDS3). The extracts were evaluated with the Salmonella/microsome microsuspension assay at concentrations of 1.5% and 1% and with acetonitrile extraction (8%) in TA98, YG1041, TA1538 and YG1585 with specific genetic characteristics for the detection of different compounds. A total of 69% surface water and 92% SPM samples were positive for at least one strain/condition. The applied methodology compared the profiles obtained at different sites along the Danube River. In this way, it was observed that different types of compounds are present in the water that are causing mutagenicity. We conclude that aromatic amines and nitro compounds for surface water and also polycyclic aromatic hydrocarbons for suspended particulate matter appear to be responsible for mutagenicity at some of the sites, because the obtained profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that may be responsible for the mutagenicity. Investigation of the specific genetic characteristics of the bacteria is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals.

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TU318 NTA meets EDA: A practical example
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Organic micropollutants play an important role in the assessment of water bodies that are used for drinking water production. On one hand, micropollutants pass through the wastewater system in sewage treatment plants and subsequently in surface water. On the other hand, there are direct discharges from industry and in addition, there are diffuse sources from agriculture, or from households, buildings and settlements. As major pollution events (i.e. PFC in the river Ruhr) show, water suppliers must always expect to find new critical substances that could pose a potential health risk in drinking water, especially when using surface water. For this reason, it is necessary to initiate a proactive screening of contaminants and their potential effects. Continuous monitoring by high-resolution mass spectrometry also makes it possible to analyze past 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 micropollutants is needed. This project is an approach to analyze organic micropollutants in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken regularly over the past year in order to obtain an annual progression of the water pollution. A LC MS QTOF system was used to carry out the NTA. Different endpoints were analyzed for the EDA: cytotoxicity (MTT assay), endocrine activities (ER-CALUX and AR-CALUX) as well as genotoxicity (p53-CALUX, umUC assay and Ames assay). Due to the investigation of raw water samples, no significant biological effect of the individual samples was to be expected. The focus of this project was therefore the identification and seasonal examination of the micropollutant 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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Bythulins (BTs) - i.e. mono-(MBT), di- (DBT) and tributyltin (TBT) - are synthetic compounds worldwide used in industrial and agricultural applications giving rise to contamination of aquatic environments. Organotins, which include BTs, were banned on antifouling paints, the main route to aquatic pollution, by Reg. 782/2003/EC. Presently, due to their persistence, toxicity and bioaccumulative properties, TBT compounds are included among the priority hazardous substances according to the European Water Framework Directive (WFD) and its daughter Directive 2008/105/EC. Imposex, the superimposition of male sexual characteristics on females of gonochoristic gastropods, is the most studied effect of TBT contamination and it is generally recognized as a specific marker for organotin 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. Nassa urriae nitidus (Jeffreys, 1867) and Helisoma (history, physical and environmental biology) were selected because less sensitive to BT pollution, can be found in the inner parts of the lagoon, whereas the latter, more sensitive, occurs only near the lagoon inlets or in the sea. To define Ecological Quality Ratio (EQR) class boundaries within WFD, the relationship between the ecological impact caused by BT pollution and the reproductive capacity of the gastropod populations was assessed. This preliminary attempt showed that most of the sites were in bad ecological status before the ban and have reached mostly a Moderate status at present, with very few sites in Good or High status. A comparison between the two species was also performed showing advantages coming from the combined use of both species to cope with the ecological quality assessment in a wider study area.

TU320 Lessons Learned from Sibro Dam and River Restoration in Sweden
E. Hallqvist, C. Becker, P. 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) and its framework 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 surface water comprises three different types of quality factors according to the WFD: biological, chemical and ecological. The latter defines connectivity and biodiversity in the ecosystem, since many aquatic organisms are independent on the ability to migrate during their life cycle. Water power represents a large fraction (almost 50%) of electricity production within the country, and a large proportion of Swedish rivers are affected hydro-morphologically. At present, there are 11,000 active and abandoned dams in Swedish rivers, and 1,800 are hydroelectric power plants. All of these dams impact the ecological connectivity of rivers and have a negative impact on biodiversity. In Sweden, a common national strategy is to use the hydropower/plants as an alternative to reliance on fossil fuels. In the same time water power is the greatest individual cause of physical impacts in lakes and streams. The challenge at this stage of Sweden’s national energy strategy is to identify technologies and management practices that promote hydroelectric power with minimal long-term adverse/ecological impacts. To illustrate the challenges, this paper summarizes work conducted in the past 2 years to manage the future of the Sibro Dam located in southern-central Sweden. The project was initiated after previous dam repair work involving the diversion of large stretches of the Sibro to protect and improve the serious ecological impacts caused by indigenous mussels and other aquatic life. The responsible municipality is obliged to improve ecological connectivity at Sibro Dam and regulation of Lake Båven. The planning/implementation involved the preparation of an environmental impact assessment (EIA), detailed engineering design for fish passage, engagement with local communities and communications between the municipality of Nyköping and Sweden’s federal court in keywords/EnFish 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
Marine and estuarine fish accumulate methylmercury (MeHg) to elevated concentrations, often higher than in freshwater systems. Because MeHg is a neurotoxin, it is plausible that high tissue concentrations could affect behavior in marine fish which in turn could affect their populations in contaminated waters. However, we measured the lethal effects of MeHg to a marine forage fish at the larval stage, the Sheephead minnow *Cyprinodon variegatus*. Because the bioavailability of MeHg from different food types may lead to different MeHg internal distributions and toxic effects, we compared artificial and natural diets with varying MeHg concentrations. Artificial (commercial fish flakes containing methylmercury) or natural diets (zooplankton containing MeHg, obtained from MeHg contaminated phytoplankton) were prepared; MeHg concentrations ranged from zero (controls) to as high as 7.8 ppm. The larvae were fed control and MeHg-contaminated diets from an age of 7 days until 5 weeks when they reached juvenile stage. Growth rates, respiration rates, and swimming activity were tested. Results indicate that MeHg-rich diets—either artificial or natural foods—have no significant impact on fish growth rates under any treatment. However swimming activity, (swimming speed, acceleration, active turn and swimming distance) was impaired after 3 weeks exposure to natural diets containing 7.8 ppm but not 2.5 ppm; artificial diets containing MeHg up to 4.8 ppm had no discernible effect on swimming. In addition, MeHg as low as 4.8 ppm had a small but significant impact on the respiration rates of these fish. The data suggest that mortality and growth are unlikely to be affected by these MeHg concentrations, but swimming activity may be reduced at elevated MeHg concentrations, and this could influence the success of populations in the wild through impairment of predation or avoidance of predators.

**TU324 Impacts of environmentally realistic antidepressant exposure on reproductive behaviour and sperm traits in fish**

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Pharmaceutical contaminants are increasingly being detected in ecosystems worldwide. Indeed, more than 1 in 10 currently manufactured pharmaceuticals have been found in the environment. One pharmaceutical pollutant of environmental concern is the antidepressant fluoxetine, which has repeatedly been reported in aquatic ecosystems. Worrisomely, the primary target molecule of fluoxetine is conserved across a wide range of non-target species. As a result, by directly acting on the central nervous system and neuroendocrine pathways, fluoxetine can affect a range of ecologically important behavioural and physiological processes in wildlife. Despite this, the effects of environmentally relevant fluoxetine exposure on processes of sexual selection in aquatic biota remain uncertain. This is concerning as sexual selection processes directly influence mating outcomes and so are fundamental to individual fitness, as well as the viability of populations and species. To address this knowledge gap, we investigated the impact of 30-day exposure to environmentally realistic levels of fluoxetine (average measured concentrations: 30 and 380 ng/L) on a range of reproductive behaviours, as well as sperm quality, in the eastern mosquitofish (*Gambusia holbrooki*), a popular freshwater fish with internal fertilisation. We focussed on these traits because reproductive behaviour and sperm quality are both crucial fitness determinants, and are known to be vulnerable to disruption by other chemical pollutant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour. This study is the first to report a promiscuous freshwater fish with internal fertilisation. Fluoxetine exposure, however, did not significantly impact sperm quality measures (i.e. performance and viability). In combination, our results indicate that fluoxetine exposure can alter reproductive behaviours with direct bearing on fitness in fish and, further, highlight the need for ecotoxicological testing using sub-lethal exposure concentrations and ecologically important behavioural endpoints.

**TU325 Determining the effects of antidepressants on multiple behaviours in a marine and freshwater amphipod**

**S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth**

Behavioural assays have been gaining recognition as a viable endpoint in ecotoxicology as they provide a link between biochemical and ecological effects of environmental contaminants. Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behaviours in aquatic vertebrates. The effects of behavioural modulating drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined behavioural assays. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparatively few have been done on invertebrate species. This one-year study aims to translate these techniques to model organisms for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Specimens of the marine amphipod, *Echinogammarus marinus* and the freshwater amphipod *Gammarus pulex* were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 μg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic responses. Both *E. marinus* and *G. pulex* showed alterations in activity at concentrations as low as 1ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and phototactic behaviours both between treatments and with length of exposure. Results indicate that fluoxetine can have an effect on some amphipod behaviours at environmentally relevant concentrations. These results may have implications for future study design of these types of experiments and aid the development of high-throughput analysis on common laboratory invertebrate species.
with 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 biomolecular 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 antidepressive drug. It binds (non-selectively) to the serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the presynaptic membrane. 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 fish in the eyed ova stage and 8 months old juveniles were chronically exposed to 4 concentrations of CIT (1, 10, 100 and 1000 µg/L) in a in a semi-static three-block design accompanied by a control exposure. The larvae were exposed for 5 month at 7°C and 11°C, the experiments with juvenile fish were conducted for 4 weeks at 7°C. To investigate the effects of CIT on the embryonic development, mortality, hatching rate, and heartbeat rate were recorded. During the exposure, also behavourial 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 enhanced swimming activity and an increased swim up in the aquaria. In an artificial swimming measurement device (small aquaria with a diameter of 17 cm), videos were recorded for 20 minutes with the aim to quantify changes in the swimming behaviour. Due to the settings of the cameras, the aquaria were strongly illuminated and the water was not ventilated during the recording. This stress situation resulted in a high activity of fish for those exposed to 1000 µg/L CIT. These moved significantly less with a lower velocity than the control fish. The results of both experiments make evident that 1000 µg/L CIT affects both larvae and juvenile brown trout, on one hand by making them more agile in the aquaria, but also by depressing stress-induced flurry swimming. The study is embodied 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 and/or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have direct and indirect effects at multiple levels of biological organisation and may have serious side effects. Given that behaviour reflects multiple physiological changes at low contaminant concentrations, and links individual- to population-level processes, it provides a sensitive tool for holistic assessment of contaminant impacts. Here, we develop a conceptual framework that integrates direct and indirect effects of chemical contaminants on behaviour, under environmentally relevant concentrations and natural contexts. Within 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, exhibiting 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 supply tools to design ecologically realistic experiments and risk-assessments. Although predicting effects of contaminants is complex, existing knowledge in ecology and evolution needs to be applied to this global environmental challenge.

TU331

Scent and sensibility: EE2 disrupts male mate choice in fish

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Among the handful of studies that have studied the behavioural effects of endocrine disrupting chemicals (EDCs), only a few have attempted to disentangle the mechanisms underlying behavioural changes, such as mate choice. In fish, for example, ecological studies have shown that males base their mate choice on
multiple cues and both visual and chemical cues play an important role in choosing the most suitable mate. Therefore, it is crucial to understand if and how EDCs affect mate choice cues (e.g. visual and chemical cues), and further, if one cue is affected disproportionately. Accordingly, the aim of this study was to investigate the impacts of a 28-days exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the zebrafish. To examine the impact of EE2 on mate 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 chemically correct (male and female cues, sex, toxicity and EE2) entered the association zone more frequently, if EE2-exposed female was paired with an EE2-chemical cue. In contrast, sight display showed a reverse pattern, with males preferring EE2-exposed females that were paired with control chemical cues. Not only does our study uncover a previously unknown behavioural impact of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposure may affect the role of the olfactory system in the occurrence of male courtship displays. Our results underscore the importance of studying multiple mate choice cues simultaneously, and highlights the possible ecological implications of altered chemical communication for exposed wildlife.

**TU332**

**Effects of tributyltin on the eyes, swimming, feeding and growth of newborn guppies Poecilia vivipara**

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Although the use of the antifouling contaminant tributyltin (TBT) has been banned since 2008 by the International Maritime Organization, it still persists in coastal environments due to its remobilization from contaminated sediments and also as a result of illegal use, including tropical regions along the Brazilian Atlantic Coast. *Poecilia vivipara* is a promising model for tropical estuarine fish ecotoxicological studies and we focused here on its feasibility to address fish early life stage toxicity caused by TBT. Newborn *Poecilia vivipara* fish at six days after birth (dab) obtained from a laboratory breeding stock were exposed for 96th 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 morphology of the eyes. Histopathological analysis of the retinal pigment epithelium (RPE) indicated a hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. After exposure to 7 μg TBT L⁻¹, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% relative to controls, respectively. The histopathological changes detected in the retina and iris may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

**TU333**

**Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants**

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**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 environmental chemicals and biological conditions, whereby behavioural 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 endogenous activity indicator (pERK) after the behavioral assessment. *Results:* Mono- and poly-cationic EE2 and α-EE2 induced 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 the reward center in the telost brain. We are investigating whether these differentially activated brain regions (Limbicopit, Thalcoleds) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazipam) found in European waters trigger similar behavioral patterns. *Outlook:* We will dissect which chemosensory system and higher brain areas are involved in the behavioral reactions to environmental chemicals. This will advance our understanding of the impact of chemicals on fish behavior.

**TU334**

**Urban sewage effluents into an alpine stream: are information on behavioural effects on Daphnia magna suitable to protect alpine cold adapted species?**

V. Di Nica, University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; V. Lencioni, F. Bellamoli, MUSE-Museo delle Scienze Trento / Dept. of Chemistry and Biology; T. Pescatore, University of Trento (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 ImageJ/nw MTTrack) were compared. Acute toxicity tests performed with *Daphnia magna* and *Dianaes cinerella* (gr. larvae, a chironomid (Diptera Chironomidae) common in cold freshwaters in the Alps, often associated to pristine environments. Both organisms were exposed for 24 and 48 hrs to different dilutions of effluents collected from a WWTP located at the Tonale Pass locality, in Trentino (1799 mm a.s.l., NE Italy). Exposure to undiluted samples. Exposure to serial dilutions of the effluent caused mortality only in *D. magna* (15% of mortality after 24 hrs at 1:1000 dilutions; 15% and 20% of mortality after 48 hrs at dilutions of 1:100 and 1:100, 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 average spatiomovement and the cumulative distance travelled in both) at both the exposure times. Overall, these findings emphasised a higher sensitivity of *D. magna* than *D. cinerea* 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?**

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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. Due to their small size, nanoparticles are not being effectively removed from wastewater treatment plants and end up in freshwater systems such as rivers and streams. Filter feeders, like the cladoceran *Daphnia*, take up these nanoparticles and
are therefore of particular scientific interest, to establish what impact the MNMs are having on the freshwater cycle and food-chain. In our study, we investigate the effects of Ag (NM300k) and TiO₂ (NM105) MNMs on the predator defence response; by chronically exposing Daphnia magna to fish kairromones and a range of nanoparticle concentrations. This experiment was conducted in accordance with OECD guideline No.211 over a course of 21 days. For statistical analysis, we measured the body length, body width and tail spine length after each moult and counted the number of eggs in each individual. An egg in a TEM is taken of each daphnids at the end of the experiment, to observe and compare the microscopic details of the anti-predator defences in the treated and untreated daphnia.

TU336 Behavioral and Physiological Responses of Daphnia magna to Fluoxetine and Propanolol Expose

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 were measured 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 profiles estimated from multiple behavioral parameters showed that fluoxetine and propanolol stimulated swimming activity at 1-10 µg/L. EC50 values for fluoxetine and propanolol estimated from survival time in the absence of food (starvation/survival) were much lower than EC50 values estimated from changes in swimming behavior. Starvation/survival is strongly affected by energy metabolism and we suggest that this parameter can be a potential sensitive endpoint for determining adverse effects of pharmaceutical to D. magna. Combining behavioral and physiological responses to high and very low exposure concentrations should be considered in models predicting adverse effects of pharmaceuticals to non-target organisms.

TU337 How toxic is a non-toxic nanomaterial: Behaviour as an indicator of effect in Danio rerio (zebrafish) exposed to nanogold

T. Botha, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University - School of Biological Sciences

Gold nanoparticles are used as drug delivery vectors based on the assumption that they have a low toxicity. Literature has however showed conflicting results over the last few years. This study aimed at investigating the toxicological effects of nanogold (nAu) over a range of indicators from sub cellular to whole organism level. Gene regulation, changes in oxidative stress biomarkers and swimming performance were assessed in Danio rerio (zebrafish) following exposures to nAu. Adult zebrafish were exposed to nAu for 96 hours, swimming performance was measured post exposure. Liver tissue was collected for DNA microarray and Real Time Polymerase Chain Reactions (RT-PCR) analyses to determine changes in gene expression (catalase, superoxide dismutase and metallothioneins). Whole body samples were stored in respective buffers for protein biomarker analysis (catalase, superoxide dismutase, acetylcholine esterase, malondialdehyde, cellular energy allocation and metallothionein). Swimming behaviour was assessed in 1.1 L TECNIPLANT™ tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a Lologet™ swimming tunnel, briefly fish were acclimatized within the chamber for one hour and then at a starting speed of 2 bls/l with a 0.5 bls/l 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 critical swimming speed when compared to the control. Since swimming performance and social interaction during swimming is essential to life whole organism behaviour shows a toxicological response to nAu which is in agreement with genetic responses seen.

TU338 The effects of silver and silver nanoparticles via different routes of exposure on behaviour in marine amphipods

M. Vannucci-Silva, UNICAMP / Institute of Biology; S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; G. Umbuzeiro, School of Technology, UNICAMP / LAEG; A. Ford, University of Portsmouth / Biological Sciences

Behavioural responses are an important endpoint because they provide a link between biochemical and ecological effects of environmental contaminants. Silver is increasingly being used in nanomaterials and, consequently, being released into the environment in different forms. The behavioural consequences of metal exposure in crustaceans are therefore of particular scientific interest, to establish what impact the marine amphipod Echinogammarus marinus after exposure to silver, in its salt (AgCl and AgNO₃) and nanoparticle (E. marinus (n=20 per treatment) were exposed individually. The exposure via water was performed with Ag (from AgCl and AgNO₃) for 5, 25 and 100 µg/L for 96 hours. In the exposure via food, the animals were fed on alternate days with control food or food impregnated with AgCl or AgNP (approximately 200 mg kg⁻¹) during 7, 14 and 28 days. The movements of the amphipods were tracked using a DanioVision™ system with EthoVision®XT software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and thigmotaxis were evaluated. In the Ag exposure via water, light significantly increased maximum velocity for all treatments (p<0.05) indicating an escape-related behaviour; excepting at 100 µg L⁻¹, where the maximum velocity had no difference 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 different using 25 and 100 µg L⁻¹. Thigmotaxis, however, where animals spent more time in the centre zone when was dark. Results from the exposure via food are currently undergoing analysis. The current results indicate that silver has effects on swimming and response to light behaviours in E. marinus, indicating that exposed animals in the environment could be more vulnerable to predation. Acknowledgement: The authors thank São Paulo Research Foundation FAPESP 2016/19634-4 for technical 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

A.C. Brooks, Cambridge Environmental Assessments / Department of Environmental Science; A. Lawrence, Cambridge Environmental Assessments / Regulatory Ecotoxicology; M. Hackett, Cambridge Environmental Assessments / Cambridge Environmental Assessments; M. Allen, F. Joyce, F. Pickering, Cambridge Environmental Assessments / Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology

Under current plant protection product (PPP) regulation, Tier I aquatic ecotoxicology studies measure mortality (acute) or reproduction (chronic). For invertebrates, these parameters are used to address the current protection goals of maintaining populations. Agreed guidelines for reproduction studies for aquatic invertebrates is currently under development using 10 µg/L AgNO₃. However, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeroptera, Plecoptera, Trichoptera (EPT) species. Currently, there are no agreed methods for measuring reproduction endpoints for non-standard test species, such as EPT species. EPT species often live as larvae for a prolonged period and have an aerial adult stage, and thus assessing reproductive endpoints from a full life cycle is not practical. Therefore, if a Tier I reproductive effect is desirable. Although behavioural endpoints (e.g. predator response, locomotion, feeding activity) do not directly relate to the protection goals of maintaining populations, they may still have a useful role in regulatory risk assessment. For example, for organophosphates (OPs) with steep dose-response curves and thus a narrow exposure window between acute and chronic effects, significant differences on reproduction can be due to mortality of adults rather than true reproductive effects; therefore, designing specific reproduction studies for e.g. EPT species may not be necessary for such substances. Instead, if a risk assessment was 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 will share our experiences of developing methods to measure such behavioural endpoints in one standard (Daphnia magna) and two non-standard (EPT: mayfly, caddis) test species that are suitable for use in regulatory toxicity tests, integrating the regulatory needs with the practicalities of ecotoxicology testing.

TU340 The effects of sublethal doses of pollutants on crop pest, Spodoptera littoralis

D. SIAUSSAT, Institute of Ecology and Environmental Sciences / Institute of Ecology and Environmental Sciences

Pesticides have long been used as the main solution to limit agricultural pests but their widespread use resulted in chronic or diffuse environmental pollutants, development of insect resistances and biodiversity reduction. The effects of low residual doses of these chemical products on organisms that affect both targeted species (crop pests) but also beneficial insects became a major concern, particularly because low doses of pesticides can induce various effects. In addition to the negative effects, some studies highlighted unexpected positive - also called SETAC Europe 28th Annual Meeting Abstract Book
The effect of copper nanoparticles on olfaction in rainbow trout (Oncorhynchus mykiss) P. Baranuma, 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 olfactory function. Although the copper ion (Cu²⁺) has a short toxicological half-life, whereas at least a partial toxicology 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. In contrast, Cu²⁺ exposure to 50% IC₅₀ continued to cause a significant impairment and did not recover. Behavioural responses of rainbow trout to the social cue supported the results of neurophysiological experiments. Although fish exposed to control water or Cu²⁺ for 96 h had an avoidance response to an alarm cue, those exposed to the CuNPs did not respond to the alarm cue. Results of DNA fragmentation indicated apoptosis was not the mechanism of olfactory toxicity for CuNPs or Cu²⁺ in the exposed fish. In summary, over the same exposure periods, CuNPs caused a greater impairment of olfactory acuity, whereas at least a partial olfactory recovery was documented for continuous Cu²⁺ exposure. However, the mechanism of olfactory toxicity caused by CuNPs is not clear and needs further investigation.

Regenerated Textile raw materials: chemical contamination for LCA A. Franchi, Buzzi Laboratorio Analisi

It’s essential, for every actor involved in the supply chain of a textile company, to increase awareness that a regenerated material requires proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory laws and also the proper control for documentation. CED (Italian Consortium for Detox Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted Substance List) for regenerated and recycled textile materials. The adoption of a PRSL for regenerated textiles would guarantee the safe re-use of these materials as an alternative to their disposal. This case study takes into account regenerated woolen textiles (high wool content > 70%) derived by post-consumer materials (knitted apparel, apparel made up by carded woven and combed woven), pre-consumer materials (combed and carded woven, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling). Operational plan involved quantitative and qualitative assessment concerning the origin and type of concerned substances: APEOS (Ethoxylated Alkylphenols), Aromatic amines from azo-colorants, Chlorophenols, PPC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals from artificial perspiration solution Results was that about 150 sample were analysed and chemical contamination were found for aromatic amines (16% of total samples), APEOS (100% of samples), Chlorophenols (26 % of total samples), PPC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). Data analysis permits to establish a PRSL (Product Restricted Substance List) protocol for regenerated raw materials with the aim to have an unique PRSL available for brands, manufacturing companies and every actor involved in the textile supply chain. The PRSL adaption could improve the recycling of textile materials as an alternative to their disposal.

Perfluoroalkylic acids concentrations in liquid wastes: a survey campaign and implications for waste disposal M. Peruzzo, Eurolab / University of Lethbridge / / Biological Sciences

A survey campaign has been carried out to determine the concentrations of twelve perfluoroalkylic acids (PFAs) in liquid wastes, before the disposal in dumpsite or incinerator. The common characteristic of these wastes was that they were classified as “wastes without dangerous substances” and could be disposed without specific treatments. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate, solid waste storage facilities, car washing, septic tanks, laundry sludge and wastes from various industrial plants such as paper, food, wood, furniture, glass and pharmaceutical industries. The large spectrum of activities allows us to get a panorama of the PFAs release in the economic sectors and to evaluate the impact of the different sources. The percentage of samples which presented total PFAs concentrations greater than 1 µg/L was 65%. The maximum concentration measured was 900 µg/L. As regards the single congeners, the percentage of positive samples (i.e. > 0.05 µg/L) ranged from 5% to 37.5% for the different compounds. It is very interested to note that PFOS and PFPO were found only in 5% of the samples, while the highest findings were for PFBA (57%) and PFBS (37.5%), highlighting the increasing diffusion of short chain PFAs respect to the already restricted C₈-PFAs. It is also interesting to note that one of the samples with the highest concentrations was a found in the pharmaceutical industry, and it was an aqueous washing solution of water liters. 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.
substances (PFASs)

D. Ballestero, J. Val, E. Langa, San Jorge University; E. Navarro, CSIC
The assessment of biopesticides: microorganisms, classification could impact the reuse capacity of final slags. The tool allows me for assessors to check how and to what extent a change in a relevant hazard perspective, including Circular Economy and carbon footprint considerations. This tool is particularly helpful when faced with complex structure-effect relationships along of equally complex conditions.

H. Waeterschoot, 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 harmonised hazard classification by EU REACH and CLP Regulations lead to increasing hazard identifications and endpoints of Very High Concern like Chlamydomonas reinhardtii being used as indicators of the safety that natural crop protectants can play in the aquatic environment. 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)

TU349

Ecotoxicological evaluation of the hydroxyl byproduct of Satureja montana on Daphnia magna and Vibrio fisheri


Many people mention substitution as the most promising option for risk reduction in the use of SVHCs. But it has to be considered that technical solutions are embedded into complex structure-effect relationships along of equally complex conditions. 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 been constantly 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

M. Zimmer, ZVO e.V.; M. Metzner, Fraunhofer Gesellschaft
The paradigm of substitution – expand your view

Many people mention substitution as the most promising option for risk reduction in the use of SVHCs. But it has to be considered that technical solutions are embedded into complex structure-effect relationships along of equally complex conditions. 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 been constantly 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.

TU346

The Paradigm of Substitution - expand your view

M. Ziemer, ZVO e.V.; M. Metzner, Fraunhofer Gesellschaft
The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the harmonised hazard classification by EU REACH and CLP Regulations lead to increasing hazard identifications and endpoints of Very High Concern like Chlamydomonas reinhardtii being used as indicators of the safety that natural crop protectants can play in the aquatic environment. 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)

TU349

Ecotoxicological evaluation of the hydroxyl byproduct of Satureja montana on Daphnia magna and Vibrio fisheri

E. Oliva, Universidad San Jorge; E. Terrado, San Jorge University; J. Navarro, Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA); M. Pino, San Jorge University / Facultad ciencias de la salud; A.M. Maimar, Universidad de Zaragoza; D. Ballestero, San Jorge University
The increasing demand of natural bioproducts 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 irritant, antimicrobial activity. Further, biopesticide applications on several 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 hydroxyl obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fisheri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydroxyl of Satureja is likely to cause toxic effects on D. magna and V. fisheri but only high dilutions (LC50 values in the range of 0.5% in both cases). These studies allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Burillo, for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU350

The impact of the hydroxyl byproduct of three biopesticides on the soil environment

M. Pino, San Jorge University / Facultad ciencias de la salud; D. Ballestero, J. Val, San Jorge University; E. Sánchez, Colegio internacional Anfora; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Pintor, Jorge University / Facultad ciencias de la salud; A.M. Maimar, Universidad de Zaragoza

The extended use of synthetic pesticides has resulted, during the last century, in the pollution of the agricultural soil environments. As an alternative to these products, environmentally friendly biopesticides are, nowadays, being developed. Although biological activity of biopesticides on target organisms is well known, studies focusing on the effects on soil-nontarget organisms are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) focuses on the production and optimization of plant/fungal/agriwaste-based crop protectants via cultivation techniques, biotransformation, selective extraction and separations by traditional and supercritical CO2 technologies. In the traditional extraction process the organic and the aqueous fraction (hydroxyl) have been separated. Both of them showed active compounds capable to act as biopesticides. In order to exclude a negative effect on the environment, these products were tested.
on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydroalcohols, obtained by semi industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Ditrichia graveolens and Lavandula latiueri. The effects on the microbial community has been assessed using the community-level physiological profile – CLPP-. This method relies on the ability of a microbial community to degrade different carbon sources present in BIoplot Ecologates®. The acute toxicity of the hydroalcohols was also tested by Eisenia fetida bioassay. Results indicate that hydroalcohols caused acute adverse effects in E. fetida, in particular D. graveolens and A. latiueri (LC50 in the range of dilution of 10-2). All three biopesticides provoked changes in the soil microbial ability to degrade different carbon sources compared to control. These results allow for a better understanding of the impacts of natural crop protectants in the soil environment as a pest management alternative. Acknowledgements: We thank J. Burilj and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).

TU351
Acute toxicity of emulsifiable concentrate of Alpinia galangal essential oil against Cyprinus carpio
H. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee, Kyungpook National University Essential oils have exhibited their fumigational and topical toxicities on insect pests and they are developed as safe biopesticides. However, their use may be caused potent toxic effects to non-target organisms in the environment. It needs to be determined their neonicotinoids (NPs) non-target toxicants in the environment. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Rictina sp. in South Korea. Acute toxicities of AGEO against Cyprinus carpio were assessed to understand its possible toxic effect on the representative aquatic organism. Cyprinus carpio in a static condition followed by OECD guideline 203 in 5 1 beakers. As AGEOs were formulated for emulsifiable concentrate (EC) as an active ingredient, they were mixed with ethanol and tertigol in a ratio of 5:1. Tertigol 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 oils against Cyprinus carpio
H. Jeon, K. Kim, H. Kim, Y. Choi, Y. Kim, 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 safe properties. Cinnamon EO is one of important EOs to be a potent candidate and is formulated as an emulsifiable concentrate (E.C.). As its use is recognized as safe, it needs to be determined its negative effect on the environment using bioindicators. To evaluate the negative effect on the ecosystem, chronic effects of cinnamon EOEC against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EO was tested, they were easy 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.
plasticizers. Our results indicate that participants are exposed to various FRs and plasticizers through their daily household environment. The Canadian adults’ external exposure of hands to FRs and plasticizers were related to the levels in their household electronic products, particularly handheld devices such as cell phones. Handheld devices could contribute to human exposure through direct contact during use while large and stationary electronic products could be important sources and sinks in household environment.

TU355
Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution
M.D. Nieto, University of York / Environment; A. Pratertasius, University of York / Department of Environmental Geosciences; A. Boxall, University of York / Environment Department

The expansion of the nanotechnology sector is leading to an increased use of products containing engineered nanoparticles (ENPs) in outdoor urban environments. Outdoor materials, such as construction materials, paints and coatings, are subject to weathering and ageing processes and will consequently lead to emissions of ENPs to the surrounding environment over time. Data on measured environmental exposure concentrations are still lacking for ENPs. Until analytical and monitoring techniques for ENPs in environmental matrices become available, modelling tools are the best approach to estimate exposure levels. Furthermore, models can analyze a wide range of potential scenarios and predict possible future trends of urban exposure which cannot be achieved by monitoring. In this study we propose a new approach combining 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 parameterize the river fate model. Using the model, the transport and fate of TiO2 ENPs in the rivers circulating within the city (the Ouse and the Foss) could be studied and spatially resolved results obtained. The identification of hot spots of emissions within the city and the study of ENP transport and fate are accomplished by this approach.

TU356
Occurrence and human exposure of parabens, triclosan and triclocarban in personal care products from Korea
S. Mok, Hanyang University / Marine Sciences and Convergent Technology; J. Lim, Hanyang University; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science; K. Lee, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University

Parabens (p-hydroxybenzoic acid esters), triclosan (TCS) and triclocarban (TCC), have been extensively used in various cosmetics and personal care products (CPCPs) as preservatives due to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC associated with the consumption of CPCPs in our daily life. In this study, ten parabens and their metabolites, TCS and TCC were measured in 243 CPCPs, which comprised of leave-on products (n=157), rinse-off products (n=59) and baby care products (n=31), collected from Korean market during 2016-2017, using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Among ten parabens, methyl paraben (MeP) showed the highest detection rate (57%), followed by propyl paraben (PP, 49%) and butyl paraben (BuP, 41%). TCC had only 20% of detection rate and TCS was rarely detected in the samples. Total concentration of parabens widely varied with ranging from <LOQ to 10200 μg/g. Concentrations of TCS and TCC ranged from <LOQ to 340 ng/g and <LOQ to 140 ng/g, respectively. Higher concentrations of parabens (> 1000 μg/g) were found at skin care, sunscreen, face cleanser, eyeliners, body/hand lotions and lipstick. The daily exposure levels of parabens, associated with the consumption of CP CPs, were calculated from 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 CP CPs, some leave-on products such as skin care, body/hand lotions, and sunscreens were the major contributors (> 80%) to total exposure levels of total parabens.

TU357
Characteristics of exposure factors for consumer products in Korean infant and caregivers pair
K. Lee, Seoul National University, Graduate School of Public Health; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science

Concerns about potential health risks of chemicals in consumer products like cosmetic, personal care products, food containers are growing. Especially infant and children are more vulnerable to chemical exposure compared to adults. Since exposure to these chemicals could be determined by consumer products usage pattern, an accurate measurement of the usage patterns of consumer products is important for realistic exposure assessment. The aims of this study were to determine exposure factors of consumer products for child and mother and analyze the relationship between consumer exposures of caregiver and infant. We determined the exposure factors of 12 kinds of cosmetics (3 basic cosmetics, 1 UV protection products, 3 hair products, 3 body products and 2 cleansing products) for adults and 10 kinds of consumer products (2 cosmetics, 3 oral supplies and 7 household products) for children and 11 kinds of food containers for household. Survey was conducted on 505 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. The number of subjects were determined by proportioning using based on the proportion of child and mother’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.
particulate matter. Levels of PAHs equivalents were measured by a fluorescence methodology and were correlated with exposure to tobacco smoke as well as with other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). In general, the studied group presented higher PAHs levels in the placenta and lower PAHs levels in the umbilical cord blood. The low molecular weight PAHs (naphthalene and phenanthrene) measured in placenta presented higher correlation than high molecular weight PAHs (pyrene and benzo[a]pyrene). More increased levels of alkylated PAHs and phenanthrene equivalents were associated with exposure to vehicle exhaust while higher levels of benzo[a]pyrene were associated with exposure to tobacco smoke at work. The highest naphthalene, pyrene, and BaP equivalents levels were found in a homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant differences were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; J. Chestnutt, in use ARC Arnot Research & Consulting; L.L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; X. Zhang, University of Toronto Scarborough / School of Engineering and Applied Sciences; B. Gieveschi, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences

The aggregate exposure pathway (AEP) model is a conceptual framework to help allocate and understand 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 source-to-exposure continuum and identifying research needs to address uncertainty in chemical evaluations. We present an overview of the Risk Assessment Identification And Ranking-Indoor and Consumer Exposure (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 indoor chemicals. Biomonitoring chemical concentrations throughout the source-to-exposure continuum and identifying research needs to address uncertainty in chemical evaluations.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBOYNI 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. Onyeyili, Federal University of Agriculture Makurdi / Department of Physiology Pharmacology and Biochemistry

Lead is a soft, ductile metal found naturally in the environment and accounting for 0.0016% of the earth’s crust. However, due to its ubiquitous nature, it is used in several industrial processes which can result to severe environmental pollution which can pass across food chains to animals and man. In 2010, about 400 deaths especially among children in Bukkyun and Ankia LGAs of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontières (MSF, Holland) to the health authorities (UNEP/OCHA 2010). The cause of the high mortality was acute and chronic lead poisoning as a result of massive environmental contamination from artisanal mining and processing of gold in Pb-rich ore by poor headsmen and farmers. This outbreak was reported as the worst in modern history (UNEP/OCHA 2010). Open-pit mining of lead in the Ishaigu Region of Ebonyi State since 1965 has exposed large volumes of marcasites, pyrites and tailings contaminating the environment and food chain pathways. The research was designed to investigate the environmental impact of lead mining on the bio-ecosystem of Ishaigu town and environs. Soil, water, grasses/plants, food, fish and quarry dust were collected between March and May 2017, processed and analyzed for lead concentrations. All water samples exceeded WHO recommended safety limits for lead. Soil and food samples contained values. Sampling of Ivo River, the main communal water source showed links to upstream pollution as the river passes through lead mining fields. The result showed the negative impact of lead mining in Ishaigu and the need for regulatory agencies/government to take measures to avert consequences of lead poisoning in human beings.

TU362 Evaluation of potential risk of rare earth element contamination from leachate originating from electronic waste disposal M. Makombe, Scientific Services, Cape Town / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. Scalfani, SCART, CTPU / University of The Western Cape / SensorLab Department of Chemistry; R. Horst, University of The Western Cape / SensorLab Department of Chemistry; R. Arnot, George, University of The Western Cape / SensorLab Department of Chemistry; R. Scalfani, University of The Western Cape / SensorLab 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 depositions and disposal in urban environments such as Fact, acid dissolution and alkaline fusion are commonly employed. Various instrumental techniques that have been used recently includes electrothermal vaporiser or laser ablation accessory connected to ICP-MS or ICP-OES, X-ray Fluorescence and electron-analytical techniques. These methods of analysis including their accuracy, limit of detection (LOD) and limit of quantification (LOQ) are compared and discussed. This study further demonstrates the potential of combining source-to-exposure models with a focus on rare earth elements in electronic waste and its disposal into the environment. Key words: Rare earth elements; electronic waste; metal concentration; spectroscopy; wastewater

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 Physical Sciences, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment

Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhales fine particles, is a promising indicator of exposure to urban and industrial pollution, although this species is 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 common areas, this research intends to investigate the potential of C. Purpurea as a new biomonitor of pollution. The composition of the shells, 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 lithophytic elements and Pb are scarcely absorbed in the snail digestive tract and soft tissues mainly accumulate Cu 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. Over 100 soil samples were collected from 190 residential and community gardens and analyzed using a portable XRF. A subset of the samples were analyzed by ICP-MS. A comparison of the XRF metal concentrations to the ICP-MS data indicated that the XRF was a suitable technique for the rapid analysis of the large number of samples collected. Elevated concentrations of metals including Pb, Cu, Cr and Zn, were found in some garden soils. Based on homeowner interviews, historical maps and archival reviews, Pb contamination was primarily attributed to the use of leaded paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automotive
repair and old orchards. An interactive map of metal distribution based on the data obtained was developed and made available to the public. Metal bioavailability was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggesting that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the homeowners.

TU365
Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for agricultural production
M. Legras, A. Di Guardi, J.L. Casul, UniLaSAL; M. Bouzid, Rouen Agrocampus
Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomerations and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. At European level, soil quality regulations are not homogeneous; in France, the legislation is mainly based on the contents in vegetables or fruits, the link with the soil never made. Some studies have highlighted the potential risk of metal contamination of vegetables grown in urban areas and the lack of site-specific risk assessments. However, experimental trials are still lacking on the potential of using urban soil as a good substrate for producing vegetables for domestic consumption. We assessed the quality of the soil on a site in the Rouen agglomeration (Normandy, France) for three pasture, a forest recreation area, and a 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 topographic 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
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Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from a chemical factory among the largest pollutants (POPs, mostly PCBs, heavy metals, and harmful matters in soil and irrigating waters and methods about their analysis, was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggesting that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the homeowners.

TU367
Metals and metalloids in inhalable fractions of urban road dust
C.I. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Kasmussen, Health Canada
Road dusts are highly enriched with toxic pollutants and metalloids such as Cu, Sb and Zn, due to road surface attrition and wear of automotive components. Despite the importance of road dust as a source of inhalable particles (< 10 µm), little has been published regarding elemental enrichment patterns in particle sizes relevant to inhalation exposures. The goal of this study is to evaluate the contribution of road dust to airborne particulate matter, focusing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air pumps: the bulk hopper debris and finer dust box samples. The 50th percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 inhalable and 32 bulk samples) were subjected to 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), Sb (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 released to the city-wide environment. This study illustrates 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, unfractrated 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)
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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 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 Tesser (Tesser et al., 1979); adsorptive and ion-exchangeable phase (using ammonium acetate); moderately reducible phase (using 513 kg/l ammonium oxalate and oxalic acid); 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 iCap6500Duo-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 third phase. Cu and Pb were enriched 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. Regulations: about allowed quantities of dangerous and harmful matters in soil and irrigating waters and methods about their analysis, was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggesting that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the homeowners.

TU369
"New" OPEs: isopropylated, tert-butylated and di-tert-butylated Triclosan/Thiobenzamide Isomers in E-waste, House, Car and NIST SIR Dust
L. Jantunen, Environment and Climate Change Canada; T.E. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; V.H. Arrandale, Cancer Care Ontario; S. Bernstein, Environment and Climate Change Canada; J.
The Oxidative Potential (OP) of particulate matter (PM) is a useful tool to evaluate the health risk associated with exposure to PM. OP is defined as the ability of PM to oxidize biological compounds and is expressed as a number ranging from 0 (no oxidizing capacity) to 100 (highest oxidizing capacity). The OP of PM is determined by the concentration of reactive oxygen species (ROS) in the PM sample.

In this study, we investigated the OP of PM collected from five different locations in the Southeastern United States: Charleston, SC; Savannah, GA; and two locations in Florida. The OP of PM was determined using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, which is based on the ability of ROS to reduce DPPH to a stable, non-oxidized form. The OP of PM was found to be highest in Charleston, SC, and lowest in Savannah, GA. The results suggest that the OP of PM is influenced by the sources of PM and the environmental conditions at the sampling sites.

The OP of PM is associated with various health effects, including respiratory and cardiovascular diseases. Therefore, the assessment of OP of PM is important for public health purposes.

In conclusion, the OP of PM is a useful tool to evaluate the health risk associated with exposure to PM. The OP of PM is influenced by the sources of PM and the environmental conditions at the sampling sites. The assessment of OP of PM is important for public health purposes.
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

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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 PPV
to revert 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 750 and 87 µg/L as acute and chronic criteria, respectively. However, these applied only to waters with a pH between 6.5 and 9, 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 allow 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

N. Galic, Syngenta Crop Protection, LLC / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior; C. Salice, Towson University / Environmental Science & Science Dept.; P. Thorbek, Syngenta / Environmental Safety

Protection goals for the ecological risk assessment of chemicals are increasingly being framed in terms of ecosystem service delivery [1]. However, the type of data collected to assess risk is generally at the level of individual organisms or simplified multi-species systems. Currently, extrapolation from what is measured to what we want to protect uses overly simplistic approaches, such as risk quotients or toxicity-exposure-ratios. Ecological models provide a more mechanistic way of considering these disparate levels and allow for integration of other relevant information as well as feedbacks across levels of organization [2]. Here we present output from the National Institute of Mathematical and Biological Synthesis (NIMBioS) working group (www.nimbios.org/workngroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of 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.

TU378
Sulphur: conflicting protection goals

G. Brouwer, Delphy / team fruitfeeth; F.M. Bakker, Eurofins-Mitsui

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 Trichogramma and other egg parasitoids in these systems in The Netherlands, at least at the time of the study (late summer 2017). Conventional orchards showed no parasitization and regular (i.e. having sulphur treatments) and untreated orchards did not show differences. These results show that specific protection goals may have country specific weight and need to be considered and balanced against potential negative impacts of eventual protective measures, such as in this case jeopardizing biological top fruit production.

The Need for Resilience in Environmental Impact Assessment (P)

TU379
Recovery in environmental risk assessments at the European Food Safety Authority (EFSA)

T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; F. Bigler, Retired; G. Frampton, University of Southampton; C. Hugstrard, Kings College London / Division of Diabetes and Nutritional Sciences; R. Luntik, Retired; F. Martin-Laurent, INRA Dijon; C.J. Topping, Aarhus University / Department of Bioscience; W. Van der Werf, Wageningen University; A. Rortais, European Food Safety Authority

The European Food Safety Authority (EFSA) performs environmental risk assessments for single potential stressors such as plant protection products, genetically modified organisms and feed additives and for invasive alien species that are harmful for plant health. In 2015-2016 a Working Group of the Scientific Committee of EFSA (the authors of this abstract) explored how ecological recovery is covered under current single-stressor Environmental Risk Assessment (ERA)
schemes at EFSA and how recovery could be assessed considering the complexity of the environment. An important aim of these activities was to promote a dialogue between different panels of EFSA and risk assessors and risk managers responsible for the food and feed chains. Another important aim was to provide risk assessors with a conceptual framework to address ecological recovery in ERAs for any assessed products, and invasive alien species that are harmful for plant health. This framework proposes an integrative approach based on well-defined specific principles and goals, the creation of operational means of achieving these principles, modelling and monitoring, and the selection of focal taxa, communities, processes and landscapes to develop environmental scenarios to allow the assessment of recovery of organisms and ecological processes at relevant spatial and temporal scales. Due to the complexity of ecological systems and the need to evaluate effects and recovery across various scales in space and time caused by natural or human-induced perturbations, a systems approach is required. The systems approach allows the integration of the various species, environmental factors, scales, and stressor-related responses necessary to address the context dependency in ecological recovery. The presentation will highlight the most important conclusions, challenges and recommendations to appropriately address ecological recovery in ERA for potential stressors that fall under the remit of EFSA EFSA's Scientific Committee, 2016. Recovery in environmental risk assessments at EFSA. EFSA Journal 2016; 14(2):4313, 85 pp

TU380 Habitat Equivalency Analysis for a Restoration Resilience Model of the Rio Döce Basin
P.N. Boeth, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomes, R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ
A Resilience Model was prepared to support environmental, economic, and social restoration of the Rio Döce Basin after the Fundão Dam failure in Mariana, Minas Gerais State, Brazil. A Habitat Equivalency Analysis (HEA) was applied to quantify lost ecosystem services resulting from the disaster and was intended as a means of informing the scale of habitat restoration that would be required. The HEA was refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services that should drive the resilience restoration goals for each reach of the Rio Döce River. HEA is a well-accepted spatially and temporally explicit method for integrating multiple complex and difficult to measure environmental variables into a few metrics to determine overall losses and gains in ecosystem services resulting from impacts or restoration actions. The HEA method is adaptable to any ecosystem and its flexibility allows for variability in the valuation of ecosystem services between communities and cultures. This paper focuses on the development and application of HEA within the context of the Resilience Model, and how selection of VECs as indicators to guide HEA at the scale, and location of restoration is aimed at developing an overall ecosystem restoration program that is at once cost-effective and results in a more resilient Rio Döce Basin.

TU381 Using risk and recovery information in environmental cost-benefit analysis for determining appropriate risk management actions at major industrial facilities
Operators of chemical manufacturing plants and fuel storage depots are required to undertake site safety assessments, with specific emphasis on the control of major emergencies and environmental releases. SEVESO II/SEVESO III regulations are in close proximity to water bodies, the coast, and or protected conservation areas. Site safety reporting requires an initial risk assessment be undertaken. The assessment draws upon both the potential severity of harm and environmental recovery in order to determine the risk tolerability under accidental release scenarios. Industry guidance exists on the evaluation of harm, but corresponding guidance on the prediction of environmental recovery was, until recently, limited. On behalf of the Energy Institute, Ramboll Environ developed a guide for risk assessors to determine the environmental recovery duration following major accidents of releases of SEVESO substances. Published October 2017, the guide provides a step-wise framework to identify an appropriate recovery duration based on the specific conditions and types of scenarios. The guide includes consideration of key factors affecting recovery and the fate and effects of SEVESO III chemicals, such as PBT substances with the potential for longer-term impacts/delayed recovery. If an assessor determines that risks are intolerable, then the regulator requires facilities to consider appropriate investment in order that risks are as low as reasonably practicable. Ramboll Environ has pioneered a methodology based on ecosystem services concepts to evaluate the costs and benefits of potential risk management options. The method is used to evaluate the risk in terms of potential ‘damage avoided’ by putting risks into a socio-economic context. Case study examples will be provided of a range of infrastructure upgrade options at fuel storage depots are compared. Environmental Cost Benefit Analysis is used to determine if the upgrade would be grossly disproportionate to the benefits that would provide. The assessment would incorporate site-specific baseline ecology, other receptors and ecosystem services provided to society. The poster will also reflect upon lessons learned by both regulators and industry in the method development. References: Energy Institute (2017). Guide to predicting environmental recovery durations from major accidents. Supporting guidance to the Environmental risk tolerability for COMAH establishments guideline

TU382 Addressing Resilience in Ecosystem Services Assessment
K. Moudjarvi, Ramboll E&H / Ecological Sciences; R. Wenning, Ramboll Environ / Ecology & Sediment Management; E. Bizzotto, H.R. Diogo, Ramboll / Ecological Services
An ecosystem services approach to landscape and nature restoration planning and damage assessment should fully account for all aspects of the environment and the human well-being derived from protection, enhancement and repair to natural resources caused by natural or human-caused events. With respect to damage assessment, conceiving of a resource as a part of an ecosystem that supplies valuable goods and services to people provides a basis for measuring changes and for valuation of those goods and services. With respect to landscape and nature restoration planning, an ecosystem services approach can lead to innovative ideas for ecological infrastructure in cities and promote ecological rehabilitation that may be ecologically and socially desirable and also economically advantageous. Resilience, however, is a key consideration that, to date, has been inadequately considered in ecosystem services assessment work. Considerations of resilience are especially important in ecosystems, because increasing resilience can reduce the risk that highly valued goods and services will cross critical thresholds and irreversibly degrade or change. Resilience also plays an important role in management of conditions that are difficult, if not impossible, to develop and implement a rational and cost-effective strategy to manage their regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oils. The equipment differs significantly in age, design and make, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Baleares and Canaries islands, and their environmental and social settings show a large variability. Site investigations were known to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office ExcelTM. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. OracleB_s Crystal BallTM add-on to Excel was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsoil investigation being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that may be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately-high risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventive maintenance to those sites which could give rise to the highest environmental and reputational liabilities.

TU384 Quality stakeholder involvement for resilience in environmental risk

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This study measures the indoor particulate matter (PM) concentration and the equilibrium equivalent radon (EEC\textsubscript{na}) concentration in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM\textsubscript{10} samples and inductively coupled plasma mass spectrometry was used to determine the concentration of heavy metals. The concentration of indoor radon was measured using a radon detector model DOSEman PRO. The potential human health damage due to the inhalation of 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 each of 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\textsubscript{10} concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 mg m\textsuperscript{-3} and 23.4 to 159 mg m\textsuperscript{-3}, respectively. In Building 1 and 2, the annual inhalation doses and the lung cancer risk were estimated by use of the ECLR and the HQ, respectively. The equilibrium equivalent radon concentration was 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\textsubscript{2.5}) is extremely large however, there is a limited understanding of health effects associated with specific PM\textsubscript{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\textsubscript{2.5}. In 6 households, personal air monitors collecting PM\textsubscript{2.5} were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM\textsubscript{2.5} filters for each household. PM\textsubscript{2.5} was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM\textsubscript{2.5} samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM\textsubscript{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 identical to those used for individual filters. Significant differences were observed in oxidative potential between personal and home PM\textsubscript{2.5} for both individual and pooled samples. Significant mortality in zebrafish was observed starting at 24 hpf in personal PM\textsubscript{2.5} samples and by 120 hpf in home PM\textsubscript{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\textsubscript{2.5} samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM\textsubscript{2.5}. Importantly, it outlines procedures for large-scale analysis of the PURE-AIR study which includes planned PM\textsubscript{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\textsubscript{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 educational infrastructures 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, toxicology 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 the present study. On it, we collected two fractions of fine PM (PM$_{2.5}$.10 and PM$_{2.5}$.2.5) in six classroom 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$_5$ 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 among 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 Y. Lan, C. Chang, C. Chung, China Medical University Abstract The purpose of this study was to assess the effects of extremely high air temperature on hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using health and climatic data from 2000 to 2010 in Taiwan. A national health insurance database, temperature database, and air quality surveillance database were used for this study. Relative risks (RRs) for increases in emergency room (ER) visits were estimated for alcohol addiction and other mental illnesses after exposure to extremely high temperatures. Relative risks were 2.04 (95% CI 1.61–2.58) and 0.97 (95% CI 0.80–1.19) for the 25th and 99th percentile of the daily mean temperature as reference. Poisson regression models using a distributed lag non-linear model (DLNM) were used. We adjusted for the effects of humidity and outdoor air pollutants. We found an association between alcohol addiction and other mental illnesses and mean daily temperature at 23.6°F on ER visits. The association was strongest within 0–7 days after exposure to high temperatures. Increases (RR 1.02, 95% CI 1.01–1.04) in major depressive disorder (MDD) ER visits was observed over a cumulative period of 7 days after exposure to high ambient temperature (99th percentile vs. 50th percentile). The opposite association was reported for alcohol addiction (RR 0.99 , 95% CI 0.98–0.99). No significant associations with anxiety, dementia, and delirium were estimated. Our findings suggest that extreme temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU391
Characteristics of Polybrominated Diphenyl Ethers Released from Primitive E-Waste Treatment F. Li, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment Primitive processing of e-waste potentially releases abundant organic contaminants to the environment, but the magnitudes and mechanisms remain to be adequately addressed. The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the sum of 39 polybrominated diphenyl ethers (∑PBDE) were 0.21-10 g kg$^{-1}$ 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 associated 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 casings, compared to 0.44–0.56 and RL–0.55 µm from printed circuit boards. The main emission mechanisms for lightly and heavily brominated BDEs were suggested to be vaporization and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implicated a noteworthy redispersion process during atmospheric dispersal.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter F. Kirschenheuter, Universitat Rovira i Virgili / Chemical Engineering; J. Rovira, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química According to last estimations, there are globally around 6.5 million deaths as a consequence of exposition 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 to schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers Tisch 3070-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer). 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 other. 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 Soberón, Universitat Rovira i Virgili / Chemical Engineering; F. Noard, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Rovira, Universitat Rovira i Virgili / School of Environment; F. Sánchez Soberón, Universitat Rovira i Virgili / Department of Chemical Engineering; V. Kumar, Universitat Rovira i Virgili / Department d Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Department d Enginyeria Química Particulate matter (PM) is a complex mixture of extremely small particles (< 10 µm) and liquid droplets suspended in the atmosphere. They are originated from a wide range of sources (such as traffic, industry, energy production or domestic combustion). Nowadays, the inhalation of this pollutant is a concern due to its potential to cause irritation and inflammation of respiratory airways, asthma attacks, and lung cancer. These effects are especially pernicious in kids, since their inhalation rates are higher, and their immune system is still not fully developed. However, most studies dealing with human exposure to PM are focused on adults. Therefore, the objective of the present study was to evaluate the children’s exposure to different sizes of PM. To do so, three fractions of PM (smaller than 10, 2.5, and 1 µm) were collected in the playground and inside a classroom of 12 schools within the Tarragona county (Spain), an area characterized by having one of the most prominent industrial clusters in southern Europe. To elucidate time-activity patterns of kids, and to know the characteristics of their dwellings, questionnaires were developed with parents of kids attending these schools. Using an infiltration model (IAQX, US EPA) it was possible to calculate concentrations of PM inside houses. A subsequent run of a dosimetry model (MPPD2.11, AR) made possible to know the deposition pattern of the different PM sizes within the distinct parts of the respiratory tract. Indoor/outdoor ratios of PM levels were variable among schools. Half of the schools presented higher concentrations of PM indoors, while the other half showed the opposite trend. Simulations indicated the great influence of PM$_{2.5}$ indoors, due to its easier capacity of infiltration from outdoors. Despite sleeping was the most time demanding activity, deposition fractions into the lung during these sleeping hours reached the minimum values. On the other hand, although moderate and high intensity activities accounted for 25% of time, these activities were responsible for the retention of 50–75% of overall PM mass. Most of this mass was deposited in the inspiratory airways (81–87%), due to sedimentation processes. Tracheobronchial region registered the lowest values of deposited particles, while PM retained in the lung was mostly PM$_{2.5}$ and PM$_{1}$. 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 Owerri, Nigeria. C. Ikaaroha, J.A. Egeonu, Imo State University Owerri, Imo State, Nigeria / Chemical Pathology Unit Dept of Medical Laboratory Science; C. Unadike, Imo State University Owerri, Imo State, Nigeria / Medical Laboratory Science; C. Unadike, Imo State University Owerri, Imo State, Nigeria / Medical Laboratory Science; C. Ndudim, Imo State University Owerri, Imo State, Nigeria / School of Environment Abstract Despite that Cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among Cement workers. Cement dealers in Nigeria use high grade of cement dust for construction and industrial purposes. Blood levels of some antioxidant enzymes and vitamins have not been adequately addressed especially in a black-African environment and particularly Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and 35 controls were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELISA while antioxidant vitamins such as vitamin E and vitamin C were determined by spectrophotometric techniques. There were progressive significant increases in blood level of vitamin C, vitamin E, catalase and gluthione peroxidase from Cement Workers to Dealers and Controls (non-cement workers), (P=0.0010, P=0.0011, 0.0005).
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=0.0009), glutathione peroxidase (P=0.0508), and catalase (P=0.013) 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; M. Guarnio, Università degli Studi di Milano / Department of Chemistry; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department
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 in vitro bioassays which cover various interactions among mixture constituents. The main objective of this study was to assess the contribution risks to TB incidences resulted from ambient air pollutant exposure. 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-polycolycyclic aromatic hydrocarbons (oxy-PAHs). This study confirms that polycyclic aromatic hydrocarbons play a key role in the toxicity linked to air pollution 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 503 16-11537S.

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. Lin, Jinan University; L. Bao, E.Y. Zeng. Jinan University / School of Environment
Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study analyzes an in vitro method to estimate the inhalation bioaccessibility of particle-bound hydrophobic organic compounds using lung fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmitoyl-sn-glycerol-3-phosphocholine, with Tenax as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results show that the bioaccessibilities of individual PAH compounds increases 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 if the human health risk via inhalation exposure to 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 mixtures
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Air pollution is one of the most severe problems 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, season, ambient air pollution, fine and ultrafine particles 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-genotoxicity 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-polycolycyclic aromatic hydrocarbons (oxy-PAHs). This study confirms that polycyclic aromatic hydrocarbons play a key role in the toxicity linked to air pollution 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
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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 epidemiological 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 particulate 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
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 policies at 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 ENVIT/000492) project aims to create a safer alternative to the paper. In this context, the aim of the present study is to replace the friction material with a new cementitious hydraulic binder. The study here presented evaluated the eco- and toxicological potential of particulate matters generated in laboratory conditions using dust benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumorigenic bronchial epithelium BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sublethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxicological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particle 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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The rapid analysis method for toxic compounds (PAHs, OCPs and PCBs) in PM2.5 using accelerated solvent extraction (ASE) and the rapid analysis 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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In this study, we developed the rapid analysis method for toxic compounds (PAHs, OCPs and PCBs) in PM2.5 using the accelerated solvent extraction (ASE) 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 profile 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.
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 (PM2.5) have caused some serious environmental and health hazards. In the past research, the health impacts associated with the PM2.5 through the Asian supply chains have been estimated in the previous researches. While these analyses showed what production activities induced these health hazards caused by “primary” PM2.5, almost of these results doesn’t include the effects of “secondary” PM2.5. This study developed the secondary PM2.5 concentrations emitted on every industrial sector using Emission Inventories 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 contributes to the PM2.5 emissions in Asia are estimated 185 t-C and we revealed top ranking supply-chains path for PM2.5 emissions induced by Japan’s final demand. The most significant supply-chain path with the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand → food crops sector in Thailand → Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollutions in Asian countries.

TU405 Source contributions to PM10 levels in a coastal area in northern France: a one year study
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The Hauts-de-France Region is one of the most concerned areas in France by exceedances of the PM10 daily mean limit value (50 µg.m⁻³). For a better understanding of these phenomena, the identification as exhaustive as possible of the sources contributing to secondary PM10 emissions in North-Eastern France was 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 with one of the greatest concentrations of shipping in the world (up to 800 vessels sailing per day). PM10 sampling and measuring campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM10 levels were measured using MP101 analyzer (Environment SA®) and collected using the DAB0 sampler (Digitel®, 30 m²/h) on a daily basis. The characterization of PM10 was performed considering major and trace elements, water soluble ions, EC/OC as well as tracers of biomass burning (levoglucosan), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM10 levels on the coastal site, identify PM10 sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (CW-NMF) model: fresh sea-salts, aged sea-salts, secondary nitrates, secondary sulphates, crustal, biomass combustion, primary biogenic emission, marine traffic, combustion, metal source. The monthly evolution of their contribution evidenced different behaviours between the sources: secondary nitrates were predominant during the cold season and appeared to be the most involved in the PM10 concentration peaks. The impact of marine traffic and a high proportion of fresh 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 PM10 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. Fanke, Technical University of Denmark / Quantitative Sustainability Assessment Division; J. Lane, University of Queensland, Brisbane; O. Jolliet, University of Michigan
Effective planning of aired 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+ supply chains, and further computes population exposure by inhalation and ingestion. From an emitter perspective, the spatial distribution of population intakes 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 source points are extended for humans exposed for hours within U-C and we revealed top ranking supply-chains path for the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand → food crops sector in Thailand → Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollutions in Asian countries.
A. Macagnano

Composite electrospun fibers based on sustainable and biodegradable materials have been developed and used in a wide range of applications, with particular emphasis on the potential exposure to humans as a result of inhalation. This includes determining deposition mechanisms in lungs and on skin surfaces, as well as determining particle surfactant properties over time, depending on the specific application and the working conditions. Further, the selectivity of fibers can be tuned by introducing different functionalized macromolecules (e.g., tetrahymena phosphatase) that are sensitive to various classes of gas and VOCs. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g., graphene flakes). Rapid prototyping PE passive samplers have been used to detect microplastics, which were then distributed to international laboratories for SVOC determination. IR Imaging Quantification on the PE in the atmosphere varies between 70 ng/g during winter compared to summer monitoring. Concentrations within the soil during the second year an additional height has been implemented as well as active sampling. The four approaches are: 1) PAS, 2) FTIR, and 3) high-throughput methods such as GC/MS and HRGC/MS. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g., graphene flakes). Rapid prototyping PE passive samplers have been used to detect microplastics, which were then distributed to international laboratories for SVOC determination. IR Imaging Quantification on the PE in the atmosphere varies between 70 ng/g during winter compared to summer monitoring. Concentrations within the soil during the second year an additional height has been implemented as well as active sampling. The four approaches are: 1) PAS, 2) FTIR, and 3) high-throughput methods such as GC/MS and HRGC/MS.
Kekulé resonance structures, 2) thermodynamic stability of all possible OH-PAH adduct intermediate, 3) electron density at each carbon on the PAH and 4) average local ionization energy (ALIE) at atom or bond sites. To evaluate the accuracy of these approaches, the predicted PAH-TPs were compared to published laboratory observations of major NPAH, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the local double rings on the PAHs, but did not offer insights in terms of which carbon is most reactive. All other 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 indicate that the environmental chemists to prioritize which PAH-TPs should be synthesized to verify their presence in the environment; and the toxicologists to prioritize which PAH-TPs should be analyzed for their toxicity and potential human health implications. Future direction of the study is to expand the prediction to screen for PAH-TPs from other parent-PAHs as well as alkylated-PAHs.

TU413 Spatial distribution of gas-phase Polycyclic Aromatic Hydrocarbons along South America and Antarctica

A. Azevedo, Instituto Federal do Rio Grande do Sul; K.S. Miglioranza, University of São Paulo; Del Plata/La Plata College, CA 680 GC-MS). The following PAHs were analyzed: naphtalene, 2-methyl-naphtalene, 1-methyl-naphtalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indenol(1,2,3-cd)pyrene, dibenz(ah)anthracene and benzo(g)h)perylen. Results, reported a higher (p<0.005) 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 horses that are likely to form in the atmosphere.

Due to their sensitivity to SOx and NOx, as well as their bioavailability 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 PAHs in the lichen atmosphere due to their carcinogenic, 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.

TU414 Importance of Dermal Exposure to Polycyclic Aromatic Hydrocarbons Derived from Barbecue Fume

J. Li, S. Xie, Jinan University, C. Wu, L. Bao, Jinan University / School of Environment; 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), its dermal absorption for the general population has not been adequately addressed. Aiming to verify the importance of dermal absorption for PAHs, barbecued (BBQ) PAHs were collected in China and women aged 35-75 years. The 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, 0.036, and 0.043 for fluorene, phenanthrene, and pyrene, respectively, higher than those for inhalation (0.097, 0.016, and 0.025). These results indicate that dermal absorption is a significant exposure route of PAHs. In the case of BBQ fumes, dermal absorption is a more important pathway for intake of low molecular-weight PAHs than inhalation.

TU415 EDS Mapping of Particles As A Component of Lichen Biomonitoring in Seattle, Washington

G. T. Guddal, Western Washington University; J. Miller, A. Johnson, Western Washington University / Environmental Sciences Department; R. Sofield, Western Washington University

Lichen are an increasingly popular medium for conducting air quality monitoring due to their sensitivity to S and NOx, as well as their bioavailability 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 PAHs in the lichen atmosphere due to their carcinogenic, 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

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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 oil air pollution is present due to 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 compared to published laboratory data. The high predictive capability of EDS approach was the most superior in accuracy, when compared to laboratory data. The high predictive capability of ALIE approach was the most superior in accuracy, when compared to laboratory data. The high predictive capability of ALIE approach was the most superior in accuracy, when compared to laboratory data.

Therefore, a comprehensive survey of oil industry air pollution 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 harbours activities. Only controversial evidence of their health impact in the area is available at the moment. Therefore, a comprehensive survey on 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 the Liguria Region: -50% among males and -49% among women for the first and -56% and -54%, respectively, for the second. Comparing these results with Lichens maps, no evidence of a clear correlation between emissions of air pollutants and regional distribution of diseases was available. On the contrary, diseases differing the most
from Regional mean were mainly distributed in areas with scarce anthropic activity. 

Conclusions. No clear morbidity trend is identifiable for La Spezia Province from 2001 to 2013. Also disorders belonging to the same pathological class –like myocardial infarction and hypertensive cardiopathy - showed a different behavior. Comparing results with Lichen maps helps putting excesses of morbidity into a Regional context, being cautious to clearly correlate such disease with industrial and Harbour activity. Indeed, most of the disorders showed the higher increases in areas with less signs of anthropic activity, according to Lichens biomonitoring.

TU418 Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut puddling (Okpa) Samples prepared using Alternative Cooking Materials

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Polythene residues are chemical components that are left over as monomers and end products after the thermal degradation of polythene. However, the use of plastic as cooking materials in bambara nut puddling (Okpa) a well-cherished food, especially among the inhabitants of the Eastern part of Nigeria may pose more danger than envisaged. The use of banana leaves in cooking food has been in existence in Nigeria before the introduction of the technological cooking materials such as polythene, cellophane plastic, tin and foil. In this study, we evaluated the risk assessment of polyethylene residues (volatile organic compounds - VOCs) and organoleptic attributes of Bambara nut puddling (Okpa) samples prepared using alternative cooking materials. Purge and trap method using Gas Chromatography and Mass Spectrometry instrument were used to estimate the concentrations of VOCs in the different puddling cooked using some alternative cooking material (cellophane, tin, foil and plastic) while banana leaves were used as control. Organoleptic evaluation was done using A Point Hedonic Scale, standard methods and ANOVA was used to compare means of the results. The result showed the presence of some Volatile Organic Compounds such as Argon, Allene, Acetic acid, Propane-1-ol, difluoromethane, Hexanoic acid, Amyl nitrite, Toluene, Butenentenitile, 2-Butenal, Thiriane, Nonanoic acid, Ethylenediamine, Furfural, Hydrogen azide, 2-pentene, Formic acid, and ocacic acid; with Acetic occurring the most and Argon, Allene, and Difluoromethane occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohexitolose, 45% hexanoic acid, 25% propane-1- ethenylthio and had other VOCs ranging from 4-9%. All the cooking materials had hexanoic acid at high concentrations of 25-42%. The result also showed that acetic acid and 2-butenenitrile ranged from 4-7% in all samples except Banana leaves puddling. Organoleptic evaluation of the Bambara pudding samples with different alternative cooking materials were generally acceptable (p>0.05) but pudding wrapping with banana leaf was significantly (p<0.05) rated low for colour and taste while others were comparable (p>0.05). In conclusion, bambara nut puddling cooked with alternative cooking materials contained polythene residues

TU419 SETAC Human Health Risk Assessment Interest Group

B. Mulleanor, Ensafe Inc.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)

TU420 Ecological risk assessment of conazoles fungicides in arable soils of the Czech Republic

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Application of pesticides, including conazoles fungicides (CFs), is an indispensable part of modern agricultural management, contributing to food security and safety. Conazoles are a class of azole fungicides, commonly used to prevent fungal growth on turf grass and agricultural crops. CFs are still widely used despite the reported ecotoxicity in water, chronic toxicity to manmals with hepatocytotoxicity, carcinogeticity, reproductive toxicity and endocrine disruption. For example, in the EU classification, epoxiconazole and flusilazole are suspected carcinogens. [1]. Presence of such compounds in arable soils represents potential short- or long-term environmental threat with a wide range of possible negative impacts on ecosystem services and health. Hence, risk assessment considering various taxonomic groups of vertebrates, invertebrate and plant species, should be performed. The objective of the present work was to assess the ecological risks of conazole fungicides based on the data from the comprehensive survey of pesticide residues in 75 agricultural topsoil floodplain locations in the Czech Republic acquired in early 2015 [2]. In this study, 51 currently used pesticides and 9 transformation products were analysed by multi-residue pesticide analysis on LC-MS/MS after soil QuEChERS extraction. The data indicated that over 70% of soils contained at least one CF and the total concentration of CFs exceeded 0.01 mg/kg in 53% of soils. Epoxiconazole and tebuconazole also frequently exceeded 0.01 mg/kg (in 25% and 11% of soils, respectively). The most frequent CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by flusilazole (23%), prochloraz (2%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CFs fungicides are of environmental concern because they exceeded risk based thresholds, tend to form long-term residues in soil and rank among suspected carcinogens and endocrine disruptors. [1] EU pesticide database, ec.europa.eu/food/plant/pesticides/eu-pesticidestdatabase. [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.
were detected in passive samplers but were not detected in water samples suggesting the importance of combining 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 analyzed by G. DUPORTE, J. Gaillard, Université de Bordeaux / EPOC UMR 5805; E. Barron, University of Bordeaux, CNRS / EPOC UMR 5805; K. Le Menach, P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; I. Baldi, University of Bordeaux / ISPed, EPIDECEN; F. Macary, Irstea Bordeaux; M. Dévier, University of Bordeaux / EPOC / LPTF UMR 5805 CNRS; H. Budzinski, University of Bordeaux, 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, we assess the depth of Korean vines which were exposed to several apple holding, situated in south-west of France. Dislodgeable foliar residues (DFR) and pesticide residues on equipements 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 sampling (cap 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 (N2-DCC-QTOF-MS and HPLC-ESI-MS/MS). Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU424 Intratracheal 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 OGC. The cells were instilled in the trachea. CMIT/MIT, have remain unsolved. This is mainly due to a lack of concordance between the few available toxicity tests and the standard 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. In this experiment, the cells were instilled in the trachea. CMIT/MIT, using a visual instillbot . CMIT/MIT was instilled over a period of 3 days and 8 weeks, respectively, to achieve acute and chronic exposures. Athreshold dose-response model was applied for estimating the threshold level as one line of evidence for a causal association between CMIT/MIT and death. Results: An acute exposure of 1.2 mg ai/kg/day of CMIT/MIT was estimated to reflect the threshold for death. The dose-response curve with this threshold showed a very steep slope and a narrow range of CMIT/MIT exposures. A narrow range of CMIT/MIT exposures, in particular, indicated an evident boundary between survival and death, thus implicating a strong causal association. A similar threshold dose-response relationship observed following acute exposure was also seen following chronic exposure to CMIT/MIT. Airborne disinfectant exposure was visible as mimimal or severe concentration of CMIT/MIT exposures and 2) functional respiratory tract failure except lung fibrosis. 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, the threshold of protein carbonyls is 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 exposed to 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5x10^3 cells) and for genotoxicity parameters in 24-hr cultures. The activity of GST increased significantly (p < 0.01) at 25 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 < 0.01) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces triopolar and micronucleus divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alternation in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

TU426 Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations T. Campani, I. Calani, P. Pozzoluni, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Casini, University of Siena / Science E. The cells were exposed to the different 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 (7.5x10^3 cells) and for genotoxicity parameters in 24-hr cultures. The activity of GST increased significantly (p < 0.005) at 75 μg/ml of Iprodione. The activity of SOD decreased significantly (p < 0.005) at 25 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 triopolar and micronucleus divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alternation in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.


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 determined the content of protein carbonyls is 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 exposed to 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5x10^3 cells) and for genotoxicity parameters in 24-hr cultures. The activity of GST increased significantly (p < 0.01) at 25 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 < 0.01) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces triopolar and micronucleus divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alternation 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 Silverswords, Menidia beryllina
predictive approaches, that take into account sorbent properties (i.e. soil sorption specifically needs to be evaluated. We therefore evaluated a range of soils. However, these models are typically based on training sets containing a chemicals used in Europe. At typical environmental pH, ionisable pharm/ionisable pharmaceuticals comprise a significant and increasing proportion of / Environment Department L. Carter, University of York / Environment Department; J. Wilkinson, The Development of a modelling framework for estimating the sorption of concentration, carbendazim induced low effects under a long Ho/cellular level in organisms exposed to toxicants. The results show that carbendazim, which has a high potential to end up in aquatic ecosystems mainly through runoff. The deleterious effects observed at the population level can often be depicted or explained by changes in homeostasis at cellular and individual levels. In the present study, an isoclonal population of Daphnia magna (clone k6) was exposed to an environmentally relevant concentration (5 mg/L) of carbendazim during 14 days. The effects of carbendazim on survivorship, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholinesterase, catalase and glutathione S-transferase), lipid peroxidation and energy-related parameters (carbohydrates, lipids and proteins jointly with energy available and energy consumption) were assessed in some generations. The long-term exposure to carbendazim presented no effect on the intrinsic rate of natural increase (r) and length of adult D. magna. However, daphnids longevity decreased at F12 generation and an increase in DNA damage from generation F3 to F13 was found when compared to daphnids in clean medium. Cholinesterases and glutathione S-transferase activities and lipid peroxidation showed differences between non-exposed and exposed populations to carbendazim. However, for catalase and energy-related parameters (except lipids) no differences were observed between these two Daphnia populations. Overall, at the tested concentration, carbendazim induced low effects under a long-term exposure to a daphnid population.

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

WE001
Development of a modelling framework for estimating the sorption of pharmaceuticals in soils L. Carter, University of York / Environment Department; J. Wilkinson, The University of York / Natural and Built Environments: A. Boxall, University of York / Environment Department

Ionisable pharmaceuticals comprise a significant and increasing proportion of chemicals used in Europe. At typical environmental pH, ionisable pharmaceuticals can become charged. Speciation can alter the fate and behaviour of a chemical in the environment including its sorption potential to soils and sludge. It is essential that this behaviour is recognised within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of ionisable chemicals in soils. However, these models are typically based on training sets containing a multitude of organic chemicals and their ability to predict ionisable pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches that take into account sorbent properties (i.e. soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of ionisable chemicals (i.e. cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anion pharmaceuticals still performed poorly (r² < 0.5). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values while sorption was consistently underestimated for 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 (iPIE grant n° 115735) for the financial support.

WE002
Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change D. Vione, M. Minella, C. Mineiro, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play an important role. While the latter play a role in fundamental photochemical processes, their effects could be very different in boreal vs. temperate environments. In the former case, photochemical processes tend to be more important in determining the fate and transport of organic pollutants because of the presence 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) in order to produce several particle specific phototransformation reactions. The transients include, among others, the hydroxyl (OH) and carbonate (CO₃²⁻) radicals, singlet oxygen (¹O₂) and CDOM triplet states ([CDOM]°). Their occurrence in surface-water environments is linked to irradiance and to key water parameters such as chemistry and depth [1, 2]. The phototransformation of dissolved compounds involves an interplay between molecular photoactivity and environmental features. Water chemistry and depth can affect both xenobiotics persistence and the possible formation of toxic or mutagenic intermediates. If an hazardous compound is preferentially produced by a certain photoreaction pathway, the environmental conditions can enhance or inhibit its formation in different surface-water environments [3]. The role of climate change on water chemistry and, as a consequence, on photochemical reactions is just starting to be investigated. The main difficulty is to disentangle climate effects from other disturbance factors (e.g. wastewater inputs) that may also operate and vary on the long term [4]. Climate change has the potential to deeply alter the photochemistry of freshwaters, but its effects could be very different in boreal vs. temperate environments. In the former case the main effects would involve water clarity (browning), while in the latter case it is the role of phototransformation that plays key roles depending on the context. [1] Vione D, Minella M, Maurino V, Mineiro 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, Mineiro C, Puzzi M, Vione D. 2016. Water Res. 105:383-394 [4] Minelli 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 380 square kilometres in Himachal Pradesh’s Solan district, the Baddi-Barotiwala-Nalagarh (BBN) industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste has concerns 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 buisy 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 replete with toxic pollutants which have not degraded completely during treatment. They may influence the genetic makeup of bacteria, leading to the survival of resistant bacteria and spread of antimicrobial resistance (AMR), a public health threat. The result of our study showed that all gaps leading to the release of
APIs in the environment are plugged. The discharge of pharmaceutical effluents should take place through proper waste management techniques and stringent environmental regulations. Currently, effluent standards are limited to chemical contaminants such as heavy metals. The government must adopt a new AMR-centric approach of waste management which considers APIs as a chemical contaminant. Laws must be made to ensure that there are no APIs in treated effluents. The government should support small-scale manufacturers to install and implement environmentally sound waste 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

T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; T. Suzuki, Y. Kosugi, K. Watanabe, Tokyo Metropolitan Institute of Public Health / Division of Environmental Health; A. Hirose, National Institute of Health Sciences / Division of Environmental Health.

The active ingredients in pharmaceuticals are discharged into the aquatic environment after use mainly through sewage treatment facilities. There is concern about adverse effects on wildlife due to the possibility of the presence of highly susceptible species. However, we still know little about what kind of impact on wildlife in the environment. Based on these backgrounds, we set up environmental impact assessment methods for the pharmaceuticals according to AMED’s strategy and evaluated the risks. We have measured the environmental concentrations (MEC) of 31 kinds of active ingredients in marketing medicine, using liquid-chromatography with mass spectrometry, in representative seven urban rivers in Japan, once every four seasons in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L are shown below: olmesartan (571ng/L), valsartan (405ng/L), ibandronate (115ng/L), losartan (117ng/L) for antihypertensive agent, and sulpiride (546ng/L) for antispsychotic agent, clarythromycin (445ng/L) for antibiotic agent, ketoprofen (150ng/L) for analgesic antipretptic agent, bezafibrate (200ng/L) for hyperlipidemia treatment drug, crotamiton (845ng/L) for antipruritic agent. Among target ingredients, the detect concentration of active ingredient contains pharmaceuticals for the lifestyle-related disease, hypertension and lipid metabolism related disease, tended to be higher. The concentrations in the winter or spring was observed a higher tendency, but the detected concentrations of active ingredients greatly varied depend on river according to the type of lifestyle and the type of pharmaceuticals been spread. It was indicated that the detected active ingredients were derived mainly from sewage treatment water as it depends on the concentrations of sucrose measured at the same time. The pharmaceuticals whose maximum 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 dilution for the environmental concentrations 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 0.00001% 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 simple way to estimate costly and time-consuming 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 on a monthly basis for six-months both upstream and downstream from five wastewater treatment plants (WWTPs) discharging into four rivers in the UK. Measured environmental concentrations (MEC-values) of 33 APIs were determined by HPLC-MS/MS. PEC-values were determined using pharmaceutical use data from the National Health Service, the fractions of chemical excreted from the body and degraded during sewage treatment, the population excretion of each WWTP, mean regional per-capita water use and the dilution ratio of treated sewage effluent in receiving rivers. API-specific PEC ranges were compared to complementary MEC ranges observed over the 6-month sampling campaign and PEC:MEC ratios were determined. PEC:MEC ratios were generally low (< 0.5), indicating that predicted API concentrations were lower than measured. Between rivers, PEC:MEC ratios were generally closest to measured values in the lowest flow (smallest) rivers and in stretches near the headwaters indicating that locations with minimal upstream contributions of sewage effluent produced the most accurate PECs. In terms of prioritisation, predicted concentrations successfully identified eight of the ten APIs measured at highest concentrations across all 5 study locations (metformin, gabapentin, telmisartan, desvenlafaxine, fexofenadine, 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

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In view of the revision of the "Guideline on the environmental risk assessment of medicinal products for human use" (EMEA/CHMP/SWP/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 into sediment triggers further assessment in the next tier of the guideline. Derived half lives were not used in refined predicted exposure concentration (PEC) calculations and transformation products (TP) were not specifically considered in the ERA. Now, UBA evaluates the data received in the last 10 years in order to determine the gaps and the benefit of the current fate assessment for the overall risk assessment e. g. classification of persistence. Especially the role of TP in the environment due to their frequent higher mobility compared to the parent compound is considered in the presented research. As a first step an overview is prepared on the overall performance of pharmaceuticals in the aquatic environment in the presented study. It is clearly demonstrated that total system half-lives already show a high persistence of pharmaceuticals in the aquatic environment. Furthermore it should be considered that especially for the sediment compartment often no kinetic model fits well enough to predict DT50 values. The risk of ground water contamination by bank filtration will be estimated by that non-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 study is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiting OECD 308, the results should be better included in the ERA and communicated.
Effects of duloxetine and econazole on freshwater species towards individual and combined conditions

G. AMARIEI, Universidad de Alcalá; K. Boltes, University of Alcalá / Chemical Engineering; J. Valimáho-Traverso, M. García, P. Letón, M. Marina, R. Rosal, University of Alcalá

Thousands of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicine and are found worldwide. Nowadays, the occurrence of pharmaceuticals in aquatic environments is a well-established issue, where there are still gaps in our knowledge on the fate and effects of these compounds in the environment. Evaluating API ecotoxicology is even more challenging due to uncertainties about appropriate dosages, durations of exposure, range of sensitive taxa, sensitivity of developmental stages, and toxicological endpoints. More attention should be paid on the non-target organisms and the chiral nature of contaminants. This work assesses the toxicity of the antidepressant drug Duloxetine and the antifungal Econazole, individually and combined, on three freshwater species—algae, crustacean and duckweed, using APIs concentration from 0.039 to 0.109 mg L⁻¹. Level I band of type drugs interactions were determined using the Combination Index-isobologram method. The enantiomers concentration of the target compounds in the culture medium (WWTPs) were analyzed to understand the relationship between degradation profile and the observed toxicity on organisms. Results reveal toxic effects of Duloxetine and Econazole leading to growth reduction and significant changes in the morphology of duckweed fronds. The EC50 values obtained showed Duloxetine as very toxic for algae and toxic for crustaceans and plants. Econazole appears as very toxic for all species evaluated. Mixed toxicity profiles (OB1s) for fungicidal and/or antifungal compounds (TCAs) are now better understood, which presents a new opportunity for R and S enantiomers in culture media. [1] Mingué L, Pedelucq J, Farcy E, Ballandonne C, Budzinski H, Halm-Lemelle M.P. 2016. Toxicities of 48 pharmaceuticals and their freshwater and marine environmental assessment in northwestern France. Environ Sci Pollut Res 23: 4992. [2] Kostich M.S, Lazorchak J.M. 2008. Risks to aquatic organisms posed by human pharmaceutical use. Sci. Total Environ 380: 1-19. [3] Kostich M.S, Lazorchak J.M. 2007. Risks to aquatic organisms posed by human pharmaceutical use. Sci. Total Environ 380: 1-19. [4] Kostich M.S, Lazorchak J.M. 2007. Risks to aquatic organisms posed by human pharmaceutical use. Sci. Total Environ 380: 1-19.

Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects of duloxetine and econazole on freshwater species

M. Ibáñez, M.O. Ibáñez, D. Kato, H. Zhang, Kyoto University

Over recent years, growing numbers of human pharmaceuticals have been detected in effluents of wastewater treatment plants (WWTPs), and their potential risks to aquatic species has been raised because they are designed to be biologically active. One of most concerned pharmaceuticals are antidepressants. For example, selective serotonin reuptake inhibitors (SSRIs) such as fluoxetine and sertraline could alter the behaviour of fish in vitro and vivo. Antidepressants such as SSRIs, serotonin-norepinephrine reuptake inhibitors (SNRIs), dopamine reuptake inhibitors (DRIs), and tricyclic antidepressants (TCAs) are now on the market worldwide. It is possible to measure the concentrations of selected antidepressants by chemical analysis, but such concentrations do not indicate the physiological activity of antidepressants in waters. For example, even if the concentration of each substance is low, through additivity compounds might produce a strong enough physiological activity to harm aquatic organisms. To determine whether antidepressants are detected in aquatic environments, we must know the extent to which such compounds may be exposed to antidepressants as determined by the inhibition of monoamine transporters in wastewater effluents. In this study, we measured the physiological activity of antidepressants in WWTP effluents for the first time by the in vitro assay (namely called antidepressant assay). We utilized fluorescence substrate, APP, for monoamine transporters (serotonin transporters (SERT), norepinephrine transporter (NET), and dopamine transporter (DAT)). By transfecting a plasmid expressing transporter into cultured cell line, and measuring the fluorescence intensity inside the transfected cells, inhibitory activity of antidepressant on the uptake of APP by transporter could be quantified. We applied the antidepressant assay to secondary effluents (SEs) of WWTPs in Japan, and aimed to detect the inhibitory activity of antidepressants in SEs. Inhibition was detected in SERT or NET-expressing cells, but not in DAT-expressing cells, suggesting that detected inhibitory activity come from SSRIs, SNRIs, and/or TCAs. Inhibition of antidepressants in SEs could be quantified as antidepressant-equivalent quantities (EQs). By comparing EQ values with the effective concentrations of antidepressants in vivo, we can know whether antidepressants in environmental water is really risky to aquatic organisms.

We010

Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects of duloxetine and econazole on freshwater species

V.F. Fonseca, I.A. Duarte, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCU; B.M. Gillanders, School of Biological Sciences, The University of Adelaide / Southern Seas Ecology Laboratories; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre
The ubiquity of pharmaceutical compounds in the aquatic environment, their growing use and their potential to elicit biological effects even at low concentrations is a major concern to environmental health and safety management. In recent years an increasing number of studies have addressed the presence and toxicity of various pharmaceuticals, using various biological endpoints in different biological models, and reporting varying effects. Accordingly, a systematic approach to assessing toxicity is key to improve current understanding of the ecological risks of pharmaceutical compounds in the non-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 was among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitive analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

WE013 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals
E. Umnangayaw, Shostok University / Marine Biology Institute; J. Gan, University of California, Riverside / Department of Environmental Sciences

Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to pg/L. More than 50 % pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is implausible to carry out whole organism toxicity studies of all pharmaceuticals. However, there is a wealth of knowledge available from drug discovery and development research that can be leveraged for predicting potential environmental exposure and effects of chiral pharmaceuticals. Assuming evolutionary conservation of primary drug target, read-across method can be used to predict the potential effect of chiral pharmaceuticals. In this study, we estimated the stereoselective effect of 11 chiral pharmaceuticals using the fish plasma model. We found metoprolol had high risk with an effect ratio, ER (ratio of human therapeutic plasma concentration to fish plasma concentration at steady state) that was less than 1.0, whereas propranolol, salbutamol, fluoxetine and venlafaxine were medium risk (1.0 < ER < 30). However, stereoselectivity was predicted in all compounds except atenolol and pindolol. In this study, we showed the fish plasma model has considerable potential for predicting stereoselective toxicity of chiral pharmaceuticals.

WE014 Effects of benzoylcoenzyme exposure at different levels of the biological hierarchy on Daphnia magna
M. Parolini, Università degli Studi di Milano / Department of Environmental Science and Policy; B. De Felice, Università degli Studi di Milano; C. Ferrario, Università degli Studi di Milano Biocca; N. Salgueiro-González, IRCCS Istituto di Ricerche Farmacologiche Mario Negri; S. Castiglioni, Mario Negri Institute / Environmental Health Sciences; P. Tremolada, Università di Milano / Dept of Biomolecular Sciences and Biotecnology; A. Finizio, University Milano - Biocca / Department of Earth and Environmental Sciences.

A number of monitoring studies have shown that benzoylcoenzyme (BE), a metabolite of cocaine, is the main illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. The few studies that exist about this molecule in fish reveal that the toxicity of this molecule towards invertebrate and vertebrate aquatic non-target organisms have shown different detrimental effects at low levels of the biological organization, mainly at biochemical, molecular and cellular levels. However, to date no one study has evaluated the consequences of BE exposure to the higher levels of ecological hierarchy. Thus, the present study was aimed at investigating the toxicity of a 48-h exposure to varying concentrations of BE, since those found in aquatic ecosystems (0.5 µg/L and 1.0 µg/L, on the cladoceran Daphnia magna at different levels of the ecological hierarchy. We relied on a multi-level approach focusing on the effects at biochemical/biomolecular (biomarkers), individual (swimming activity) and population (reproduction) levels. As previous studies of BE have shown that this molecule can induce oxidative stress, we assessed the amount of reactive oxygen species and of the activity of antioxidant (SOD, CAT, and GPx) and detoxifying (GST) enzymes and the lipid peroxidation (TBARS) as oxidative stress endpoints. We also measured the acetylcholinesterase (AChE) activity because this enzyme is strictly related to behavioral changes in aquatic organisms. Alterations in the swimming behaviour of D. magna were investigated by a video tracking analysis, while the consequences on the reproduction were assessed by a chronic toxicity test. Our results showed that the exposure to two BE concentrations similar to those found in aquatic ecosystems induced oxidative stress and inhibited the activity of AChE, affecting the swimming behavior and the reproduction of Daphnia magna individuals.

WE015 Impact of the antidepressant drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario)
S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, University of Tuebingen; R. Trischkorn, University of Tuebingen / Animal Physiological Ecology;

The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antidepressant 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, 1, 10, 100 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 100, 1000 µg/L) at 7°C & 11°C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (HSP70), changes in the intestinal microbiome and additionally the glycogen storage in the liver of MF-exposed fish. Besides, swimming and predator-prey behaviour were investigated. There was no influence of MF on the developmental parameters in brown trout larvae. Neither behaviour nor stress protein level were influenced by MF. The liver tissue of the MF-exposed trout was in a good condition. The glycogen storage was tendentially increasing in MF-exposed fish compared to the control, whereas the glycogen content of the trout exposed to 1000 µg/L MF was partially decreased. The intestinal microbiome of MF-exposed larvae showed a significantly different composition compared to the control. The results for the experiment with GU will be presented (analyses not yet finished). This work is part of the project Eff-Net (Effect Network in Water Research) funded by the German Research Foundation (DFG).

WE016 Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guanylurea on F1 progeny 28 days post hatch.
Z.P. Pandelides, University of Ontario Institute of Technology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Research; Studies have demonstrated that the type 2 diabetic drug metformin and its only known metabolite, guanylurea, are common environmental contaminants found in the ng-g/L concentration range in surface waters and wastewater effluent. This should be of concern as recent work in our lab shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin and guanylurea from embryo through 28 days post-hatch have a significant decrease in length and weight of both males and females when compared to control fish. Furthermore, our studies show that larvae exposed for 28 days to both compounds have a significant dysregulation in lipid and fatty acid metabolism, possibly leading to this stunted growth. A full life-cycle exposure to both compounds at environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure to the F1 progeny. The effects of metformin and guanylurea on the length and wet weight were compared 28 days post hatch and will be discussed. Possible implications of exposure to metabolomics and gene expression will be explored

WE017 Life-cycle effects in Oryzias latipes exposed to environmentally relevant concentrations of metformin and its metabolite, guanylurea.
E. Ussery, University of Ontario Institute of Technology / Biological Sciences; Z.P. Pandelides, University of Ontario Institute of Technology; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Research. One of the current most common contaminants in the aquatic environment is the type 2 diabetic drug metformin. Metformin has been measured in the ng-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 male and female. Medaka were coexposed to control fish, with guanylurea appearing to be roughly 1,000 times more potent than its parent compound, metformin. Furthermore, these studies show significant changes in the metabolism of 28 day old male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. These results raise concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds in environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

WE018 Environmental Fate and Effects of the Antidiabetic Drug Metformin and Its Transformation Product Guanylurea
J. Straub, F. Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Safety; V. D’Aco, Quantum Management Group, Inc.; T. Davidson, BioISIBiosystems and Integrative Sciences Institute / Centro de Ciências da Universidade de Lisboa / MARE / Marine and Environmental Sciences Centre; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre
Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excerted in unchanged form. This has led to concern about the potential aquatic life impacts associated with the presence of MET in surface waters. The transformation product guanylurea (GUU) is produced by WWTP, and both MET and GUU are further degraded in the environment. A comprehensive 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 showed alignment with PECs at US EWS and J. Straub, F. Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Safety

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 Gagio, University of Milan; M. Parolini, University of Milan / Environment Safety and Policy
The massive release of human pharmaceuticals into the aquatic ecosystems continues to be a serious environmental problem. Among pharmaceuticals, psychotropic drugs such as antidepressants are one of the main therapeutic classes detected in freshwater worldwide. Selective serotonin reuptake inhibitors (SSRIs) are commonly the first-line antidepressant drugs prescribed to alleviate anxiety disorders in humans, and fluoxetine (FLX), the active principle of the Prozac®, is one of the most commonly used worldwide. 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 a subset of genes of the antioxidant response (sod1, sod2, cat, gpx, gst), stress and anxiety (osxl, prl2, npy and ucn3), 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 Bezafibrate toxicity in model marine diatom Phaeodactylum tricornutum
B. D’Aco, Quantum Management Group, Inc.; T. Davidson, BioISIBiosystems and Integrative Sciences Institute / Centro de Ciências da Universidade de Lisboa / MARE / Marine and Environmental Sciences Centre; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCU; 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, Bezafibrate 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, bezafibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have serious effects on marine life, including 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 bezafibrate (0-60 µg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometry. Bezafibrate exposure impaired both photosystems, which reduced the 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 bezafibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipidd 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 activity. 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
J. 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/ecotoxicity and on sales amounts for the products containing MPA in Europe. A predicted environmental concentration (PEC) in Europe from all products containing MPA was calculated based on compound actual use data from IMS Health, Inc. per applicant and country, incorporating population data from Eurostat, for the decade 2004–2014. A crude initial PEC was derived based on standard ERA assumptions of no removal in sewage treatment or surface waters. The crude PEC was refined by incorporating predicted sewage works removal, based on new biodegradability data, and by country-specific dilution factors. The lowest of the no observed effect concentrations from chronic and subchronic tests with algae, daphnia and fish was determined for an asssessment of MPA’s environmental risk. The data were used to develop a model to predict no effect concentration (PNEC). Potential risk for surface waters was then quantified by dividing the PECs by the PNEC. Potential risk from MPA was also assessed for sewage works and bacterial populations. In addition, MPA is not expected to bioaccumulate nor to adsorb to sewage sludge or to sediment to a significant extent. Considerations of potential risks of MPA are given in the poster.

WE022 Cytostatics in Dutch surface water - overview of use and potential risks to the aquatic environment
334 SETAC Europe 28th Annual Meeting Abstract Book
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 to sludge, many contaminants, including pharmaceuticals, are not yet partly 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, are in the top 10 of cytostatics in the Netherlands and to determine if cytostatics pose a potential risk to the aquatic environment, an inventory was made of cytostatics use in the Netherlands. 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 environmental concentrations were derived. Comparison to predicted and measured environmental concentrations will allow to conclude if the selected cytostatics pose a potential risk to the aquatic environment.

WE023 Environmental risk assessment of human pharmaceuticals - what can we learn from regulatory effect data so far? S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; J. Bachmann, German Environment Agency (UBA) / Section IV 2.2 Environmental Risk Assessment of Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals

Since the coming into force of the guideline on the environmental risk assessment of medicinal products for human use (EMEA/CHMP/SWP/4447/00 corr 2), the German Environment Agency (UBA) is tasked with environmental risk assessment of human pharmaceuticals. Applicants seeking approval of medicinal products need to submit fate and effect data, in case predicted environmental concentrations exceed 10 ng/L in surface waters, or the substance is of specific concern through its mode of action. For an inventory was made of cytostatics in aquatic environments. 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 environmental concentrations were derived. Comparison to predicted and measured environmental concentrations will allow to conclude if the selected cytostatics pose a potential risk to the aquatic environment.

WE025 SETAC Pharmaceuticals Interest Group G. Masca, 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. Fleoter, HAW Hamburg / Department of Environmental Engineering; S. Schwonbeck, G. Koennecker, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment

The marketing authorisation process for veterinary pharmaceuticals in the EU and other countries requires an environmental impact assessment (EIA) for each veterinary medicinal product (VMP). This EIA follows a phased approach with conservative estimates of environmental exposure in phase I, which may later require refinement by experimental data in phase II. Core of the phase I assessment is a catalogue of 19 questions on use and characteristics of the VMP under consultation. These questions aim at establishing an initial predicted environmental concentration, which, together with information on therapeutic use and targeted 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.

Obesogens and lipid disruptors (P)

WE027 Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses R. Lopéz, Instituto de Experimental Assessment and Water Research (IDAEA-CSIC) / Environmental Toxicology; L. Navarro-Martín, C. Lucarelli, IDAEA-CSIC; E. Ortiz, IDAEA-CSIC / Department of Environmental Chemistry; A.E. Codina, CNAG; D. Raldua, IDAEA-CSIC; C. Barata, CSIC / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; R. Tauler, IDAEA-CSIC / Environmental Chemistry

Exposure to PFOS (perfluorinated octyl sulfonate) has been related to toxic effects on lipid metabolism, immunological response, and different endocrine systems. We present here a combined metabolomic and transcriptomic analysis of zebrafish embryos exposed to different concentrations of PFOS (30-1000 ppb) from 48 to 120 hpf. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest used concentration. Functional 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 a concentrations well below the 1 ppm considered the LOAEC/NOAEC for many of the macroscopic effects traditionally linked to PFOS toxicity in zebrafish embryos, including lipid disruption, effects to sensorial organs, and lethality. It is also remarkable the functional correlation between these macroscopic effects and the molecular changes we observed at metabolic and/or transcriptomic levels at concentrations 10 to 100 below the macroscopic NOAEL.

WE028 Impacts of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss).
A. Capitão, CIIMAR; D. Gomes, Universidade do Porto / Faculty of Marine Sciences; J. Neves, Universidade Católica de Louvain / Institut des Sciences de la Vie; A. De Grooto, Université Catholique de Louvain; J. Rees, Y. Larondelle, C. Debier, Université Catholique de Louvain / Institut des Sciences de la Vie

Fish can be exposed to nutritional and chemical stress. In aquaculture, fish oil is increasingly replaced by plant-derived oils, which results in a modification of the fatty acid (FA) composition of the diet. Also, pollutants such as methylmercury (MeHg) are still present in aquatic environments. Adipose tissue is an essential endocrine organ involved in energy homeostasis and can be affected by some stressors. However, there is a lack of knowledge about the effects of FA and MeHg on rainbow trout adipose tissue. In this context, in vitro experiments were carried out on trout primary cultured adipocytes to study the effects of FA and those of MeHg. Effects of FAs - During 2 days, differentiation of confluent cells was induced through a hormonal cocktail. Cells were then incubated during 13 days with 0, 75, 150, 300 and 600 µM of α-linolenic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 2 and 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
A. Capitão, CIIMAR; P. Cunha, B. Freitas, M. Santos, E. Cardoso, CIIMAR - University of Porto; M. M. Santos, CIIMAR/FUCP / Biology/Endocrine Disruptors and Emerging Contaminants

The increase of obesity is one of the 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 species of mammals. Such 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 to µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolite guanylurea in developing fish, we found a significant decrease in length (~6%; mm) and wet weight (~22%; mg) of male Japanese medaka (Oryzias latipes) when exposed to 3.2 µg/L metformin from embryo through 28 days post hatch. When male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length and wet-weight. Using radio labeled metformin, we demonstrated that about 1% of the waterborne concentration of metformin could be taken up in both embryo and larval medaka after exposure windows ranging from 24 hours to 7 days. We also conducted a metabolomics assessment of metformin and guanylurea exposed fish to elucidate the sub-lethal biochemical mode of action for each contaminant exposure. Significant changes were detected in the metabolome of 28-day larval male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. This biochemical effect is likely a contributing factor to the observed decreased growth in exposed fish. In combination, these results suggest that the current concentrations of metformin and guanylurea in receiving waters are of ecologicalological concern for resident fish populations.

WE032 Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Instituto de Ecologia; C. Cáceres, Universidad Autonoma Metropolitana Iztapalapa / Universidad de California, Santa Barbara, California USA

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 sublethal concentration of each metal (LC50): 0.35, 5.0 and 3.0 mg L−1 of Cd, Cr and Pb
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bligh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Kruskal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treatments was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease for the other parameters. The levels of lipids and protein, lipid and carbohydrate levels of up to 75% in only 96 hours (4 days) of exposure to metals and their mixtures. This indicates that juveniles exposed to metals had high stress levels, (as was also observed in relation O:N). It should be mentioned that the surviving organisms of the tests, died 48 hours (2 days) after it was observed the mobilization of their energy reserves.

Environmental risk assessment and management of the spoil material produced in tunnelling (P)

Environmental assessment of foaming agent persistence in conditioned soil for EBP-TBM tunnelling


Earth Pressure Balanced Shields are currently the most used full face tunnelling machine thanks to the wide use of conditioning agents in different soil types that change the mechanical and hydraulic behaviour of the soil into a paste-like, 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 soil threshold limits in European legislation for these components or comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained as the main component of two commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Moreover, the degradability of one product was evaluated in the presence of an additive used to improve the compactness and subsequently transport of the spoil material. For this purpose, microcosms were set up using soil samples conditioned separately with the two foaming agents. Control microcosms, consisting of un-treated soil, were also set-up to compare the microbial community before and after the foaming agent addition. At selected times, soil samples were collected for assessing SLES concentration by ASE extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, viability and dehydrogenase activity in the conditioned and control soils. Results showed that SLES degradation depended on the soil type, with DT50 ranging from 11 to 19 days; the additive increased significantly the spoil persistence 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 spoils materials containing foaming agents


The rapid development of TBMs in the tunnelling industry has been mainly due to the development of new foaming agents carried out by the Mapei SpA R&D Institute. Thanks to the development of new foaming agents carried out by the R&D Group, MAPEI has 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 foaming agents have been conditioned by a third-party accredited laboratory as WHO. The conditioning tests are suitable to 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 containing 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...
Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) followed by the modified Methylene Blue Active Substances (MBAS) method in spoil material from excavation processes


Recent years have been characterized by a rapid worldwide growth in underground constructions in the form of new infrastructures such as pipelines and communication cables as well as road and railway tunnels. The utilization of underground space offers a new strategy to urban planning, including a huge development of the mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Performances of TBMs depend on soil, geological conditions, and characteristics of the tunnel boring machines. Significant amounts of rock broken into various sizes mixed with anionic surfactants are produced during the execution of engineering works. The potential re-use of this non-renewable natural resource, for example as land covering, depends on the assessment of its environmental compatibility; otherwise, the spoil materials must be treated as a waste. In this context, it is important to evaluate the residual concentrations of SLES in the excavated soils in order to evaluate their possible final destination. Given the absence of official analytical methods, it has become necessary to develop and validate a reliable and accurate methodology to quantify anionic surfactants in the spoil materials and, more in general, in the environmental solid matrices. For this purpose, the aim of the present work was the optimization of an analytical method for the determination of SLES in conditioned-soil samples. It consists of a first phase of extraction of anionic surfactants from the soil by the use of Pressurized Liquid Extraction (PLE) and the following analysis in the extract by the MBAS (Methylene Blue Active Substances) method using the water official method partially modified. The optimised method has been applied to real excavated soil samples because the determination of residual concentrations of the anionic surfactants in the spoil materials produced during excavation process is currently one of the mandatory parameters for assessing their eco-compatibility.

Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB-TBM applications


The development of the mechanized tunnelling industry by EPB-TBMs (Earth Pressure Balance -Tunnel Boring Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, and more in particular sodium lauryl ether sulphate (SLES) are used as foaming components of foaming commercial products. Soil debris from excavation processes can contain residual concentration of SLES. The potential re-use of the spoil material for public green areas or industrial purpose (e.g. land covering) depends on the site-specific SLES persistence in the excavated soil and on the related environmental exposure scenario. In this context, we evaluated the SLES leaching in two different soils in order to simulate check whether underground water contamination may occur in a scenario where the spoil material is located close to a water body. For this purpose, we evaluated the persistence (DT₅₀) of SLES in two soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) conditioned separately with two common commercial foaming agents, respectively F1 and F2, used at conditioning ratio giving final concentration in both the soils of about 150 mg/kg. The presence of strengthening foaming polymers (P1 or P2, 527 and 50 mg/kg respectively), needed in some cases to increase foam persistence, was also considered. After a preliminary phase at laboratory scale, a mesocosm experiment was conducted in order to entail the scale-effect, which is very significant when the soils were involved. SLES solutions were set-up mixing 100 kg of each soil with water, foam and polymer and then stored for 28 days in high-density polyethylene bins (HDPE diameter of 30 cm and height of 100 cm). The effect of soil type, grain size or aeration on SLES persistence was evaluated. For this purpose, eight bins containing S1 or S2 conditioned separately with the two foaming agents, were weekly turned to improve aeration, while the corresponding eight blends were not turned. At selected times (0, 4, 7, 12, 20 and 28 days), soil and leachate samples were collected from the bins for assessing SLES concentration by MBAS spectrophotometric method, preceded by ASE (Accelerated Solvent Extraction) in the case of the soil matrix. The results showed that residual SLES concentration in soil and in leachate is dependent both on the type of soil and on the nature of polymers.

Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling

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Anionic surfactants (ANS) are a heterogeneous group of amphipathic compounds characterized by linear aliphatic chains (ranging from C₈ to C₁₈) with a polar group (sulphate or sulfonate) neutralized with a counter ion. Given the variability of their molecular composition ANS are considered mixtures. They are utilized in several applications (i.e. detergents, cleaning products, fracking or soil conditioning in the excavation industry). Among ANS, the sodium lauryl ether sulphate (SLES) is commonly utilized as a foaming agent to facilitate the excavation procedures in mechanized tunnelling. However, its use raises concern for the environment considering the presence of SLES residues in soil debris produced during the excavation. In addition, the absence of soil threshold limit for SLES in the EU legislation does not facilitate the re-use of soil debris as by products (e.g. land covering) and, consequently, a huge amount of such detritus can be discharged as a waste with high economic costs. In absence of a threshold limit, performing an environmental risk assessment (ERA) of foaming agents containing SLES can be a possible alternative. However, the ERA is hampered by both the rather scarce data on the effects of SLES and the site specific condition of use which lead to different levels of exposure. Indeed, the selection of the type and quantity of foaming agents depends on soil, geological conditions, and characteristics of the tunnel boring machines. Furthermore, several commercial formulations are available on the market with different percentages of SLES and several other components. This study is part of a wider project aiming to develop a methodology to be applied to identify environmentally acceptable levels of SLES residues in soil debris produced during the tunnelling operations in Italy. Particularly, we report the results regarding the preliminary ERA that has been used to select, among all the available commercial formulations, the one leading the lowest level of risk for the environment in a specific condition of use. The risk has been characterized based on PEC/PNEC ratios. PECs were calculated by predictive models and considering the percentage of SLES in the commercial formulations as well as the required treatment ratios for tunnelling operations. PNECs (soil and surface water) for SLES were derived from ecotoxicological data (terrestrial and aquatic organisms) which were obtained from laboratory tests on several test organisms.
agent products are anionic surfactants such as the alkyl ether sulphates (AES). The possible re-use of huge amounts of spoil material produced during the excavation process as by-products (e.g. land covering) or its discharge as a waste depends on the residual concentration of AES in the soil. The first option has the undoubted advantage to lower the costs of disposal. However, there are concerns about the potential environmental risk related to the re-use of conditioned soil. In fact, even if anionic surfactants are generally considered biodegradable and not toxic, there is little information in literature on their environmental fate and the possible ecotoxicological effects of the commercial formuations of foaming products and of the conditioned soils. The aim of this study was to evaluate the environmental compatibility and the ecotoxicological effects of two different soils treated with two different foaming agents containing the anionic surfactant AES. Applying a suitable battery of bioassays. For this purpose, two soils were prepared, containing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m³) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox® test with the bacterium Vibrio fischeri, Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and 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 additives used in mechanized tunneling. The study highlights the importance of a site-specific ecotoxicological evaluation in the tunneling projects in order to have a real environmental compatibility of the spoil material.

**WE041 Expeditious test for on-site monitoring activity in mechanised 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. For this purpose a process to plan strategies for the spoil disposal management in a virtuous cycle of reuse of the resources leads to relevant economical and logistical advantages. The raising awareness about the chemical composition of the products injected during the excavation resulted in the development of experimental procedures aimed at studying the environmental impact of chemicals and their permanence in the soil during the excavation and after the tunnel is reused. A battery of bioassays have been developed to evaluate the effect of specific concentration values of these chemicals on terrestrial and aquatic environments, as well as to measure the reduction of the concentration of these compounds in each environment due to the action of the microorganisms inhabiting them. All these experimental procedures must be carried out in specialized laboratories equipped with sophisticated apparatuses, in which controlled environments are predisposed, so that at present it’s not possible to measure the level of pollution through expeditious tests directly on site. A joint research activity between Sapienza University and National Research Council of Rome has developed a test procedure able to provide experimental information on the presence in the spoil of the chemicals often used in mechanized tunneling. The results of preliminary laboratory tests convinced that the expeditious assessment proposed can describe the amount of chemicals in the soil and their evolution in time, complementing the laboratory activities currently accepted. In fact, this fast procedure must be regarded as a first screening which can be run directly in site on a large number of samples without the use of expensive, delicate or complex instruments, to be used in combination with few more precise laboratory tests. Moreover, it seems this test better suited for monitoring large volumes of spoil than those involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

**WE042 Toxicity of some additives used in mechanized tunneling: effects on daphnids, algae and cress.**

D. Baderna, S. Maiarana, A. Passoni, R. Bagnati, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; M. Lodi, E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

Surfactants and polymers are used in mechanized tunneling to facilitate the excavation and to preserve the tunnel boring machine (TBM) from wear, block and break. As a by-product of the process, several tons of rocky debris are produced. These excavation rocks are made of rock fragments contaminated by the additives such as anionic surfactants, glycols, sealants, polyacrylates and polyacrylamides. In the past, rocky debris were disposed as waste with a large economic impact on total excavation cost, while some disposal alternatives were recently applied, trying to recycle these complex materials as road filling material, covering rocky areas or river banks. These disposal solutions, however, have attracted the attention of regulators and environmental protection agencies, especially in Italy. In fact, the toxicity of these active mixtures is not yet fully known as well as the potential effects resulting 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/pvPb & PMT/pvPM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P)**

**WE043 Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China**

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Bioaccumulation and trophic transfer of 13 organic ultraviolet absorbents (UVAs) were investigated in riverine wildlife organisms in the Pearl River catchment, South China. The UVAs were widely present in the fish with the highest level detected for UV 531. Generally, the UVAs concentrations were higher in the freshwater fish than in shrimp. Dietary habits of the fish showed effects on bioaccumulation of the UVAs with higher levels in the carnivorous species than in the herbivorous, planktivorous and detritus feeding fishes. Tissue distributions were generally in the order of liver > belly fat > muscle. Obviously higher concentrations of 2-ethylhexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogBAF) for most of the UVAs were > 3, suggesting potential of biomagnification 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 benzoazinol ester stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

**WE044 Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies**

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Bioaccumulation is one of the PBT (persistence, bioaccumulation, toxicity) cut-off criteria for plant protection products (EC/1107/2009) in the EU; furthermore, high bioaccumulation is generally considered a critical parameter in other regions, too. The standard regulatory assessment of bioaccumulation is based on bioconcentration in aquatic species, i.e. for regulatory purposes in fish. However, standard fish bioconcentration studies are time consuming, expensive and they use a comparatively small number of species. Thus, there is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally clustered candidate molecules regarding bioaccumulation potential and the prediction whether a candidate molecule will exceed the BCF (bioconcentration factor) trigger value. Furthermore, Hyalella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimental BCF values from in vivo through bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtien, 2012). Further work is presented in order to (i) increase the data base of Hyalella – fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20 000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges since Hyalella as an aquatic invertebrate can be quite sensitive. The results from
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 actives and 5 non-actives in over-dosing of environmental pH range (pH 3 to 9). A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-I guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R = 0.40), and b) that significant correlation was shown only with loga at pH = 3 (R = 0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R < 0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., logKOW) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BMF from quantum-chemistry-based estimations of partitioning coefficients (to correlate data from lipophilicity and albumin). Estimation of BCFs from BFM for the investigated chemicals will be also performed and verified with existing BCF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radiolabelled test chemicals.
WE049
PBT/vPvB: All equally bad or some worse than others? - How to inform risk management
K. Thiele, WUR; S. Gabbett, Wageningen University / Social Sciences

In the past, risk managers have identified 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 three different properties. This implies a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may therefore be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE050
Modelling Persistent & Mobile Organic Compounds using an updated Multimedia Urban Model: A Toronto Case Study with Organophosphate Esters (OPEs)
T. T. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry, L. Jantunen, Environment and Climate Change Canada; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; M. L. Diamond, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are a group of chemicals found at relatively high levels in the environment, in both terrestrial and aquatic ecosystems. 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 (POMCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using polyparameter linear free energy relationships (ppLFErs) to represent partitioning, and we modified the wet deposition processes to account for intermittent rainfall. We looked at three chlorinated (Cl-OPEs) and three non-chlorinated OPEs (non-Cl-OPEs) in Toronto, Canada. Our goal was to estimate their emissions to Toronto air and to evaluate their environmental pathways. Air emissions were estimated by from measured outdoor air concentrations and model results were evaluated against measured water and rain concentrations in Toronto tributaries. Based on estimated emissions to air, modelled water and rain concentrations were within an order of magnitude of the measured concentrations, with an RMSE of 140% of the mean measured water and rain concentration. Since the water and rain concentrations were taken independently of the air concentrations, these results gives some credence to the model estimates and showed that the emissions estimates were accurate to approximately, an order of magnitude. Estimated aggregate emissions to outdoor Toronto air of OPEs for 2010 ranged from 110 (TDCCP) to 1,200 (TECP) kg/y and were significantly higher than emissions of ΣPCBs (90 kg/y) and ΣPBDEs (9 kg/y) for 2008, calculated using the same model. The results show that using modelling techniques developed for polar, hydrophobic compounds can provide estimates of emissions and fate to a similar level of accuracy as was previously achieved for persistent, bioaccumulative persistent toxic compounds. These model estimates provide evidence of relatively high emission rates to air and, by showing OPE mobility in water, support the hypothesis of long-range transport of Cl-OPEs by rivers. The major route of transfer for Cl-OPEs to surface water systems is through stormwater runoff, either through the washoff of films on impervious surfaces or soil wash-off.

WE051
An approach for the evaluation of PBT and vPvB substances subject to authorisation and restriction procedures in the context of socio-economic analysis
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A key objective of the European chemicals legislation REACH is to ensure that the risks posed by substances of very high concern (SVHCs) 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 are assessed from chemicals’ use including PBTs/vPvBs, are use-specific. Furthermore, due to stock pollution properties of PBTs/vPvBs, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBT/vPvB substances, the evaluation of PBT/vPvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e. target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from different substances of PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific or multiple uses of a PBT/vPvB substance (stage 4), and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared (stage 5). The approach offers a ready-for use framework for a concern-based evaluation of PBT/vPvB substances to be used as decision-support in REACH authorisation and restriction processes.

WE052
Polymers: The Next Frontier in Environmental Hazard Assessment
A. Carrag, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kao USA

Polymers are a very large and diverse class of chemicals widely used in cosmetic and personal care products. Their use and function are essential in creating high performing products that meet the needs of consumers. As used in cosmetic formulations, polymers can act as thickeners, emulsifiers, conditioners, opacifiers, film formers, theology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together. “They have a 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. According to FIFRA, PBTs are not required to undergo the use, and for comparing these impacts across different scenarios. Impacts are assessed from chemicals’ use including PBTs/vPvBs, are use-specific. Furthermore, due to stock pollution properties of PBTs/vPvBs, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBT/vPvB substances, the evaluation of PBT/vPvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e. target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from different substances of PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific or multiple uses of a PBT/vPvB substance (stage 4), and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared (stage 5). The approach offers a ready-for use framework for a concern-based evaluation of PBT/vPvB substances to be used as decision-support in REACH authorisation and restriction processes.

WE053
A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products
E. Nien, Smithers Viscient / Department of Regulatory Affairs; K. Malekani, Smithers Viscient / 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 guideline,
requirements, strategies and challenges. Abstract A PBT substance is one that is persistent (P), bioaccumulative (B) and toxic (T) or very persistent (vP) and very bioaccumulative (vB). The PBT assessment approach is well described under the REACH regulation (Regulation EC No 1907/2006) starting with a screening process based on available data and when a potential PBT is identified, then a definitive assessment is required. While this procedure is clearly understood for industrial chemicals, it is largely unregulated for other REACH substances and can be different for pharmaceuticals. There is therefore a definitive PBT/vPvB guidance for pharmaceuticals from the European Medicines Agency (EMA), although it is recommended that the assessment be made according to REACH criteria. Application of the REACH guidance to the PBT assessment of pharmaceuticals is not straightforward. A PBT evaluation of a substance is triggered within REACH if more than 10 tonnes of the substance is used per year. There is no established trigger value for performing a PBT assessment for pharmaceutical products, although it appears that a PBT assessment is applicable to pharmaceutical products that go into Phase II. However, we experience is that there is room for interpretations during the review process – especially for products that end at Phase I. Some RMs have consistently rejected the use of all available data; especially data derived from QSARs and instead treat the product as non-PBT. Furthermore, there is currently no information on the regulatory consequences of the PBT-assessment for any given product, the situation may change in the future. It is our hope the EMA will issue clear guidance on how a PBT/vPvB assessment should be performed for pharmaceutical products and the consequences for products which fulfil the PBT/vPvB criteria. This presentation will describe our experiences and the challenges we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE054 Evaluation of new assessment methods and enhancement of PBT/vPvB criteria for ionisable substances
H. Holzmann, RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics
The identification of persistent (P) bioaccumulative (B) and toxic (T) substances under the EU regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) was developed to assess neutral organic compounds. However, nearly 50 % of the chemicals pre-registered at the European Chemicals Agency (ECHA) are partly or completely ionised under environmental conditions (Franco et al., 2010). Since the charge of chemicals strongly influences their properties and environmental behaviour, the currently valid concept under the REACH regulation does not provide an efficient tool to assess a sufficient amount of ionisable substances. The objective of the project is to refine the P assessment of ion 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, two substances are studied: N,N-diethyl-3-methyl-2-amino-amid (DAE), which solely differ in their polar head group: 4-n-dodecyl phenol (DNP), 4-n-sodium dodecylbenzenesulfonate (DS) and 4-n-dodecylbenzyldimethylammonium chloride (DA+). Sediment and surface water were collected from a rainwater detention basin in Aachen, Germany. Preliminary studies using DP and DS were performed according to OECD 308 and 309. In the water-sediment system, formation of non-extractable residues (NER) was 13 % for DP and 10 % for DS after 65 days. The amount of 14C CO2 was 48 % (DP) and 63 % (DS). In surface water, about 40 % (DS) and 30 % (DP) of the initially applied amount of radioactivity was mineralised to 14CO2. Degradation studies with DA+ are in progress and the results will be presented. The results will be used to refine the evaluation of the P criteria for ion and ionisable chemicals in the PBT assessment. An unexpected challenge: ionizable compounds in the REACH chemical space. The International Journal of Life Cycle Assessment, 15(4), 321-325.

WE055 Assessment of the persistence of ion or ionisable organic chemicals under REACH
D. Classen, RWTH Aachen University / Institute for Environmental Research; J. Ackermann, Federal Environment Agency Umweltbundesamt / Chemicals; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics
For the protection of humans and the environment, the identification and regulation of chemicals with persistent (P), bioaccumulative (B) and toxic (T) properties are central within the environmental assessment. The criteria for the identification of PBT substances under REACH (Registration, Evaluation and Authorization of Chemicals) (EU Nr. 1907/2006) and the guidance for the PBT-assessment have been developed for neutral organic molecules, and do not properly address charged chemicals. Due to their charge, ion and ionisable substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphoteric characteristics, the chemicals intrinsic properties (e.g. water solubility, log Kow) change as a function of the environmental pH. This dependency affects the distribution of these substances within environmental compartments. The ionic function may also lead to different interactions between organic or mineral solid particles and the substance, influencing their bioavailability for potentially decomposing microorganisms, which are governing biotical degradation. In order to improve the evaluation of the persistence of ionic and ionisable substances in the PBT-assessment, sorption and degradation pattern of charged molecular substances is of interest. For non-charged functional group will be investigated. Since the ionisation behavior of 14C-labelled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonic acid sodium salt and 4-2-Dodecylbenzyldimethylammonium 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. Rieke, E. Bondarenko, H. Steinhoff, University of Osnabrueck / Physics; G. Ur, K. Hideg, T. Kalai, University of Pecs / Organic and Medicinal Chemistry; M. Mathies, University of Osnabrueck / Institute of Environmental Research
Supplements of HO4888 (N-Ac-SDZ, HO-4917). The labeling at the pyrimidine moity 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 aminoxyl moiety of HO4888. A broadened ESR signal was also recorded when SDZ was used in animal husbandry for treatment of infections. After application of treated livestock to soil, SAis interact with organic soil components, e.g. by reversible sorption or irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment (sequestration) or/and covalent binding to soil organic matter. The paper presents a new approach of using stable magnetic spin probes to investigate the kinetics of covalent immobilization of 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 aminoxyl moiety of HO4888. A broadened ESR signal was also recorded when SDZ was used in animal husbandry for treatment of infections. After application of treated livestock to soil, SAis interact with organic soil components, e.g. by reversible sorption or irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment (sequestration) or/and covalent binding to soil organic matter. The paper presents a new approach of using stable magnetic spin probes to investigate the kinetics of covalent immobilization of soil humic acids and to distinguish between sorption, sequestration and covalent binding. Leonardite humic acid (LHA) was mixed with laccase to enhance

WE057 The role of non-extractable residues in the environmental risk assessment from regulatory perspective: requirements and challenges
A. Wiemann, UBA Umweltbundesamt; J. Hogeback, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. Gildemeister, Umweltbundesamt / German Environment Agency / IV2.2 Pharmaceuticals; D. Löffler, T. Ternes, German Federal Institute of Hydrology
Non-extractable residues (NER) play different roles in 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 and information requirements and soil sorption can be reversibly bound to the soil/sediment and pose a potential risk to the environment or irreversibly bound which can be interpreted as sink. Hence, the potential release of parent or transformation products from NER in soil or sediment should be considered. However, distinguishing between these two 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 mobilised in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenic bound NER) are considered to be irreversible and bound to soil/sediment or transformed into biomass and therefore a risk to the environment is not anticipated. Furthermore, a stepwise extraction scheme is proposed which would allow the determination of these different NER types. The comprehensive scientific assessment of this extraction scheme supported by experimental data is funded by UBA. Transformation 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 NER assessment. Further, the fraction of 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 / Analytical Chemistry

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 ion exchange 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 exchange-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. Relatively 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'. Nonetheless, log k' has a clearly larger applicability domain than log Kow, because log Kow is unavailable for ionic chemicals derived from strong acids/bases (e.g., sulfonates, quaternary ammoniums), whereas log k' can be measured for such ions too. This study offers a step forward to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

**WE059**

**Simulation of the fate of co-labelled 13C3-15N-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 Hydrorheology; F. Polesel, Technical University of Denmark / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Kästner, Helmholtz Centre for Environmental Research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU Environment

The combination of dynamic simulation and stable isotope techniques allows the tracking of the assimilation of pesticides into biomass [1]. Here, we simulated the fate of a co-labelled 15N-glyphosate in an OECD soil/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 AsA, non-stable bound and with very low removal. Kinetic input parameters were 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 AMPa and CO₂, formation of living and dead biomass (proteins) and chemical adsorption. At the end of the experiment (80 days), non-extractable residues accounted for 23% of the 13C and 26% of the 15N. 10% of the 13C and 12% of the 15N were recovered from the protein fraction (mostly non-living amino acids), which is equal to the biogenic non-extractable residues (NER). Biogenic NER consist of assimilated 15N and are thus considered to be irreversible 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-labelled 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 Environ Sci Technol, 44(19), 2107–2171. [2] Wang, S., Seiwert, B., Kasile, M., Miltner, A., Schäffer, A., Reemtsma, T., Q. Yang, Nowak, K. M. (2016). (Bio)degradation pathways of glyphosate were modelled in a field relevant isotope co-labeling approach. Water Res., 99, 91–100. [3] Brock, A. L., Kästner, M., Trapp, S. (2017). Microbial growth yield estimates from thermodynamics and its importance for degradation of pesticides and formation of biogenic non-extractable residues. SAR QSAR Environ Res, 28(8), 629–650. [4] European Chemical Agency (2017). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.11: PBT/vPvB assessment, Helsinki, Finland.
II NER and type I NER should be considered as potentially releasable residues in persistence assessment but the probability of type II release is much lower. For these types the potential of remobilization needs to be tested and evaluated. Our concept is to consider the total amount of NER minus bioNER as the amount of potentially remobilizable xenon NER (type I + II). If a clear differentiation of type I and type II is possible and the latter is irreversibly bound, only type I NER needs to be considered in the persistence assessment. If no characterization of NER is available, we recommend to assess the total amount as potentially remobilizable.

**WE062**

Photodegradation of Atrazine in the Presence of Indole-3-acetic Acid and Natural Montmorillonite Clay Minerals

C. Gu, Nanjing University / School of the Environment; L. Zhang, Nanjing University

In this study, a new natural degradation pathway of atrazine and the potential mechanism are proposed. Atrazine was oxidized under simulated solar irradiation by indole-3-acetic acid at the environmentally relevant concentration under aerobic condition. The reaction was initiated by the production of hydrated electrons generated from the photoreduction of indole-3-acetic acid, and then this species transformed into hydroxyl radical after a series of radical reactions with proton and dissolved oxygen. During this process, the presence of montmorillonite greatly enhanced the yield of hydrated electron and promoted the further degradation of atrazine by hydroxyl radical. The novel reaction is to some extent affected by pH and the type of exchangeable cation present on montmorillonite. Based on our results, we hope to gain knowledge on the role of amino acids in natural environments. The possibility of applications for the development of new materials may be considered.

**WE063**

Photodegradation Half-lives of a Fragrance Ingredient in Natural Waters at Depth Calculated from Laboratory Study Results

J. Lin, Firmenich Research & Development; M. Neill, ETH Zurich / Institute of Biogeochemistry and Pollutant Dynamics; M. Emberger, A. Casilli, V. Hewins, Firmenich, Inc / Research & Development; S. Gimenova, Firmenich / Product Safety and Regulatory Affairs

Photodegradation, an important abiotic degradation process, is rarely considered in the persistence assessment of chemical substances. This is due to the difficulties and in the lack of knowledge to extrapolate from laboratory studies to the complex environment. As the first step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment, we chose a fragrance ingredient, Myrhone® as an example, and used laboratory study results to calculate its photodegradation half-lives at depths in natural waters. Direct photodegradation was revealed to be the dominant photodegradation process of Myrhone® and the quantum yield was determined to be 0.51 in the laboratory. Four main volatile photodegradation products, which continued to photodegrade, were observed, isolated by preparative multidimensional GC and identified using NMR. Direct photodegradation half-lives of Myrhone® in natural waters at different depths were calculated based on its molar absorption spectrum, quantum yield, and the irradiance at depth of natural waters. The irradiance values at depth were obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, date and location. Kd are empirical values determined by the interaction of a number of factors, including absorption by dissolved organic matter and particulate matter, scattering, and the angular distribution of the light field. A correction factor for chlorophyll was applied to the first step of photolysis which governs this half-life that ranged from 1.3 to 9.1 days for small size lakes and, 6.3 to 45 days for large size lakes under realistic conditions in Australia. The calculation of half-lives at the surface of water was validated by two outdoor photolysis experiments. The calculated half-lives of 0.38 h and 1.14 h were in agreement with the measured half-lives of 0.40 h and 1.15 h, respectively. This agreement indicated that mathematical models can be developed to define complex environmental conditions for the extrapolation of laboratory data to the environment. The next step is to design experiments to measure half-lives at depth in natural water to refine and validate the calculation of half-lives. Thoroughly validated models can be valuable tools for the persistence assessment of chemicals based on photodegradation information.

**WE064**

The Photolytic Fate of Fungicides

J. Apell, MIT / Civil & Environmental Engineering; C. McNeill, ETH Zurich

The use of pesticides has allowed for increased crop productivity in agriculture. However, because of their frequent application onto agricultural lands, their environmental fate is of particular interest. Pesticides have been ubiquitously detected in natural waters throughout Europe as well as in water supplies, which suggests these pesticides may be more mobile and persistent than their initial evaluations indicated. A potential reason for the mischaracterization of these pesticides’ persistence may be the environmental fate of the 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 photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

**WE065**

Study Design Considerations for E-Fate Testing of UVCB Substances

C. Lowrie, Charles River / Environmental Fate and Metabolism

Substances of unknown or variable composition, complex reaction products or biota. In this case, UVCB data is produced for the exemplars which can not fully identifiable and their composition may be difficult to predict. Under REACH Registration, it may be necessary to test these substances, which from many perspectives represents significant challenges. Reference is made to REACH Regulations and in particular Annex VII Section 9.2 where a series of degradation studies are proposed including simulation testing in surface water, soil and sediment. This approach is commonly used fungicides investigated, the results show that both direct and indirect photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides. In this study, a new natural degradation pathway of atrazine and the potential mechanism are proposed. Atrazine was oxidized under simulated solar irradiation by indole-3-acetic acid at the environmentally relevant concentration under aerobic condition. The reaction was initiated by the production of hydrated electrons generated from the photoreduction of indole-3-acetic acid, and then this species transformed into hydroxyl radical after a series of radical reactions with proton and dissolved oxygen. During this process, the presence of montmorillonite greatly enhanced the yield of hydrated electron and promoted the further degradation of atrazine by hydroxyl radical. The novel reaction is to some extent affected by pH and the type of exchangeable cation present on montmorillonite. Based on our results, we hope to gain knowledge on the role of amino acids in natural environments. The possibility of applications for the development of new materials may be considered.
descriptors. The choice of phenols is motivated by the fact that they are the most likely compounds to undergo triplet-sensitised phototransformation in sunlight surface waters. Results show that the reaction rate constants with $^3$AQ5S$^-$ and $^4$ICBP$^-$ give the best QSR models that can be used to simulate the photodegradation of phenols and similar compounds in the presence of CDOM. Quality differences in the QSARs generated for these reactions are probably due to differences in the chemical structure of the four 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.

**WE067**

In silico Tools to Assess the Confidence of QSR Model Predictions

R. Klung, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry; S.S. Kutsarova, O. Mekenyan, University of Zlatarov / Laboratory of Mathematical Chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Ecological Chemicals.

For the regulatory acceptability of QSR predictions solid information about the reliability of the applied models is crucial. This regards the model in general as well as the particular prediction for a certain chemical. The presented study provides computerized tools to support the assignment of prediction reliabilities. The first topic of concern is the applicability domain. Generally, the applicability domain comprises various aspects. The focus of this presentation is on the mechanistic domain and on the chemical domain in terms of structures and substructures. In particular, the application of atom-centered fragments (ACF) is demonstrated. While ACF characterization of the general structural domain of a training set is established already, the approaches shown here provide more specific information about the reliability of a prediction. On one hand, this is achieved by extending the ACF concept to the training set. Furthermore, sets are separated into subsets with regard to performance or value ranges, and these subsets are employed to derive advanced reliability indicators. Secondly, automatically obtained model selectors can assist in selecting the presumably best-performing model from a model suite for a certain chemical depending on its structure and properties. Model selectors in this regard are computed scores derived from application of the model suite to chemicals with known experimental data. Thirdly, consensus modelling strategies are presented and examined to compensate for individual model errors. When combining predictions from different models, consensus outcomes can accordingly increase the levels of confidence, while conflicting outcomes are indicating lower reliabilities. In this respect, specific indicators should be added to the in silico method of Ecological Chemicals suites, and consensus approaches contribute to weight of evidence assessments. For all three aspects, working tools will be presented, and their performance will be demonstrated via examples from existing models and data sets. Acknowledgment: This study was financially supported by the European Union 7th Framework Program SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

**WE068**

Data Gap filling with ECOSAR in K-REACH compliance, a limitation and weakness

J. Ra, Korea Institute of Industrial Technology / Environmental Science and Engineering; H. Park, Korea Institute of Industrial Technology; S. ok, Kitech / Regional Office.

ECOSAR is a computer based QSR program developed by US EPA within the regulatory constraints of the TSCA. However, it is also used in the other country or organization such as EU, Korea, OECD, etc. for their regulatory purpose. We introduced ECOSAR program to generate toxicity data and fill the data gap for developing species sensitivity distribution of 20 organic compounds. However, ECOSAR shows more pragmatic than theoretical characteristic. Thus, we investigated whether this model shows acceptable results on the deficient data of 20 organic compounds or not. Therefore we collected published data for fish and daphnia available and compared their geometric value to the output of ECOSAR. Some chemicals show similar output value to experimental data within double scale but others show very large difference of 1,400 times higher value in ECOSAR output. The least predictable substance is acrylic acid where 4 experimental data are used for the geometric mean value. On the contrary, methyl hydrazine shows almost same for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the approval process of active substances, data-gaps have recently been identified by EFSA regarding Article 4, 3(b) of Regulation (EC) No 1107/2009: A plant protection product shall have no immediate or delayed harmful effect on human health ... directly or through drinking water (taking into account substances resulting from water treatment). In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidance documents non for experimental testing is available. Published EFSA 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.

**WE070**

Water Treatment - A Regulatory Challenge under Regulation (EC) No 1107/2009

F. Schnitzler, S. Dorn, J. Wilbuer, Dr Knoll Consult GmbH

Regulation (EC) No 1107/2009 aims to protect humans and the environment and lays down rules for the authorisation of plant protection products in commercial form and for their placement on the market, use and control. Plant protection products consist of or contain active substances, i.e. the molecules or materials responsible for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the approval process of active substances, data-gaps have recently been identified by EFSA regarding Article 4, 3(b) of Regulation (EC) No 1107/2009: A plant protection product shall have no immediate or delayed harmful effect on human health ... directly or through drinking water (taking into account substances resulting from water treatment). In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidance documents non for experimental testing is available. Published EFSA 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 vPvM substances. In order to identify PMT as a substance of concern 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 given a ranking. The simple presence of the substances on the candidate list is the most effective management strategy. With the protection of drinking water and pristine water bodies in mind, both bioaccumulation and mobility of persistent chemical substances are non-desirable. The environmental effect felt by bioaccumulative and mobile chemical substances varies both temporally and spatially, where mobile compounds can potentially accumulate in semi-closed drinking water cycles, while bioaccumulative compounds are able to accumulate in a closed loop system. 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
R. Holmberg, Danish EPA / Chemicals; E.B. Wedebye, N.G. Nikolov, Technical University of Denmark (DTU) / Division of Diet, Disease Prevention and Toxicology, DTU Food; K. Tyle, DK EPA / Chemicals
U. Germany, has initiated a tool to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PMT). The exposure potential and importance of fern of surface water (vPvM) and 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 persistency (P) algorithms as used for the persistency screening under PBT assessment was used. A new screening algorithm for very persistent substances (vP) was set up by adjusting the P screening algorithm. For mobility (M) and very mobile (vM) substances new screening algorithms were developed using the substance properties of water solubility (Sw) and the soil/sediment organic-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 the screening algorithms for P and M properties as 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 distinguish between vPvM and PMT substances in management. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish Qsar DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to address specific substance groups of interest; substances registered after the last REACH registration deadline; or address future modifications, if relevant, in the proposed vPvM/PMT criteria.

WE073
Identifying PBT substances amongst REACH registered substances
H. Amy, NGI / Environmental Technology; S. Hale, Norwegian Geotechnical Institute; A. Striffler, denkbares; D. Sättler, UBA / Section IV Chemicals; L. Schliebner, UBA; M. Neumann, German Environment Agency (UBA) / Section IV 2.3 Chemicals
The chemicals that have the greatest chances of appearing in drinking water are those that are mobile in the aquatic environment enough to enter drinking water sources and persistent enough to survive water treatment processes. Despite the group of substances and the ecological relevance of the market, there is very little consideration as to how to identify or categorize which of them are persistent, mobile and toxic. (PMT) and thereby pose a potential threat to drinking water. The list of REACH registered substances as of May 2017 was independently evaluated for their likelihood of being a PMT. The evaluation of persistent (P), very persistent (vP) or potentially persistent (i.e. Pscreen) was performed according to REACH guidelines. For mobility, a criteria of a measured (or estimated) log Koc was 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.

WE074
Recent Advances in Toxicology, Safer-Alternatives Assessment, Value-in-Use and Best Practice Guidance of Short-Chain Fluorotelomer-based Products for AFFF, Textiles and Other End-Uses
S. Korzeniowski, BeachEdge Consulting; J. Bowman, Fluorocouncil Per- and polyfluoralkyl substances (PFAS) is a term that describes a wide and diverse array of chemistry containing fluorine and carbon. The focus of this poster presentation will be on the fluorotelomer-based products of the PFAS group with six or less fluorinated carbons (“short chain”). Fluorotelomer-based products can be in either the polymeric or non-polymeric PFAS categories. Within the polymeric PFAS category, the fluorinated repellent products, including durable water repellents (DWRs), are found. Other fluorotelomer-based products perform exceptionally well and provide fire-resistant properties and critical properties on high-end performance garments, workwear, personal protective equipment and in medical applications. This project will highlight recent advances in toxicology, including multiple endocrine evaluations, safer-alternatives assessment methodology, analytical advances, challenges and success in the development of short-chain fluorotelomer-based products and an overview of their usage in firefighting, some critical uses. A perspective on when and how best to use these products, while at the same time minimizing the environmental footprint will be featured in this Poster Presentation.

WE075
LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoroalkyl acids in Veneto region (Italy)
F. Russo, M. Vazzoler, V. Groppi, Region Veneto, Direzione Prevenzione, sicurezza alimentare, veterinaria; F. Zanon, D. Prà, R. Lava, M. Mazzola, G. Onofrio, L. Da Rugga, ARPA Veneto; M. Bonato, University of Padua, Department of Biology and Department of Veterinary Medicine and Zootechnics; M. Malito, T. Gaeta, I. Santivito, L. Tallandini, University of Padua, Department of Biology; M. Carrer, L. Palmeri, University of Padua / Department of Industrial Engineering; N. Tornmen, University of Padua, Department of Biology; S. Valsecchi, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNRS; S. Pololessello, Water Research Institute-CNR / Water Research Institute
In 2013 the short-chain fluorotelomer-based pollution of surface- and drinking water has been discovered in a large area of the Veneto region, in Northern Italy. The most important source of pollution was identified in a fluorochrome 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 on the management of short chain perfluorinated compounds (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 to 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 all local 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.
The Groundwater of Hydrogeological Sub-Region II at Buenos Aires province, is well characterized from a physico-chemical perspective. Until today is well established that fluoride and arsenic are the main concerns related with the potential use as source of drinking water. However, an ecosystemic perspective that focus on their invertebrate communities and the ecotoxicity potential is missing at least in this subregion. In this work we showed the preliminary results obtained after the sampling and analysis of ten on 20 total wells projected to be evaluated. This area is known as Junín Formation, which consists sandy and silty sediments of silty loam of reddish brown to light brown color, very friable, and with scarce calcareous bodies of pedogenic origin. The Junín Formation of wind morphology constitutes an alternation of low elevations and depressions. Aeolian sediments, which belong to the Junín Formation (Aeolian Platense), normally do not exceed 5 m in thickness and usually have calcareous (coarse) levels. The alluvial and colluvial deposits (sandy silts, sands, gravels and blocks) have a reduced vertical and areal expression. The samples were characterized according their main anionic and cationic constituents, presence of glyphosate and chlorpyrifos, TOC, arsenic and fluoride. Also, cytogenetics and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eesena fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates founded. They were mainly oligochaetes, Copepods, Acari, Collembola, Insecta, Oligochaeta, Nematoda. A preliminary biotic and ecotoxic index were created to characterize each sampling well.

**WE079**

**Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study**

M. Hernández Zamora, Escuela Nacional de Ciencias Biologicas-I.P.N / Laboratoire d’Experimental Hydrobiologie; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biologicas-I.P.N / Laboratoire d’Experimental Hydrobiologie

**Aquatic and terrestrial ecotoxicological assessment of the quality of wastewater industrial reuse.**

Wastewater effluents: How research can improve risk assessment and regulation (P)

**WE081**

**Application of eco-genotoxicological and microbiological parameters for the assessment of the quality of wastewater industrial reuse.**

S. Caccioli, Italian Institute of Health ISS / Department of Environmental and Public Health; P. Kooij, KWR Watercycle Research Institute; K. Baken, KWR Watercycle Research Institute / CWG; A. Kolkman, KWR Watercycle Research Institute; P. de Voogt, University of Amsterdam / IBED

**We analyzed su**

**WE077**

**Chemical analysis, monitoring and toxicological evaluation of very polar compounds in drinking water and drinking water sources**

R. Sjers, KWR Watercycle Research Institute / Chemical Water Quality and Health; P. Kooij, KWR Watercycle Research Institute / CWG; A. Kolkman, KWR Watercycle Research Institute; P. de Voogt, University of Amsterdam / IBED

Very polar organic compounds are of special interest for drinking water utilities, since they are subcomponents that can be end up in drinking water. The distribution of persistent and mobile compounds in the urban water cycle is widespread since they can leach to groundwater and pass wastewater and drinking water treatment. Currently there is an analytical gap, a monitoring gap and a lack of toxicity data for persistent and mobile organic compounds (PMOC). We aimed to close these gaps by the implementation of a target HILIC-MS screening method for very polar compounds and quaternary ammonium compounds and a non-target HILIC screening. With these methods 45 samples from surface water, river bank filtrate, groundwater and drinking water in The Netherlands and Flanders have been analysed. Detected compounds include known contaminants melamine, urotropin, metformin and guanylurea and newly detected compounds cotinine, cyanuric acid and creatinine. Despite of the removal during drinking water treatment (>70%), these compounds were found in drinking water. One compound is introduced during treatment: dichloroacetic acid. Most compounds and highest concentrations were detected in surface water and drinking water produced from surface water. The monitoring data of the very polar compounds gives insight into the seasonal variation of surface water quality. For the detected pollutants a human toxicological risk assessment is performed and results will be presented.

**WE078**

**Beyond DEHP: High-molecular-weight phthalates and non-phthalate plasticizers in German Rivers**

R. Nagorta, Federal Environment Agency (UBA) / Water and Soil; J. Koschorreck, Umweltbundesamt

The phthalate plasticizer Di(2-ethylhexyl) phthalate (DEHP) is a well-documented ubiquitous contaminant and frequently regarded as the predominant plasticizer in the environment. The use of DEHP and other phthalates was banned in the EU because of their endocrine-disrupting activity. As a result, the production of these phthalates decreased significantly. In contrast, the global plasticizers demand is continuously growing. Market data show that high-molecular-weight phthalates are now extensively substituting DEHP together with various types of non-phthalate plasticizers. Previous investigations on plasticizers in the aquatic environment have largely focused on DEHP and selected low-molecular-weight phthalates. However, little attention has been given to the presence of other phthalates and non-phthalate plasticizers. In consequence, their occurrence in the environment, fate and effects of these alternative plasticizers in the environment. The objective of this study was to obtain spatio-temporal trends for DEHP and its substitutes in freshwater systems. We analyzed suspended particulate matter samples (SPM) for the presence of 23 plasticizers, i.e. 17 phthalates and 6 non-phthalates. Samples from recent years were analyzed from the German Environmental Specimen Bank (ESB), which covered 16 sampling sites from major rivers including Rhine, Elbe and Danube. Retrospective trend monitoring with archived ESB samples that were collected over the last decade enabled trend analysis for DEHP and its non-regulated substitutes. Today, the high-molecular-weight plasticizer Diisononyl phthalate (DINP) is the most abundant plasticizer detected in the SPM samples. Our results indicate a fast appearance of new plasticizers like Dibutyl phthalate, Diisononyl cyclohexane-1,2-dicarboxylate (DINCH) in freshwater environments and we identified several compounds, for instance Di(2-propylhexyl) phthalate (DPhP), as potential chemicals of emerging concern with increasing levels.
Pharmaceutical residues in sewage effluents pollutes the aquatic environment and may adversely affect fish populations. Conventional sewage treatment plants (STP) are not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBP) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale parallel ozonation line. To investigate endocrine, reproductive and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₃/L).

We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day-night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformedities and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent contained both organic and a nitrogenous component that induced adverse effects.

Major aim was to investigate endocrine, reproductive and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₃/L).

We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day-night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformedities and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent contained both organic and a nitrogenous component that induced adverse effects.
Weighted, homogenized and centrifuged for the determination of hydroperoxides, lipoperoxides, carbonated protein content, and the antioxidant activity of superoxide dismutase and catalase, results shown statistically significant increments regarding control group in all the biomarkers evaluated, thus indicates that the hospital effluent tested in this work can generate oxidative stress on Xenopus laevis larvae, based on the results obtained, hospital effluents can generate oxidative stress in other species and due the lack of appropriate WWTP hospital effluents can represent a risk for aquatic organisms.

WE086
An assessment of (anti-)androgenic activity in sludge from a rain spillway basin of the WWTP Aachen Soers as well as in sediments from the catchment area of the recipient water, the river Wurm
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Hormonally active micropollutants (MPs) are 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 sludges in sewage treatment plants. To be able to detect 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 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 a 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 androgenic anti-potential as well as cytotoxicity in the highest concentrations of the samples. The full depiction of the (anti-)androgenic activity in the catchment area of the Wurm will be available at the time of the conference.

WE087
Processes underlying the environmental fate of pharmaceuticals in the Nairobi River Basin “impact zone”: implication for environmental risk assessment
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Recent investigations have highlighted the widely-spread occurrence of active pharmaceutical ingredients (APIs) in African water bodies. Wastewater (treated or otherwise) is the main source of APIs to the environment and identified heavily contaminated areas have been ascribed to the poor African wastewater treatment facilities (WWT). The formation of so called “impact zones” is severe in urban areas characterized by informal settlements with little in the way of wastewater treatment. The Nairobi River Basin (NRB) is an example of such impacted areas. The wastewater generated from the city’s informal settlements and the insufficient WWT is directly discharged in the Nairobi River basin leading to a large-scale “impact zone” characterized by occurrence of high levels of ammonia, biochemical oxygen demand and low dissolved oxygen and commensurately elevated levels of APIs. Also, the presence in this area of industrial wastewater 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 individualization of eventual bacteriological community shifts as an effect of the direct discharge of untreated wastewater loaded with APIs. In addition, since preliminary studies on the biodegradation of the anti-tertrevirapine, commonly used in Africa, has showed persisterly (similarly to studies on the antiepileptic carbamazepine in Western countries) the occurrence of nevirapine will be studied to test its suitability as indicator of sewage pollution in African river bodies. The identification of other APIs in this study contributes to the development of a methodology for the determination of the impact zone spatial boundaries and a dedicated environmental risk assessment approach for APIs in the impact zone.

WE088
Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis
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Combined sewer overflows (CSOs) are controlled releases of raw, untreated wastewater to a river during times of heavy rainfall to avoid back-flushing of buildings and streets. The impact of CSOs on a river catchment with respect to pharmaceutical residues is not well understood. In London, CSOs occur ~12 times per week as its Victorian sewage 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 evidence of degradation and transformation products; (b) determination of 30 pharmaceutical and metabolite occurrences in influent and effluent wastewater; (c) screening for CSO markers in receiving river water over a six-week period; (d) screening to identify metabolites/transformation products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent, four CSO markers were identified including caffeine, bezafibrate, benzoylegogmine and furosemide which were present only in influent at relatively high/consistent concentrations. Following this, targeted analysis of the River Thames samples revealed that CSO marker concentration increased mainly during wet periods where the tide was low. A further 14 compounds were also determined to observe any ‘dilution effects’ related to CSO plumes. 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 analysis facilitated an understanding of complex occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CPB Martins, AM Edge, DA Cowan, LP Barron, J. Chromatogr. A, 1396 (2015) 34–44

WE089
Occurrence, fate and bioactivity of pesticides in wastewater
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Unlike for contaminants of emerging concern (CECs), data available for the occurrence, fate and bioactivity of pesticides (herbicides, fungicides, and insecticides) in wastewater treatment plants (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 using the yeast strain Y1016) we investigated six pesticides as wastewater effluents treated using secondary treatment or ozonation was investigated. It was found that of the 12 pesticides showed either antitestrogenic or antiandrogenic activity and 7 compounds showed pleiotropic effects. This study was first to confirm endocrine activities based on yeast-based assays of recent neonicotinoids. The use of extended time points for the Vibrio fischeri, beyond the traditional 30 minutes, highlighted the necessity for some compounds was underestimated using only the acute test. Using a structure-activity relationship approach similar to the one used in hazard assessments, the relationship between toxicity and key 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.
and treatment performance.

WE090

Fate of perfluoroalkyl substances within a small stream food web affected by sewage effluent
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Within our experiment, the fate of fourteen PFASs was studied in an ecosystem of a small stream affected by STP’s effluent. The unique field experiment design was carried out to allow long-term studies focused on bioaccumulation of PFASs in indicator organisms and their ability of adaptation to the polluted environment. Two hundred brown trouts (Salmo trutta) originating from clean site were stocked. They were recaptured after one, three, and six months they spent in the environment affected by the effluent of that local STP. Besides the fish stocked into the polluted locality from the clean site, also fish originally inhabiting the downstream locality and macroinvertebrates from both sites were sampled and analysed. Passive sampling approach using polar organic chemical integrative samplers (POCIS) was applied to determine occurrence of PFAS in water soluble fraction over the course of the experiment instead of conventional grab water samples. Twelve of the fourteen target PFASs were found in concentration above the LOQ in at least one of the two localities (from downstream locality while only three were present in samples from clean site. The compound pattern varied significantly between fish, species of macroinvertebrates, and POCIS indicating several exposure pathways leading to bioaccumulation of PFASs in fish body. Concerning the accumulation of PFASs in fish, the highest concentrations were found in the liver of individuals sampled after three months of exposure. These concentrations rapidly decreased after six months although there was no significant change in occurrence of PFASs in water during the experiment. Such finding can be linked to both increase of water temperature leading to higher enzymatic activity and adaptation of studied fish to the polluted environment. Based on our results we also suggest that the process of adaptation might be related to the gender of fish as we found significantly higher accumulated content of PFASs in male fish at first moment of exposure. Acknowledgements: The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic - projects "CENAKVA" (No. CZ.1.05/2.1.00/01.0024) and "CENAKVA II" (No. LO1205 under the NPU I program) and by the Ministry of Agriculture of the Czech Republic (NAZV "KUS" No. Q1530120).

WE091

Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin
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The Adriatic Sea has been under intensive influences of human activities, which are pressuring the marine ecosystems as a whole. The morphology of this land-locked marginal sea and the intensity of human pressure on its coastline influence enhances the trace metal concentrations on sediments giving rise to pollution effects especially in the northern Adriatic Sea. This work was developed under the PERSEUS EU Project (Policy-oriented marine Environmental research in the Southern European Seas), guided by the Marine Strategy Framework Directive (MSFD), which aims to achieve the Good Environmental Status until 2020 in European water bodies. Spatial and historical tendencies of sedimentary trace metals (Zn, Pb, Cu, Cr and Ni) and their characteristics (e.g., grain size and organic carbon) were assessed in recent layers and dated cores from western Adriatic Sea to reconstrcut their sources, transport and accumulation. Our findings suggest that the Po River prodelta acts both as a bypassing and accumulation zone and exports ~30% of trace metals associated with fine particles southward, being mainly accumulated in the coastal mud wedge of the Central Adriatic. Based on the outcomes of this study, the area in the Po River vicinity could be considered an area of concern especially related to Zn and Pb accumulation. According to the requirements of the Marine Strategy Framework Directive (MSFD), we proposed a long-term monitoring plan, with a pluriannual temporal frequency (e.g., 5 years), suitable to point out possible changes in metal accumulation in the western Adriatic Sea. The anthropogenic signal of Pb and Zn can be recognized in sediment cores from the northern down to the Gargano Promontory, ~500 km away from the metal sources, with a delay of ~10 years. In line with many systems around the world, we observed a recent decrease in trace metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW) in deep sea areas of the southern Adriatic, which could 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

Photoacatalysis as a potential pre-treatment process to reduce organic pesticide entry
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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 exposed to sunlight. This is a major threat to major goals of the EU Water Framework Directive, aiming to increase the quality of surface water bodies. Hence, tools to counteract this difficulty are needed. A targeted application of photocatalysis as pre-treatment is one promising approach to reduce PPP loads directly in wash waters from AM. Thereby, PPP concentrations and associated toxicity can be reduced prior entering aquatic ecosystems via wastrates. In this pre-treatment photofenton process, TiO2 and other photocatalysts (Aeroxide P25 and Hombikat UV100) were used for photocatalytic destruction and efficiency of different commercial TiO2 photocatalysts (Aeroxide P25 and Hombikat UV100) to date performed photocatalytic treatment process to reduce organic pesticide concentrations and major metabolites before and after a combined TiO2 × UV treatment. Therefore, UV-visible absorbance spectroscopy, Total Organic Carbon (TOC) measurement and liquid chromatography was used. Further, to assess for the photocatalysts’ efficiency, acute toxicity tests were conducted. In detail, Daphnia magna was exposed for 48 h to (un-)treated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytical treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 to reduce PPP concentrations and associated toxicity in water, which was treated by UV light. This is a proof related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

WE093

Study of the efficiency of removal of organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland
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This project combines different options for energy generation through the degradation of industrial and domestic effluents using electroactive microorganisms, these systems coupled to build wetlands (BES/CW) acquire the capacity to treatment effluents of various kinds. Although several studies have been 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 cm². The distance between both electrodes was 6 cm without proton exchange membrane, both electrodes were connected by a resistance of 1000 Ohms. The feeding was performed by gravity applying four pulses of 1.5 L/h using synthetic water whose composition was similar to date reported by Yadav et al., (2012). The effect of two types of contaminants was evaluated azo dye (AD) and alkylphenols (AP), the voltage measurements were made daily after 20 days of operation, the time necessary for the development of the biofilm (from 9:00 h in intervals of 2h). The
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mA/m² and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13:00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a suitable option for the production of energy from domestic wastes for secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto a Sawdust-Based Adsorbent

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Wastewaters from textile and other dye-using industries usually contain more than one dye. In such an aqueous matrix therefore, the adsorptive characteristics of a dye species are likely to be affected by the presence of the other dye species in the medium. The removal of crystal violet from aqueous solution by sulphuric acid treated sawdust, ionic in nature, and the influence 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 interpreted using artificial neural network (ANN) analysis of variance (ANOVA) statistical concept. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolourisation of 68.39 mg/L CV (97.2%). A linear model was obtained for the decolorization process through this design. The experimental values obtained were in good agreement with predicted values, and the model developed was highly significant, with correlation coefficient of 0.985. The adsorption in all the dye systems investigated followed Freundlich isotherm, and the maximum monolayer adsorption capacity was between 18.87 - 24.39 mg/g, depending on the composition of the adsorbate matrix. The adsorption kinetics was well described by the pseudo-second order model (R² > 0.95). All the eight adsorbate systems investigated were endothermic (ΔH positive: 35.30 to 43.66 kJ/mol), thermodynamically feasible (ΔG ≤ -2.36 to -6.13 kJ/mol) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

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Discharges from wastewater treatment plants (WWTPs) are a source for pollutants to the environment. Here we studied influent patterns and removal of selected elements in two Norwegian WWTPs, Ladehammeren (LARA) and Høvringen (HØRA) in Trondheim, Norway. Both WWTPs have significant industrial loading contributions (up to 40% in LARA), employ preliminary and primary treatment steps, including chemically aided flocculation (ClFeO₃) and sludge samples, were taken to determine influent concentrations and removal of Al, P, S, Cr, Fe, Ni, Cu, Zn, As, Cd and Pd. To study release patterns and gain information about potential sources, diurnal variations of elemental concentrations were determined and modelled in 8 h composite samples of raw wastewater from 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. pulicaria. No significant differences in feeding rate between the sampling sites was recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the mutagenic and endocrine effects originates by dissolved or particulate matter as 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.

WE096 Rapid detection of E. coli in wastewater effluent and impact of effluent discharge on riparian invertebrate diversity

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Effluent samples from wastewater treatment plants are expected, due to the treatment processes, to have lower concentrations of toxicants and pathogens than the influent. As such, they are expected to have a lesser impact on the environment than the influent. The aim of this study was to seasonally assess the efficiency of Phuthaditjhaba’s wastewater treatment 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 Phuthaditjhaba’s wastewater treatment plants in removing pathogens from its effluent. Further identification and presence or 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

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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 may cause various effects on the aquatic biota. To decrease the influence 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 River Wurm. For the determination of MPs, an HPLC-method was developed. 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. pulicaria. No significant differences in feeding rate between the sampling sites was recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the mutagenic and endocrine effects originates by dissolved or particulate matter as 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 dredging

M.H. Wegelmans, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system,
many sewage overflows into surface water are present. Sediment located 250 m before and after the overflow needs to be discarded and burnt after dredging while ‘normal’ sediment can be reused as soil. Discard and burning is expensive for waterboards, besides the fact that it costs a lot of energy and causes air pollution due to transportation, which is not sustainable. Also it causes a loss of raw materials. The water board Noorderzijlvest has started a pilot for reusing sewage overflow dredgings as soil for construction purposes or agriculture. For this purpose two depots have been set up: on with reference sediment and one with overflow sediment. During one year the concentrations of pharmaceuticals and pathogens will be monitored as well as antibiotic resistance and endocrine disruption. The basis of the project is the hypothesis that pathogens will be killed during the process of drying and pharmaceuticals will be (biologically) degraded which makes the project a proof of concept. In June 2017 the sediments from both depots were sampled and analysed. In October dredging was performed and the pilots have been set up. The first monitoring round was performed one week after set up. In each monitoring round chemical analyses are performed on pharmaceuticals. Pathogens are identified by both culturing methods and Next Generation Sequencing (NGS), combined with viable PCR analyses to quantify specific pathogens that have been identified by NGS. Antibiotic resistance will be monitored by means of ESBL (extended Spectrum Beta-Lactamase) measurements. Endocrine disruption will be monitored by means of ER-Calux tests. In the presentation the background of the project will be sketched, then the results of the monitoring until May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for reuse possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at oil refinery industry in Kazakhstan
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This paper presents the first attempt to assess the wastewater treatment processes at the oil refinery sector in Kazakhstan and evaluate to what extent these processes follow international and national regulations regarding industrial waste water treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan’s environmental regulations promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. The national regulation allows discharge of wastewater to natural or artificial ponds by not exceeding the pollutant concentrations already existing in the pond. Therefore, the factories use ponds for wastewater treatment or for storage of pollutants, consequently allowing discharge of high concentration of pollutants (total petroleum hydrocarbons (TPH) exceeds concentration by 30-80 times, ammonia (NH₃) by 25 times, total dissolved solids (TDS) by 6 times, biochemical oxygen demand (BOD) by 6 times and surfactants by 5 times) to pond. The reason for the initial high pond concentration is a result of a time gap between the start of pollution discharge by the factories and there is no analysis done for different hydrocarbon fraction. Consequently, it is strongly recommended to provide a unified and transparent methodology to assess the pollutant substances in the discharged wastewater. Thus, the assessment by environmental authorities for each oil refinery is negotiated separately between the factory and the governmental body, giving the factory a strong position to define the parameters assessing the wastewater. As such, the choice of the factories provides analyses of, e.g., heavy metals, mercury contamination in discharged wastewater. TPH concentration in wastewater is often exceeded at each factory and there is no analysis done for different hydrocarbon fraction. Consequently, it is strongly recommended to provide a unified and transparent methodology for the country’s oil refinery industry to assess all important pollutants in discharged wastewater and to include all types of hydrocarbon fractions.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health (P)

WE100 Accumulation of Enrofloxacin in the sea lettuce Ulva lactuca
J. Rosa, University of Coimbra / Department of Life Sciences; S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences University of Coimbra; A. Freitas, J. Barbosa, INIAV- Instituto Nacional de Investigação Agrária e Veterinária; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria; M. Partida, CFE-Center For Functional Ecology / Department of Life Sciences University of Coimbra; F. Ramos, Faculty of Pharmacy University of Coimbra The demand for food products is pushing aquaculture to increase its production throughout the world. The increase in production can lead to negative effects since much more fish are growing in much smaller places. Aquaculture is still highly associated with the frequent use of chemical compounds in water, either to treat or prevent disease outbreaks in culture ponds. Integrated multilocus aquatic systems (IMTA) can be a suitable approach to fish production, since one can have 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 antibiotics 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 IMTA systems can be used 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 manure can be transferred to the environment. As manure rich in pathogens, they can be a medium to 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 GeneAmp Real-Time PCR system. The ΔCt values, ΔACt 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 (mg L⁻¹ to low μg L⁻¹), they have been specifically designed to be biologically active at low concentrations in human and veterinary medicine and therefore it is reasonable to think 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

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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 after chronic time exposure to organisms along the post-depuration process. 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-GP activity and LPO levels), detoxification (GST activity) and neurotoxicity (AChE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam *S. plana*.

**WE103**

**Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies**

E. Han, D. Lee, Seoul National University / Environmental Planning Institute

In recent decades, pharmaceuticals in the environment have been concerns for environmental protection. Especially in the environment, the antibiotic residues 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 Residues of Antibiotics usage has been decreased since the enforcement of these policies, the assessment for these policies in view of environmental risk has not been performed yet. In our previous work (1), an emission prediction model for calculating the predicted environmental concentrations (PECs) of the active pharmaceutical ingredients (APIs) used not only for human but for veterinary purposes was presented. For veterinary usage, the model covers pharmaceutical life cycle posterior to consumption, including direct discharge, manure composting, and land application over the agricultural soil. The emission model was combined with SimpleBox and SimpleTreat into a single spreadsheet-type model for calculating the PECs. In the present study, antibiotics which are of top 26s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy about pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Han; Dong Soo Lee, Application of emiss

**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/selected to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (ARPI) proved not to be sensitive for antibiotics) are used to represent all bacterial diversity. There is therefore concern that the potential impacts of antibiotics on environmental health are not fully considered in ERA. We have developed a microtiter assay that broadly follows and meets the validity criteria of the OECD 201 test guideline as a cost effective way to determine the effect of antibiotics on cyanobacteria growth. We applied this assay to determine growth inhibition in a wide range of bacterial species; 2) differences in cyanobacteria sensitivity to antibiotics can span several orders of magnitude; and 3) the current framework for ERA of antibiotics inadequately addresses the risk to bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established.

**WE105**

**Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum**

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Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macroinvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., via altered microbial activity and/or microorganism-mediated food quality). However, relatively little is known about these effects on shredders. Therefore, we performed a comprehensive study involving three experiments, which aimed at unravelling the importance of waterborne and diet-related effects of the antibiotic ciprofloxacin (CIP) on the model shredder Gammarus fossarum. During a 7-day feeding activity assay, we assessed the effects of waterborne CIP exposure on gammarids' survival and feeding activity, while alterations in leaf palatability for *G. fossarum* due to microbial colonization of the leaves in the presence of the antibiotic were investigated using food choice assays (i.e., diet-related pathway). Furthermore, during a long term assay of 24 days, sublethal effects (the shredders’ energy processing and physiological fitness) were assessed when either subjected to a direct antibiotic or to waterborne exposure. A treatment where the animals received shredded 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' leaf consumption and growth were significantly affected when subjected to the diet-related pathway. Our data indicate that indirect effects of antibiotics on shredders via the diet-related effect pathway could be more relevant than waterborne exposure. Since shredders play a key role in the leaf litter breakdown of heterotrophic stream ecosystems, diet-related effects might result in implications for the energy dynamics of these systems.

**WE106**

**Efficacy of removal antimicrobial resistance genes during avian manure composting process.**

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Antimicrobial resistance (AR) is an emerging and global problem. Therefore, there is currently a remarkable effort to understand the mechanisms of resistance, to promote the responsible use of antimicrobials and to seek effective therapeutic alternatives. While most livestock studies are focused along the food chain, there are few available studies about the role of livestock manure in the spread of AR. The direct application of animal waste (or slurry) to crops may favor the transmission of AR from cattle to vegetables. The objective of this work is to evaluate the impact of the composting process on the persistence of AR genes. For this, a composting of 10 weeks of duration has been carried out from straw and avian manure. Composting samples were taken in triplicate at the end of each week, and total DNA was extracted from each. 22 genes coding for resistance to tetracyclines, sulfonamides, phenicols, aminoglycosides, quinolones, beta lactams, vancomycin and colistin were detected and quantified by real-time PCR. 16 of the 22 genes were detected in at least one sample. Analysis of the temporal evolution of the resistances shows that there is a marked reduction (> 97%) in the genes coding for tetracycline, b-lactam, quinolone and macrolide resistances, while an increase in aminoglycoside and sulfonamide resistance genes is observed. These genes usually form part of integrons, which have more persistence into the environment. Besides, we have found positive correlations among almost all ribosomal protection genes and with the deactivation genes; whereas efflux pump genes were positively correlated among them, suggesting that the persistence of antimicrobial resistance genes could be related to their mechanisms of action. In conclusion, although the composting process does not end up eliminating the AR genes, it can be considered a alternative to the environmental management of the avian manure. RTA2014-00012- C03-02 and S2013/ABI-2747.

**WE107**

**Environmental Assessment Of Multi-Class Pharmaceutical Residues In the Tejo Estuary**

S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences
University of Coimbra; A. Freitas, A. Vila-Pousa, INIAV- Instituto Nacional de Investigação Agrária e Veterinária; J. Rosa, CFE Centre for Functional Ecology / Department of Life Sciences University of Coimbra; J. Barbosa, INIAV- Instituto Nacional de Investigação Agrária e Veterinária; 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 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 antipsychotic, hormones and anxiolytics. The objective of this work focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in Spain according to the technical prescriptions of the authorized products. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EMEP/CVMP/ERA/418282/2005). 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 PE(ES) for ENR (443 μg/g), 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 this results is discussed and the effective exposure to CIPR is proposing in battery cages is indicated to minimize the risk of these drugs. This work is funded by RTA2014-00012- C03-02 and S2013/ABI-2747.

WE109 Evaluating the use of veterinary antibiotics in dairy environments to inform on antibiotic contamination of soil and groundwater

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The University of Nottingham owns a high throughput dairy farm with around 200 milking cows, from which the pressed liquid waste ends up in a 3,000 m³ slurry tank. Contained within the slurry we can find antimicrobial foot washings, waste milk and bedding particulates (among other components). Large volumes of liquid slurry are produced in farms and this waste material is commonly applied to fields as a fertilizer in the UK. The health of a dairy herd is supported by the administration of antibiotics so the dairy farm setting works as an antimicrobial resistance (AMR) reservoir and as a route of entry into the environment. Antibiotics’ persistence in dairy settings occurs through mediums such as slurry, milk and subsequently, in soil via spreading. These routes can act as a channel for the transference of compounds and the inactivation of AMR within the food chain through intake by plants and migration to other sources via water run-off, possibly affecting the therapeutic effectiveness or increasing resistance against human and animal health. Therefore, the increasing soil retention of polar substances after soil amendment and the high persistence found for some antibiotics in batch experiments (e.g. sulfonamides), make further research on exposure assessment necessary along with the analysis of veterinary antibiotics in dairy environments in order to assist in shedding light on the long established concern of the environmental fate and behaviour of veterinary antibiotics in farming and to propose better handling practices as a basis for future regulations. The main objective of this study is to measure the distribution of select antibiotics currently in use within the farm environment, relating their presence to the length of use and the last date of prescription. For this purpose, specific optimized analytical methods including 19 antibiotics belonging to 10 different families were employed for clean-up and pre-concentration of different matrices (slurry,soil,milk) by means of liquid-liquid extraction, followed by solid-phase extraction (SPE) and identification and quantification by liquid chromatography-mass spectrometry (LCMS). For instance, several veterinary antibiotics under study were detected in wastewater slurry with concentrations up to 18.6 μg L⁻¹ for oxytetracycline suggesting a high number of antibiotic scenarios is being encouraged to implement in this first step towards a more comprehensive study. Summarizing, this is the first paper towards a more comprehensive study. Summarizing, this is the first paper towards a more comprehensive study.

WE110 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. Floeter, Hamburg University / Applied Sciences / Environmental Engineering

An increasing amount of pharmaceuticals are detected in waterbodies all over the world. Antibiotics are of special concern for the environment: Due to the high amount of medication, its specific activity against prokaryotes and a possible antibiotic resistance formation in the environment. Cyanobacteria have prokaryotic antibiotic target structures of antibiotics and are of high importance for the primary production and nitrogen cycle in marine waters. To investigate the long term effects of antibiotic exposure on limnic and marine cyanobacteria, the limnic cyanobacterial test according to OECD 201 and the marine cyanobacteria test described by Heseding et al. (2016) were performed. Exposed cultures were recultured at the end of the test and then recexposed to the same antibiotic active substance as part of a repeated test. As test organisms Synechococcus elongisporus (limnic cyanobacteria) and Synechocystis spec. (marine cyanobacteria) were selected. The tests were carried out on a 24-well microwell plate. In the test, the percentage inhibition of the growth rate (cell number) i.e. summarised in the respective negative control over a period of 72 hours. The derived EC50-values after repeated exposure were compared for different antibiotics of environmental concern. The investigations are carried out as part of the PharmCycle project.

WE111 Impact of antibiotics on the feeding rate of the freshwater shrimp Gammarus pulex

G. Consolandi, University of Portsmouth; M. Bloor, University of Portsmouth / School of Earth and Environmental Science; A. Ford, University of Portsmouth / Biological Sciences

Antibiotics are one of the main categories of pharmaceuticals and their release into the freshwater environment can impact the natural bacterial and fungal communities, which can threaten the survival of organisms that rely on them as a food source. One such organism is the freshwater detritivore Gammarus pulex that commonly feeds on detritus such as, naturally conditioned media such as slurry, milk and subsequently, in soil via spreading. The feeding rate of Gammarus pulex was altered when their food source (Alnus glutinosa) was exposed to environmentally realistic concentrations of antibiotics during the natural leaf conditioning process. An increasing amount of pharmaceuticals are detected in waterbodies all over the world. Antibiotics are of special concern for the environment: Due to the high amount of medication, its specific activity against prokaryotes and a possible antibiotic resistance formation in the environment. Cyanobacteria have prokaryotic antibiotic target structures of antibiotics and are of high importance for the primary production and nitrogen cycle in marine waters. To investigate the long term effects of antibiotic exposure on limnic and marine cyanobacteria, the limnic cyanobacterial test according to OECD 201 and the marine cyanobacteria test described by Heseding et al. (2016) were performed. Exposed cultures were recultured at the end of the test and then recexposed to the same antibiotic active substance as part of a repeated test. As test organisms Synechococcus elongisporus (limnic cyanobacteria) and Synechocystis spec. (marine cyanobacteria) were selected. The tests were carried out on a 24-well microwell plate. In the test, the percentage inhibition of the growth rate (cell number) i.e. summarised in the respective 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.
p=0.667) were not a concern in relation to feeding at environmentally realistic concentrations (scenario 1 and 3). (p=0.05). When exposed to a mixture of Sulfamethoxazole and Trimethoprim (scenario 2) there was an impact on the \textit{Gammarus pulex} feeding rate (Z=13.239, p=0.004). However, further investigation would be required to investigate these drugs individually to identify if the obtained results were driven by one or the combination, and also to establish if there is a genuine environmental concern associated to this mixture or if the data is blurred in some way.

**WE112** Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil

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Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulphonamide 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 (class 1 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 Mooi River: Flucanazole and fluconazole resistant pathogenic yeasts species

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The presence of yeast species in water sources that are associated with faecal pollution have been demonstrated. Some of the isolated species are potentially pathogenic and could cause superficial and life-threatening infections. Fluconazole on the other hand is the most used antifungal agent in the treatment of yeast infections as well as prophylactic agent to prevent Candida and Cryptococcus infection in HIV patients. The aim of the study was to determine yeast pollution, susceptibility of these to, and the levels of, fluconazole in the Mooi River, North West (South Africa). Yeast isolates were enumerated using membrane filtration, selective media and incubation at 37°C and identified using biochemical methods (staining and 26S rRNA gene sequencing). Resistance to fluconazole was determined by disc diffusion. Environmental DNA was isolated directly from water using membrane filtration and a commercial DNA isolation kit. Yeast levels as indicated by qPCR were measured. Fluconazole resistance was then assayed for two selected fungal species. Molecular analysis of the isolates was performed using 18S rRNA gene sequencing. The yeast identified has been associated with polluted waters. Some isolates in the present study are pathogenic and hold direct contact with polluted water could cause infections to immune compromised people and were all resistant to fluconazole. Quantitative PCR of the 26S rRNA gene indicated that a high number of gene copies were present at all sites. Fluconazole levels ranges from

**WE114** Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its impact on the microbial communities of an agricultural soil amended with organic waste products

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The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural soils and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feucheralsen (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 even higher in the OM amended samples, suggesting that OM contributes to antibiotics transport in soils. Batch degradation experiments revealed that SMX removal is quite fast with half-life values ranging between 18 and 350 days in non-sterile and sterile soils. This degradation process was shown to occur principally in both the coarsest and finest soil-size fractions, while almost no biodegradation was observed in the mass-dominant silt fraction of the soil in agreement with its low microbial biomass content. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, sul1 and sul2), DGGE fingerprinting and high throughput sequencing revealed important impacts of SMX on soil microbial biodiversity and species richness and the emergence of specific taxa, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil, SMX can penetrate mobile DOM with enhanced mobility in presence of added OM. SMX appeared also quite readily biodegradable, especially when in contact with coarse and fine soil size fractions, where it had the strongest impact on soil bacteria. Keywords: Antibiotics, SMX, organic matter, impact, DGGE, Miseq, ARG, biodegradation

**WE115** Risk assessment of antibiotic resistance and related genes in human impacted environments

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The origins of antibiotic resistance in the environment is relevant to human health because of the increasing importance of zoonotic diseases as well as the need for predicting emerging resistant pathogens. Antibiotics are used in diverse settings for food production. Domestic animals are treated with antibiotics for both curing disease and promoting growth. Aquaculture uses antibiotics to manage infectious disease. Wastewater treatment plants receive sewage from various sources, including hospitals and households which are both important sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance is complicated. It should include at least quantitative information of the gene, sequence of the gene, host cell of the gene and genetic environment of the gene (e.g., mobility of the gene). Resistant genes, have significantly contributed to the escalation of life threatening infections targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening infections, making the development of new antibiotics even more crucial.
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spurring serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there 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 identified environmental matrices enriching the occurrence of resistance genes (e.g. water surface). Interestingly, there are cases where gene variation is weakly correlated with antibiotic concentration (e.g. sediment) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of selection pressures (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

WE117
Sulfamethoxazole degradation in river water microcosms and effect on the natural microbial community

The widespread use of antibiotics causes concern on their occurrence and fate in different environmental matrices. Following administration, antibiotics are only partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (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-induced or the consequence of selection pressures (e.g. via urban effluents) or natural 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 g/L of SMX. At fixed times, water sample were collected for chemical (SMX residual concentrations) and microbial analysis. The disappearance time of 50% of the initial SMX concentration (DT50) and the effects of the antibiotic 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 (t=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 the ARG spread is a physiological adaptation of natural microbial community to its presence.

WE118
The indiscriminate use of antibiotics in the aquaculture sector has raised public concern because of possible toxic effects, development of bacterial resistance, and accumulation of residues in individual tissues. Even if several countries have developed regulations about their use, it is clear that long-term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. Alternative strategies for better management of antibiotic administration are of primary interest to improve absorption rates and, as a consequence, to avoid their release into the aquatic environment. The present study investigates, for the first time to our knowledge, a new methodology for oxytetracycline (OTC) administration through the use of iron oxide nanoparticles (NPs) (made of magnetite γ-Fe₃O₄) in zeafish (Danio rerio). Fish were divided into 4 experimental groups: control; group A exposed to 4mg/L OTC (through water), group B exposed to 10mg/L OTC, group C exposed to 40mg/L OTC, and group D exposed to 100mg/L OTC. HPLC analysis, histological analysis and other methods were applied to perform different evaluations. No detoxification processes or anatomical alterations were observed in fish exposed to bare NPs. Exposure of fish to the SAMNs@OTC complex resulted in a 10 times higher OTC accumulation with respect to using water exposure. This new method for OTC administration seems more efficient with respect to the traditional way of exposure and shows the potentiality to reduce antibiotic utilization and possible environmental impacts.

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

WE122 Identifying and Controlling Sources of Ultra-Trace Metals in Control Blanks and Ensuring High-Quality Data for Sensitive Environmental Risk-Based Decisions
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The control of blank contamination is a necessary requirement when evaluating the qualitative and quantitative accuracy of analytical results for decision-making purposes of site delineation, toxicological evaluations, and site remediation. This control is essential to differentiate actual site concentrations from potential sources of contamination, including soil 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 relating 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 the equipment rinse blank. This presentation will provide details of the investigation process and resulting implementation of several important corrective actions.

WE123 Comprehensive Analysis of Elemental Contamination in Environmental Samples through Solvent-vapour Liquid-liquid Micro Extraction (ICP-MS)

The analysis of elemental contamination is a significant task for laboratories working in environmental analysis. Besides direct regulation of contaminant levels, for example in waters, also a number of other sample types must be screened, such as aquatic 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 quadrupole ICP-MS, for the analysis of environmental samples. Dedicated software solutions, such as tools to simplify method development, increase productivity or tackle advanced applications, such as chromatography, nanoparticle analysis, will be presented to show the breadth of accessible applications using modern ICP-MS instrumentation.

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES
L.R. Diniz, Universidade Estadual do Maranhão / Agroecology; L. Capellini, Universidade Federal de São Paulo UNIFESP / Departamento de Química Fullerences are allotropes forms of carbon produced in highly energetic processes of pyrolysis, laser ablation or origin anthrophogenic sources. In the last years, the increasing application of nanomaterials in several areas of human endeavor besides their physical and chemical properties, contribute for the growth of the global economy. However, the growing production and application of nanomaterials is also promoting discussions about the possible risks of these compounds to the environment and human health. Data have already been reported on the occurrence of fullerences in different matrices, including the atmosphere, soils and sediments, and fresh water. Despite this, little information has been related to marine environments while coastal areas and estuaries are suspected to be one of their major sinks. The purpose of this study is developed and optimize an analytical method to evaluate the presence of nanofullerene (C60) in seawater samples. It will be tested two methods of extraction: (1) supersonic liquid micro (DLME), and (2) QuEChERS, after, all the samples will be analyzed by liquid chromatograph tandem mass spectrometry (LC-MS/MS). Keywords: Marine pollution. Fullerences. 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 recently reported. 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 by using high-performance liquid chromatography tandem mass spectrometry (LC-ESI-MS/MS), ultra-performance convergence chromatography (UPC2®) and combustion ion chromatography (CIC). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE127 Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylene (PTFE) membranes
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Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring technique. Traditional grab sampling followed by laboratory extraction and instrumental analysis is well established method, but only provides a snapshot of the water quality status. Achieving representative sample with grab sampling takes considerable labour, time and cost. Here, time-integrative passive sampling technique is recognized as a promising monitoring tool. Passive sampling technique allows the simple sampler construction and application, provision of time weighted average concentration and in situ sampling. Various configuration of passive sampling devices are currently available, one of which is the organic chemical integrative sampler (POCIS). POCIS consists of Oasis HBSS® sorbents 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 HBSS 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
in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APS were prominent, with mean concentrations of 4.90–266.24 ng/L in surface water and 5.07–14.73 μg/kg in sediment samples. Four M-APS were prominent, with mean concentrations of 0.97–29.92 ng/L in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APS (53.26%) > M-APS (25.39%) > SAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APS (42.70%) > M-APS (25.43%) > TCs (14.69%) > SAs (13.90%) > QNs (3.24%) in sediment samples, and M-APS (42.12%) > N-APS (34.80%) > SAs (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharged from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

WE131 Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea
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Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=2), fresh water (n=24), sediment (n=24), soil (n=24) and freshwater fish (n=27) samples were collected in Asan lake region, and the levels of PFCs in samples were analyzed. The freshwater fish were collected by using nets near wastewater treatment plants located between Pyeongtaek and Asan cities in Gyeonggi Province, and provides water for nearby industrial complex and agricultural areas. Two large streams join the lake and there are many industrial complexes near the streams. To analyze 16 PFCs, 2 samples were taken at each stream and 8 samples were taken at main lake. Analyses were carried out using LC-MS/MS after solid-phase extraction. The results showed that concentrations of ∑PFCs were ND–19.69 pm g⁻¹ (for ∑PFCs) in air, ND–447.8 ng L⁻¹ (for ∑PFCs) in water, ND–9.7 ng g⁻¹ dry weight (dw) (for ∑PFCs) in sediments, ND–7.7 ng g⁻¹ dw (for ∑PFCs) in soil, and ND–35.0 ng g⁻¹ dw (for ∑PFCs) in the fish, respectively. The predominant species among the PFCs were perfluorooctanoic acid (PFOA) in air, perfluorooctanoic acid (PFOA) in water, perfluorooctane sulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOS and PFOA were detected in all water, sediment, and fish samples. In air, 85% of total PFCs mainly existed as the gas phase compared to particulate phase. In water and sediment, higher levels of some PFCs were observed at the confluence of two streams, implying that anthropogenic activities from industrial complex in the upstream are the main source of contamination. Our study first reported the data of 16 PFCs levels in multimedia environment including air, water, soil, sediment, and fishes in Korea.

WE132 Seasonal changes in water and sediments' microplastics in a Mexican estuary (Tecolutla), L. Fischer Hernández, P. Ramírez Romo, U.A.M. Ixtapalapa / Hidrobiología 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 particles are efficiently transported through water. There are just a few MP studies in Mexican aquatic ecosystems, so the objective of the present work was to analyze the seasonal changes in numbers, size, color and form of the MP present in water and sediment of Tecolutla’s estuary. Water and sediment samples were collected in five different sites in three different climate seasons (northern storms, dry and rainy). In the laboratory water volume was measured and filtered through a cellulose filter (Whatman #40) filter, which was later dried at 50 °C for 24 h. Sediment samples were dried at 50 °C, a 40 g subsample was taken and hydrogen peroxide (30%) was added to disintegrate all organic matter, followed by a zinc chloride solution (ρ = 1.5 g/ml) to float the MP particles. Later the solution was decanted through a cellulose filter and dried at 50 °C for 24 h. MP particles on the filters were observed through microscope (Dissecting followed by digital Celestron) and photographs of the particles were obtained with imageJ software. Validation of the polymer identity was done through Scanning electron microscopy. MP size in water range from 10 to 1,730 μm, and their presence was higher in the northern storms season, followed by dry and rainy seasons with the highest numbers in a small tributary. Sediments had more MP and higher numbers in the dry season, with size ranging from 30 to 2,500 μm with highest numbers in the boat dock. Black was the most abundant color in both matrices followed by blue and red. Most MP were fibers. In conclusion MP were present in water and sediments year round, bigger particles were found in sediments and smaller in water. This is the first evaluation of MP in a Mexican estuary so continuing this type of research is important to
understand the biological significance of their presence.

WE133  
Simultaneous biodegradation of water treatment additives: Transformation and byproduct formation, impact of biocide shock dosing and salinity  
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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 uptake in cooling towers. Several treatment technologies such as reverse osmosis, electrodialysis and membrane distillation may facilitate the reuse of discharged brackish cooling tower water. However, cooling towers water contains different water treatment chemicals such as corrosion inhibitors, biocides and antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is the use of water treatment systems such as constructed wetlands (CWs). Biodegradation is one of the main contaminant removal mechanisms in CWs. However, the biodegradation potential of CWs for many of the water treatment chemicals is not well understood. In this study, the simultaneous biodegradation of different representative water treatment chemicals by bacteria from CWs was explored. The representative water treatment chemicals comprised of 1H-benzotriazole (corrosion inhibitor), DBNP4 (biocide), glutaraldelyde (biocide), PEG (surfactant) and HEDP (antiscalant). The following questions are addressed: Does shock dosing with biocides affect the CW biodegradation potential for the target chemicals? What is the influence of different salinities on the biodegradation of the target chemicals? Which signature microbial transformation products are being produced by single target chemicals that can be used as markers for the CW transformation processes? Does the presence of multiple compounds in the CW effluent simulate the simultaneous transformation 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  
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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 Aumeier catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunnen River close to Tübingen (Germany) in the southwest of Germany, which is mainly influenced by agriculture. Salt tracer tests are combined with measurements of conservative ions and chemical tracers and modelled using different mass balances based on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunnen River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or biochemical processes in biofilms from target screening data, mainly on pesticides. With the collected information from different disciplines, we get a larger picture about the pollutant mass transport in the Schönbrunnen River and adjoining compartments.

WE135  
Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria  
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Pharmaceutical pollution of surface waters is increasingly recognized as a global environmental risk for the Albufera National Park, Valencia, Spain. Presence of emerging contaminants in sewage sludge and assessment of their impact to aquatic ecosystems, and specially living beings.

WE136  
Assessment of emerging contaminants in the L’Albufera Natural Park (Valencia, Spain)  
D. Sadutto, University of Valencia / Environmental and Food Research Group, CIDEN (UV, GV, CSIC); M. Andrés Costa, Universitat de València / Environmental and Food Safety Research Group; R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive  
Assessment of emerging contaminants in the L’Albufera Natural Park (Valencia, Spain) and the Mediterranean basin. Covering an area of 125 hectares, which has lost the last 25 years the quality of its water due to urbanization and the growing number of inhabitants has introduced a number of emerging contaminants that thwarts this wetland. In this study, 42 drugs of abuse and 45 pharmaceuticals have been studied in influents and effluents of 10 Wastewater Treatment Plants (WWTP), 7 irrigation channels and the Lake of L’Albufera de Valencia (Valencia, Spain). The hydrological and chemical processes in these pollutants can affect to aquatic ecosystems, and specially living beings. The objective of the present study was to evaluate the water quality of the Iacorubi river in its estuarine region, in order to evaluate the anionic changes occurring in the surroundings. Three sites were chosen, in which sediments and water samples were collected. The sediments were analyzed for the presence of sterols and pharmaceuticals by GC / TOF-MS after extraction with methyl tert-butyl ether. The water samples were analyzed with respect to the parameters: ammonia concentration, total phosphate, total phenols, fecal coliforms and sulfide, according to the methodologies described in Standard Methods (APHA). TOF-MS chromatographic analyzes of sediments and water samples were also performed on extracts obtained using SPE (Strata-X/dichloromethane). The results obtained showed high concentrations of ammonia and total phosphate, besides high fecal coliforms. Between the analyzed steroids, cholesterol and derivatives such as coprostanol were identified at varying concentrations in the sediments of the several sites. Estradiol derivatives and drugs such as anxiolytics and remedies for sleep control were prominent in GC / TOF/MS chromatographic analyzes. The results confirmed the high contamination of the waters of the Iacorubi River by the discharge of domestic sewage. Ecotoxicological tests using fish are being conducted, including assay to assess genotoxicity.
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the deprovision process in the wastewater treatment plants (WWTPs). The study of emerging pollutants present in this sludge are far limited comparing with the water, mainly because of the challenge that involve their high content in organic matter making difficult their handling, storage and analysis. In Spain, the 80% of this sludge is used in the agricultural sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples were collected from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 1400 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 Stratex® 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 nitrates (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-phenylalanine). On the other hand, several compounds were tentatively identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to draw the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture. Continue researching is needed to assess the real environmental risk related to this sewage sludge, and the potential effects on soils and crops. However, reports on CBs in aquatic 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 in China. Na-PCP has been sprayed as molluscicide in Dongting Lake from 1960s to 1990s, it was estimated that over 9.8×10^6 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/encounter contamination status, distribution of CBs in fish from Dongting Lake.

**WE140 Occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia)**

V. Čerjavnik Plač, University of Ljubljana, Veterinary Faculty / Veterinary Faculty; I. Fonda, Fonda d.o.o.; M. Gombač, V. Cerkvenik Flajs

From January to October in 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 harbor of Koper. One mussel 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 hydrophilic polystyrene-divinylbenzene (PS/DVB) copolymer Chromabond HR-X and secondly molecularly imprinted polymer (MIP) AFFINIMIP® 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 extractions 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**

O. Erunwunse, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; A. Muhub, 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 phenol-sulphonic and pentachlorophenol (PCP) has been identified as one of the most important sources. Dongting Lake is the second largest freshwater lake in China; it has the most severe schistosomiasis epidemic situation in China. It is also an area with most widely distributed in China. Na-PCP has been sprayed as molluscicide in Dongting Lake until 2003 with a production quantity of about 2000 tons/yr. CBs have been detected in water, sediment, soil and sewage sludge. However, reports on CBs in aquatic 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 onchocermoniasis 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 9.8×10^6 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/encounter contamination status, distribution of CBs in fish from Dongting Lake.

**WE142 Reproductive and maternal effects of Tamiifu metabolites in medaka (Oryzias latipes)**

Jiang Deng, Y. Wu, I. Meng Ian, W. Chen, Department of Biomedical Science / Faculty of Life Sciences; D. Miškelytė, Vytautas Magnus University / Department of Environmental Biology, Kaohsiung Medical University, Kaohsiung

Tamiifu is the most commonly used anti-influenza drug. Human intake Tamiifu and excrete the Tamiifu metabolites into the aquatic environment. The Tamiifu 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 long-term Tamiifu metabolite exposure. This study mainly carried out the 56-day 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, gulping of air, rapid up and down movements. Estimated LC50 value was 358.80mg/L and the derived safe concentration value was 35.80mg/L. With survival from the range Finding Test, NOEC was 100mg/L and LOEC was 150mg/L. No acute toxicity effects were observed for concentrations below < 100mg/L. The 24, 48, 72 and 96h median lethal concentration LC50 values of Aetocabitoxin were 800, 700, 594.5 and 358.80mg/L respectively.

**WE143 Earthworms (Eisenia fetida) response to chronic exposure to triclosan (TCS)**

Z. Jallauskaitė, Vytautas Magnus University / Department of Environmental Sciences; D. Mitkelytė, Vytautas Magnus University / Department of Pharmacology and Toxicology

Triclosan (TCS) is a broad-spectrum antibacterial and antifungal agent extensively used in industrial, household and personal care products. TCS widespread use has resulted in its introduction into environment and it has already been detected in surface waters, sediments, soil, living organisms and humans as well. The aim of the present study was to determine the response of Eisenia fetida earthworms to chronic triclosan exposure. Earthworms E. fetida were exposed to 10-750 mg kg^-1 of triclosan for 56 days. The impact of exposure, growth, survival 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. Polesel, Technical
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, RDA; S. Ryu, Park, International Institute of Science, RDA

Recent studies have reported organochlorine pesticides (OCPs) as chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with potential significant impacts on human health and the environment. OCPs were designated as persistent organic pollutants (POPs) by the international community at the Stockholm Convention on Persistent Organic Pollutant. This study was conducted to investigate the OCPs residue in orchard soils and fruits (grape, peach, apple and pear). The residue was detected in orchard soils and fruit samples. The method was established using the modifed QuECHERS method for OCPs 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 RSD percentage (5.5-3.5 and 1.6-4.8%) was below 20, which was the normal percent value. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDD, and 4,4- DDE were detected at 1.3-444.9, 2.2-31.9, 4.5-863.1, 1.9-48.0, and 2.3-119.3 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. Pierdet, LPTC EPOC UMR5805; C. Grémillon, University of Bordeaux / EPOC UMR 5805; M. Désèver, University of Bordeaux / LPTC UMR 5805; C. Guille, University of Bordeaux / IPE; V. Delaunay, INRA BORDEAUX; H. Bzduszki, University of Bordeaux / Civil Engineering Department; M. Simon, Aalborg University; F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department

This study investigated the fate of pharmaceuticals in different vineyard soils and the subsequent passage to the harvested plant (lettuce). The results showed that the residue in orchard soil were lower level than bioaccumulation. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritize 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.

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WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland
E. Stuart, WCRA Environment Limited; I. Wilson, G. Merrington, we

Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical 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 involved a combination of risk assessment and regulatory approaches. In this project the aim is to assess the scale of contamination levels in organic materials and the likely impact of these levels on agricultural land and the environment.
up of phthalate esters

J. Gao, Institute of Soil Science, CAS / Key Laboratory of Soil Environment and Pollution Remediation, CAS; F. Zhu, Institute of Soil Science CAS
To investigate whether spent mushroom substrate (SMS) amendment was an appropriate way to reduce di(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DnBP) contents in soil and whether SMS could reduce DnBP accumulation in bok choy and water bodies.

WE149 Novel Analytical Strategies for Anthropogenic Compounds in Plants: Vegetative Biomonitoring for Contaminated Soils and Wastewater; R. Wahman, J. Grassmann, Technical University of Munich; P. Schroeder, Helmholtz Zentrum Muenchen / 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, fibers and medicinal products, they can also serve as “green biofilters”, i.e., they can remove pollutants from the environment. In this study, we will be able to provide an open access database of plant 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 contaminated wetland plants (CWP).

WE150 Pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge; R. Kodesova, A. Klement, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budejovice / Plant Protection; N. Svoboda, Czech University of Life Sciences Prague / Dept of Hydrogenoses; A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenoses; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenoses
This study was focused on a mobility of pharmaceuticals from sewage sludge in soils and their uptake by plants. Soil samples were taken from top horizons of seven different soil types (Stagnic Chernozem Silice, Haplic Chernozem, Gleyic Phaikozem, Haplic Luvisol, Arenosol Eutrophic, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sewage were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. Then, a ponded infiltration was applied and cumulative water outflow and solutes discharge from the bottom were measured. b) Spinach (Spinacea oleracea L.) was planted in soils mixed with sludge packed in plastic columns under greenhouse conditions. The amount of pharmaceuticals in plant parts (i.e., roots and leaves) was evaluated after harvesting. Compounds’ discharges as well as their root uptakes were soil and sludge dependent. In general, mostly larger discharges were observed from the Arenosol Eutrophic and Cambisols. Mobility of compounds depended on their sorption affinity to particulate organic matter and considerably decreased with an increase in soil pH and enzyme activities.

WE151 Will spent mushroom substrate application affect the dissipation and plant uptake of phthalate esters
J. Gao, Institute of Soil Science, CAS / Key Laboratory of Soil Environment and Pollution Remediation, CAS; F. Zhu, Institute of Soil Science CAS
To investigate whether spent mushroom substrate (SMS) amendment was an appropriate way to reduce di(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DnBP) contents in soil and whether SMS could reduce DnBP accumulation in bok choy and water bodies.

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

WE152 Experiences of demonstrating aquatic plant recovery following herbicide exposure using sloped mesocosms; F. Pickering, Cambridge Environmental Assessments
Recovery is important when considering short term exposure of aquatic non-target plants to herbicides in edge of field water bodies. Mesocosm studies allow the effects on both individual species and communities to be assessed simultaneously. Unlike indoor laboratory studies, where test item concentrations are artificially maintained, mesocosm studies allow for a more realistic application and dissipation of test item. Therefore, mesocosm studies can assess direct and indirect effects whilst a test item is present, and also monitor the period after dissipation has occurred to assess possible recovery. Using our sloped mesocosms at Cambridge Environmental Assessments (CEA), we are successfully able to test up to ten macrophyte species, each with different physical structures and characteristics (e.g. rooted; emergent). Some traditional measures of plant health can be seen as subjective (e.g. necrosis scoring and macrophyte mapping). At CEA, additional metric parameters such as number of nodes, number of leaves and stem lengths are routinely measured throughout the in-life phase. As a result, a combination of parameters are measured for each species tested. This ensures that the endpoints of a study are suitable robust and can be used to assess recovery. Here 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. Merereall, Dow AgroSciences Italia s.r.l. / Ecosystemology; K. Ralston-Hooper, Dow Agrosciences; G. Karaiskou, AgroSciences Italia s.r.l. / Ecotoxicology; J. Grassmann, Technical University of Munich / Chair of Urban Water Systems Engineering; T. Letzel, Technical University of Munich
It is recommended that standard protocols for Non Target Terrestrial Plants 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 monitoring of the test item’s effects when conducting a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. Data will be presented from research 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.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)
WE154 Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.

V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); C. SULMON, ECOBIO, CNRS UMR 6553, Université de Rennes 1 / UMR CNRS ECOBIO; A. BIJELIC, LIEC, CNRS UMR 7360, 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 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 dynamics. 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 1.75 pg L⁻¹) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competition with rice). For each combination of species and concentration, 10 different traits corresponding to morphological, biomass and physiological responses, as well as the response profile of 50 metabolites were quantified for aerial and underground plant parts, then representing respectively soft (easy to acquire) and hard traits. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and competitor presence/absence. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modify points (1) and (2). In parallel, metabolic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE155 How to consider recovery of aquatic plants in risk assessment?

U. Hommen, Fraunhofer IME; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; H. Krueger, EAG Laboratories Exposure of non-target plants to plant protection products or other stressors can be restricted in time. For each endpoint, specific recovery periods were, e.g. by degree exposure or transport. In such cases, the plants might recover if the effects are reversible. Neglecting the recovery potential in the risk assessment is definitely protective but might be over-restrictive 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 this oral 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.

WE156 Rimsulfuron toxicity and recovery in duckweed (Lemna minor)

M. Opincarne, University of Florida / School of Natural Resources and Environment; P.C. Wilson, Z. Li, University of Florida IFAS / Soil and Water Science

Rimsulfuron is an herbicide for which very little is known about its toxicity to aquatic macrophytes. This study was designed to evaluate the effects of rimsulfuron on the model aquatic macrophyte Lemna minor at low concentrations. This study also evaluated recovery by L. minor following a 5 day exposure period. Growth rates were measured at 1, 3, and 5 days following exposure to rimsulfuron-fortified 10% Hoaglands media at concentrations of 0, 0.0003, 0.0006, 0.00125, 0.0025, 0.005, 0.01, and 0.02 mg/L. After 5 days exposure, growth rates were significantly lower for rimsulfuron concentrations ≥0.0006 mg/L. Following the 5-day exposure period, plants were rinsed with deionized water and placed in fresh Hoagland’s nutrient media. Impact on growth rate was measured as percent impact compared with growth of the control. Growth rates for 0.0006 mg/L were reduced 25.4% relative to the controls. Interestingly, a horometric response was observed at the 0.0006 mg/L treatment concentration. In this case, the growth rate was 10.67% relative to the control. Following exposure, significant reductions in growth rate were observed on days 3, 5, and 10. However, 15 days after removal from the rimsulfuron treatment solutions, growth rates recovered to control levels. While rimsulfuron exposure significantly reduced growth rates of L. minor at all concentrations ≥0.0006 mg/L, effects were found to be reversible. Rimsulfuron was fast acting, with toxicity observed 1 day following exposure. In contrast, a longer period of time was required for growth rates to recover to control levels.

WE157 Toxicokinetic/toxidynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants

S. Leine, Bayer AG / Effect modelling; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; A. Solga, Bayer AG; T. Preuss, Bayer AG / Environmental Safety

For assessing the risk of plant protection products (PPP) to aquatic ecosystems, environmental concentrations of the active substance need to be estimated. Throughout Europe different approaches are used to predict these environmental concentrations. To characterize the TK/TD pattern on aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to assessments for long exposure patterns (streams) in which chronic concentrations usually last for a few hours or days, only. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (exposure patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the effect side, either an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time variable exposure patterns. For characterizing risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work, we present the validation/calibration results of a TK/TD model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemna model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemna model allows to perform a more realistic environmental risk assessment and to link time variable-exposure to effects.

WE158 Assessing soil toxicity of methylparaben using plants and collembola

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Methylparaben is an endocrine disrupting chemicals (EDCs) and is contained in personal care products such as cosmetics and qua.

E. Billoir, Université de Lorraine / LIEC, CNRS; E. Billoir, Université de Lorraine, CNRS UMR 7360

Throughout Europe different approaches are used to predict these environmental concentrations. To characterize the TK/TD pattern on aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to assessments for long exposure patterns (streams) in which chronic concentrations usually last for a few hours or days, only. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (exposure patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the effect side, either an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time variable exposure patterns. For characterizing risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work, we present the validation/calibration results of a TK/TD model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemna model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemna model allows to perform a more realistic environmental risk assessment and to link time variable-exposure to effects.
WE159 Evaluation of phytoxicity for Bisphenol A with new endpoint, phytoestrogen
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Weeds and endocrine disrupting chemicals (EDCs) are known as chemicals that show hormone-like action or inhibit hormones, the phytoxicity assessment of EDCs does not have any specific toxic endpoints for these substances. The factors (growth, photosynthetic activity, chlorophyll, etc.) used to evaluate common toxic substances such as heavy metals are also applied to EDCs. These factors are not suitable for EDC materials, which have relatively low toxicity to organisms, and phytoestrogens, an estrogen-like substance associated with the reproductive function, 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 (to mung bean) using traditional 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
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

DEHP is used as a plasticizer and insecticide. Especially, it can be used as plastic vinyl applied in farmland. Nonylphenol is used as surfactant, and 4-nonylphenol is mainly used with various isolomers which are used as insecticide and detergent. Although DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll contents, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the soil toxicity of the two substances to the plants was conducted using various factors and the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

WE161 Toxicity of a glyphosate based formulation on phytoplanktonic green microalga
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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. Toxicity tests were conducted using various factors, and the results of this study can be fundamental for soil risk assessments 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.

WE162 Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment
G. Meregalli, Dow AgroSciences Italia s.r.l. / Ecotoxicology; C. Vaj, V. Zaffagnini, A. Carone, Dow AgroSciences Italia srl

Indicator species are the basis of the ecological risk assessment framework. Endpoints derived for these species are used in the risk assessment to evaluate the safety of, e.g. plant protection products (PPP) to non-target species. In certain cases indicator species are also indigenous species to a particular region (e.g. Myriophyllum 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 aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control M. spicatum, which is an invasive alien species in North America. On the other hand, recently in Europe there have been reports of Myriophyllum aquaticum, a new alien invasive species genetically related to the indicator M. spicatum. In Piedmont (Italy), M. aquaticum has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of M. 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 prevent the spread of alien species and to restore the habitats degraded by 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 above mentioned examples.
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 such standard sampling
procedures, to determine the required test concentrations, to characterize control variability and inform test design and to identify appropriate
validity criteria. Results of this ring-test will be presented alongside progress on a
second ring-test with the herbicide imazapyr, scheduled for Spring / Summer 2018.

WE165 Study of the toxicity effects of Cd, Ni and Zn on macrophytes, antioxidant responses and time for steady-state bioaccumulation under constant metal concentrations exposures
s. martinez, CONICET PRIET UNL; M. Saenz, PRIET CONICET, National University of Luján; W.D. Di Marzio, CONICET-PRIET / PRIET

Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. Examples of human activities that contribute in heavy metal contamination are mining, smelting, fossil fuel combustion and industrial applications. Human activities may also indirectly cause changes in the environment that mobilize metals that were otherwise bound in stable forms, making them bioavailable. Aquatic bodies directly or indirectly receive pollutant discharges and metals in wastewater are easily adsorbed on organs. 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 effect. Macrophytes are key elements in aquatic ecosystems associated with heavy metal contamination. These plants can serve as bioindicators and the study of 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 for 2 weeks. After that time the material per plant 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 antioxidant enzymes activity was evaluated for the three lower concentrations of each one. These enzymes are involved in the plant defense mechanisms activated by heavy metal exposure. Determination of catalase (CAT), glutathione peroxidase (GPOX) and ascorbate peroxidase (APX) were carried out from the total plant mass. In the main, fresh weight resulted in the most sensible endpoint reaching an inhibition of almost 50% for 64 mg Zn/L and presenting significant inhibition for concentrations higher than 2 mg Ni/L and 1 mg Cd/L. Cd exposed plants over 1 mg/L presented signs of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-15 in all cases. CAT activity at test concentrations remained near control values, while APX and GPOX enzymes showed an increase indicating possible sublethal effects.

WE166 Physiological responses of Thlaspi prae cox (Brassicaceae) to Ni hyperaccumulation
T.D. Mištěnovič, K. Jakubcová, J. Vojanová, University of Belgrade / Faculty of Biology Institute of Botany and Botanical Garden Jewrevocev; N. Mihailovič, University of Belgrade / Institute for the Application of Nuclear Energy; V. Maksimovič, University of Belgrade / Institute for Multidisciplinary Research; D. Mišić, University of Belgrade / Institute for Biological Research Siniša Stanković Maksimović, University of Belgrade / Institute for Multidisciplinary Research; D. T. D. Mišljenović

Metal hyperaccumulation is a very rare ecological phenomena, occurring in species of the Brassicaceae family. The ability of T. prae cox to hyperaccumulate Zn and Cd have been extensively studied, while data on Ni hyperaccumulation are scarce. Our aim was to bring more understanding of the physiology of T. prae cox exposed to Ni and its tolerance limits might be relevant for the potential application of this species in phytostabilization or phytorextraction technologies at contaminated soils.

WE167 Phytorextraction of heavy metals in Cienega of Tamasopo wetland, México, by Typha latifolia C. Wong, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorio de ciencias ambientales; A.J. Alonso, Universidad de Guanajuato / Departamento de Farmacia

Heavy metals are persistent inorganic toxic pollutants that come from diverse anthropogenic activities [1]. They can be easily absorbed by the roots of plants due to their relatively high mobility in the soil matrix [2]. Aquatic plant species are known to have great importance, forming a substantial component of the primary production in many aquatic ecosystems, especially in wetlands. Plants can remove and accumulate metals from the solution by phytorextraction; however, the metals can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. Concentrations of heavy metals in aquatic plants depend both on metal speciation and on the species of plant absorbing the metal [2]. High concentrations of some trace metals in aquatic plants have led many authors to believe that they accumulate from water and/or from sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns:[1] true exclusion in which metals are removed from the plants; [2] shoot exclusion, in which metals are accumulated in the root but translocation to the shoot is restricted; and [3] accumulation, where metals are concentrated in the plant parts [4]. The present research examines the phytorextraction in situ of heavy metals by Typha latifolia to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo, which were classified as free (control) and contaminated with Cd, Ni and Zn; 2) establishment of a treated sediment system; 3) sampling of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 ° C for 18 hours in Lindberg / Blue stove; 3) grading and spraying of root and leaves in analytical mill (KIKA Werke M20); 4) acid digestion with HNO3 in plate at room temperature of the root and leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that Typha latifolia accumulate Mn, Zn, Cr, Pb, Cu, As, Hg, Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as Typha latifolia in heavy metal accumulation and detoxification mechanisms.

WE168 Heavy metal removal by aquatic plants
M. Saenz, PRIET CONICET, National University of Luján; J. Alberdi, priet conicet unlu; s. martinez, CONICET PRIET UNL; s. curieses, priet conicet unlu; W.D. Di Marzio, CONICET-PRIET / PRIET

Aquatic plant biomass represents a potential biological source for the recovery of heavy metals from aqueous solutions. Aquatic plant species including free floating and submerged, as Lemna, Spirodella, Ceratophyllum and Myriophyllum, have shown potential for metal removal from wastewater. The aim of this study is to evaluate the efficiency and capacity of different species of aquatic macrophyte in removing heavy metals from an artificial wastewater in a multi-metal solution. The initial whole ecotoxicity of a multi-metal system composed by Cd, Ni and Zn was assessed by growth inhibition test with the green algae P. subcapitata, acute toxicity test with D. magna and ex vivo cytotoxicity test with E. foetida coelomocytes. An experiment was set up for 10 days, by the addition of 10 grs of fresh weight of plants from different species mentioned above, in the metals solution. Previous works have shown than 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 with an acuvm 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 efficacy method for metal removal and recovery.
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 the OECD guidelines for the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W).

The combinations of mixture were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena striosa, had EC50 and/or EC10 in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. juncea (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61 and 85.91%, respectively. The proportions 87.32 and 40.61% of waste affected 50% of the length of the longest root of C. juncea and P. glaucum. The results showed that: the species tested presented different indices of toxicity to metal(loids); the screening of the Fines mineral 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

J.M. Martins, IGE UMR 5001 / Université Grenoble-Alpes; A. Cantaré, Université Claude Bernard Lyon 1 / UMR Ecologie Microbienne 5557; J. Gervaix, Université Claude Bernard Lyon 1 / UMR Ecologie Microbienne 5557; A. Richaume, Université Claude Bernard Lyon 1 / UMR Ecologie Microbienne 5557

New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs (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 metal-oxide NPs (OM) to modify microbial communities and soil functioning (3). A high OM content is likely to increase NPs toxicity by favoring their dispersion. Based on this assumption, our goal was to assess 1) whether the plant modifies the microbial toxicity of NPs because of organic matter enrichment in the rhizosphere through the root exudation and 2) whether the plant variety mitigates the ecotoxicity according to plant traits. Endpoints that relate to soil fertility by mining waste; the activity of micronutrients of the Fines mineral caused phytotoxic effects by metal(loid) in carbon and nitrogen cycle) were used to assess NPs effects. 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®) designed 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 30 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 soil solutions 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 hampered 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 ecotoxicity depends on the wheat variety 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.

WE173 Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure

G. Moltedo, ISPGA-Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Martuccio, C. Sebbio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRA Institute for Environmental Protection and Research; A. Cicero, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Network

The marine phanerogam Posidonia oceanica, thanks to its worldwide distribution

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. curisses, J. Alberdi, CONICET PRIET UNL; W.D. Di Marzio, CONICET PRIET UNL

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 mining, agriculture, wood preservation. The aim 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 the OECD guidelines for the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixture were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena striosa, had EC50 and/or EC10 in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. juncea (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61 and 85.91%, respectively. The proportions 87.32 and 40.61% of waste affected 50% of the length of the longest root of C. juncea and P. glaucum. The results showed that: the species tested presented different indices of toxicity to metal(loids); the screening of the Fines mineral 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.

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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 metal-oxide NPs (OM) to modify microbial communities and soil functioning (3). A high OM content is likely to increase NPs toxicity by favoring their dispersion. Based on this assumption, our goal was to assess 1) whether the plant modifies the microbial toxicity of NPs because of organic matter enrichment in the rhizosphere through the root exudation and 2) whether the plant variety mitigates the ecotoxicity according to plant traits. Endpoints that relate to soil fertility by mining waste; the activity of micronutrients of the Fines mineral caused phytotoxic effects by metal(loid) in carbon and nitrogen cycle) were used to assess NPs effects. 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 30 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 soil solutions 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 hampered 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 ecotoxicity depends on the wheat variety 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.

WE173 Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure

G. Moltedo, ISPGA-Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Martuccio, C. Sebbio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRA Institute for Environmental Protection and Research; A. Cicero, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Network

The marine phanerogam Posidonia oceanica, thanks to its worldwide distribution
and to its capability to accumulate certain environmental metal pollutants, would be a potentially valuable bioindicator species of metal pollutants. Mercury represents one of the most abundant marine pollutants in the Mediterranean Sea. In 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 (such as glutathione S-transferase activities, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the micrornuclei frequency) were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the 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 diagnosis methodology for plants after chemical accident only relied on the change in their phenotype such as leaf-browning, 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 multiple and comprehensive biomarkers such as the morphological characteristics, physiology, the metal concentration, the enzyme activity, the secondary metabolites, etc. 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, untargeted 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 evaluated using barley (Hordeum vulgare), and Privet latifolium. 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 metabolicomic 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 Forest Genetics; M. Barata, National Research Council / 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 region, now 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 properties. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in leaves and the issues concerning the concentration and availability of nutrients in the soil. Therefore, this study evaluates the effectiveness of the rosemary plant to improve soil quality and the effect of the incorporation of two composts derived from anaerobic digestates on the phenolic contents of rosemary plants grown a semiarid soil. In the study, two composts (CM, mainly composed by cattle manure anaerobic digestate and CS, mainly composed by pig slurry anaerobic digestate) at rates of 30 t/ha and 60 t/ha, respectively were incorporated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (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. Zubrod, 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. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; M. Konschat, University Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschat, 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 nutritional quality of leaf litter. Gammarids preferred conditioned FRx10 over control leaves, which may reflect changes in microbial community structure. This increase in palatability as a consequence of SF may be related to the fungicides’ ability to reduce fungal pest pressure, allowing trees to divert energy and carbon from defense to growth or storage. The same treatment resulted in a 300% increase in gammarid growth, while fungicide stress has increased the variable non-structural carbohydrates by 100%. These 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. Loutsi, DuPont De Nemour Hellas S.A.

Environmental Risk Assessment in Sediments (P)

WE178 Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination
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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 main objective of the 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 (WWTP) and (WWTP)eficient 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, the bioassay results indicated that WWTP sites induced higher bioavailability of both compounds.

Impacts of sediment metal contamination
The Lake Ohrid basin is located in the Balkan Peninsula, underlining that sediment contamination is presently understudied. It is therefore important to combine chemical characterization (total and available pools) with the biological monitoring and chemical fingerprinting into whole sediment bioassays and chemical fingerprinting of bioavailable compounds to develop ecotoxicological sediment quality assessment methods. This will allow for the classification of the aquatic risk that is posed by contaminated sediments. Bioavailability is often studied by measuring metal uptake by benthic organisms; however, the mode of action of the pesticides is less understood. A toxicity assessment of sediments is not sufficient to assess the risks caused by such pollution in aquatic ecosystems, since chemical data alone provide no indication of biological effects. Biological responses of exposed organisms need to be taken into account, allowing to define the ecotoxicological status of the studied system. The ancient lake Ohrid, the oldest continental lake in the world, is a UNESCO World Heritage Site, 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 agricultural and “Mem” or nearby the outlet of a creek for “Pog”. In the two sites under metalic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Ni and Cu, and 87.2 mg/kg for Mn. Despite these high concentrations, metals are not necessarily bioavailable. This is why it is also important to combine chemical characterization (total and available pools) with the study of lethal and sublethal effects after acute and chronic exposure. In our study, we assessed ecological risks in Lake Ohrid using an integrative approach consisting in: (1) chemical and physical characterizations of sediments, (2) assessment of metal bioavailability, (3) ecotoxicological bioassays, and (4) the study of sub-lethal effects on organisms. During this presentation, the main results from this integrative work at Lake Ohrid will be presented.

Active Biomonitoring and DGT Passive Sampling: Holistic Assessment of metal bioavailability in sediments and associated risks
K. De Schampaelse, Universiteit Antwerpen / Department of Biology (SPHERE and ECOBE Research Groups); H. Hetsjens, Universiteit Antwerpen / Department of Biology (SPHERE Research Group); J. Teuchies, E. Amato, L. Bervoets, Universiteit Antwerpen / Department of Biology (SPHERE Research Group); P. Meire, Universiteit van Antwerpen / Department of Biology (SPHERE Research Group); R. Blust, Universiteit van Antwerpen / 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 the 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 Chelex-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a potential indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flanders (Belgium), to evaluate diffusion of 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. During a pilot study, carried out in November 2017, 3 bivalves and a polychaete worm are exposed in the Zenne river (north of Brussels) to test for their active biomonitoring applicability. During the 4 weeks exposure period, DGT passive samplers will be deployed 3 times for a period of 24h at the sediment water interface and in the water column. Relationships will be determined between the bioaccumulation in the exposed organisms and the determined DGT fluxes. Bioaccumulation and passive sampling measurements as the sediment water interface and in the water column will be evaluated. The experiment aims at establishing relationships between bioaccumulation in different macroinvertebrate species and passive sampling measurements, and further validating the DGT passive sampling technique as a monitoring tool for sediment quality assessments in both freshwater and brackish aquatic systems.

WE184 Bioturbation in contaminated sediments: effects on exposure, toxicity and biogeochemistry.

T.M. Remaillié, W. Bennett, Griffith University / Environmental Futures Research Institute; S.L. Simpson, CSIRO; D.O. Land / Water / Centre for Environmental Contaminants Research; E.D. Vincent, University of Antwerp / Department of Biology; D.T. Welsh, Griffith University / Environmental Futures Research Institute; E. Lombi, University of South Australia / Future Industries Institute; D. Howard, Australian Synchrotron; D.F. Jolley, University of Wollongong / School of Chemistry. Sediments are a major sink for a range of contaminants. Organism-sediment interactions such as bioturbation can alter sediment physicochemistry, and facilitate the diffusion of reactive chemical species (e.g. 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) assess the potential use of bioturbation in the management and natural recovery of heavily degraded sediment ecosystems. Increased bioturbation in predominantly metal-contaminated sediments increased bivalve (Tellina deltoidalis) and amphipod (Viciotriopisa austriatensis) survival from 53 to 100% and 42 to 93%, respectively; and reproduction in a second amphipod (Melita plumulosa) from 3 to 65%. This was attributed to the decreased concentrations of dissolved copper in the overlying water associated with bioturbation. Conversely, increased bioturbation in sediments contaminated by metals and hydrocarbons decreased reproduction (44 to 23%), which was attributed to an increased release of polycyclic aromatic hydrocarbons (PAHs). High-resolution chemical imaging dissolved oxygen and metals in a legacy contaminated sediment mesocosm with a bioturbator present showed the in-situ restoration of the redox boundary. Metals were weakly associated with sediment organism-induced fluxes of nickel and zinc into burrow and overlying waters. The presence of nickel and zinc in burrow and overlying waters demonstrated that organism exposure is likely to be greater from the burrow waters than from the pore waters. This is consistent with increased accumulation of zinc observed with co-habitation of bivalves and amphipods. Low copper and lead concentrations in burrow waters during bioturbation events was consistent with the results of previous tests, where copper concentrations were lower in the presence of high bioturbation intensities, possibly due to binding with iron-(oxy)hydroxide phases or to re-suspended particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biogeochemistry and contaminant exposure to surrounding ecosystems.

WE185 The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod

M. Gillmorer, C. Staubert, J. Zurr, M. Sissling, S. Price, University of Wollongong / School of Chemistry; G.A. Price, University of Wollongong / School of Chemistry; L.A. Golding, CSIRO Land and Water; J. Stauber, CSIRO / CSIRO Land and Water; M.S. Adams, CSIRO, S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry. Mining of lateritic nickel ore deposits within the Southeast Asia and Melanesia region is expected to intensify as sulphide nickel ore deposits become depleted. The close proximity of these mining operations to coastal ecosystems places marine benthic organisms at a potential risk of adverse effects related to nickel exposure. Currently, limited data exists for the effects of sediment nickel exposure on coastal

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA

J. You, H. Li, F. Cheng, Jinan University / School of Environment Department of Chemistry; E. Amato, University of Antwerp / Department of Chemistry; E. Bengtsson, Griffith University / Environmental Futures Research Institute; S. Simpson, CSIRO / Centre for Environmental Contaminants Research; T. Benejam, R. Vivien, Centre Ecotox; S. Pesce, Iroee Lyon-Villeurbaine / Microbial ecology of anthropised river systems; L. De Alencastro, Ecole Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hyridique Ingénieurs; S. Höss, Ecossa / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGEFF. Sediments represent an important compartment for sedimentary contaminants. It constitutes a habitat or spawning site for many organisms and is an essential trophic resource for higher level organisms. It can be impacted by anthropogenic activities, particularly through urban wet weather discharges like stormwater and combined sewer overflows. In Switzerland, the Vidy Bay located in the middle of the northern shore of Lake Leman, in front of the city of Lausanne, 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 analyses to test with chromium, macrophytes and nematodes, as well as the study of the structure of oligochaete communities and tolerance of microbial communities induced by pollution (PCT) 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 pollutant event at all studied sites. Most ecotoxicological test results did not indicate significant toxicity in this area, the study of in situ communities revealed the presence of pollution-resistant species among oligochaetes and bacterial 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 hydrodynamic 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 DemO AC Project aimed at assessing the ecotoxicological status of the River Wurm near Aachen. This stream is heavily impacted by anthropogenic activities, such as urbanization, 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 Elendorf, 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 as an indicator of the acute and chronic potential. The results showed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryo toxic 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 conspicuousness will be verified by further investigations. The described toxicological profiling of sediments will also be completed by chemical analysis. Phase 2 of the DemO AC-project will contain comparative studies in order to evaluate the possible influence to sediment toxicity after implementation of full-scale ozonation.

WE189
Comparing conventional and integrative concepts for sediment classification systems
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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 ecological relevance, the chemical and the biogenic quality of the sediment samples from three catchment areas of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Scheldt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system.

WE190
Submarine sewage outfall adversely affects the sediment quality of Santos, Brazil estuary - An acute toxicity study
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The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system.
mortalities as predicted by models and the scientific literature. Physiological parameters investigated in rainbow trout acted as early signals of biological defects pointing out a high level of genotoxicity measured in erythrocytes in exposed individuals as well as in the control batch; these decreased during the experiment until a basal level pointing out the resilience of fish whereas they were exposed for 28 days to high fine sediment concentrations. Roach exposure to suspended fine sediments did not induce genotoxicity or an oxidative stress. These results meant that fine sediment exposure did not lead to a physiological stress through the alteration of respiration and osmoregulation homeostasis but suggested that trout experienced undesired past stressful conditions (aquaculture) independent from the sediment exposure. However, we cannot conclude that exposures of juvenile fish to such sediment concentrations would not lead to biological detrimental effects without further considering environmental sediment quality.

WE192  
Assessing the bioavailability of metals in natural sediments by DGT passive sampling and bioaccumulation  
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Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem and are of major concern for water system management due to their impact on the surrounding water quality and resident biota. Sediment (benthos) metals can be present in various forms, from 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 limited techniques available to test the bioavailability 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) ecotoxicological risk assessment. In this study, DGTs were deployed 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 mortality. The Ecotoxicological Risk Assessment (ERA) LC50 and LC10 values will be determined. These estimations will be used to further understand the potential risks posed by these sediments.

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 in recent years. Methods such as pressurised liquid extraction, cell disruption or microwave-assisted less disruptive, more standardized and integrated approaches.

WE194  
Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria  
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Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decreto of Italian Ministry of Environment n. 173/2016), establishing criteria and methodological procedures for dredging sediment characterization, their classification and identification of appropriate management options and monitoring. One of main novelties is represented by the Environability indicator assumed by economic, social, environmental and technical point of view. It aims to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species 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 mortality. The Ecotoxicological Risk Assessment (ERA) LC50 and LC10 values will be determined. These estimations will be used to further understand the potential risks posed by these sediments.

WE195  
Toxicity of sediment-bound lufenuron to aquatic arthropods in laboratory bioassays  
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment; M. Pellegrini, ISPRA Institute for Environmental Protection and Research / Environmental Risk Assessment Team; M. Kraak, University of Amsterdam / IBED-FAME; J. Vonk, University of Amsterdam IBED Institute / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment

Lipophilic pesticides are frequently detected in sediments, potentially leading to toxic effects on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory bioassays with a few standard test species (Chironomus sp. and Hyalella azteca). It is, however, uncertain whether these standard benthic test species are representative for a wider array of freshwater benthic organisms. We selected the benzoylurea insecticide lufenuron as one of the benchmark substances to evaluate the prospective environmental effect assessment procedure for sediment-associated pesticides. 10-day and 28-day toxicity estimates from sediment-spiked laboratory bioassays with benthic arthropods belonging to different taxonomic groups are presented. In the 10-day sediment-spiked toxicity tests the LC50 values showed the following order from low to high LC50: Caenis rerio > Chironomus riparius > Gammarus pulex > Chironomus dilutus > Hyallella azteca > Asellus aquaticus and Sialis lutaria. The Hazardous Concentration (HC5) of the 5% of the tested species (HC5 and 95% confidence limit) derived from these 10d-LC50 values was 2.2 (1.2-5.7) µg/g organic carbon (OC). This HC5 value is approximately a factor of 2 lower than the 10-day LC50 estimate (4.37 ± 2.2) µg/g OC for the most sensitive standard test species Chironomus riparius. Valid 28-d LC10 values could be derived for 7 benthic arthropods. These 28d-LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis rerio > Ephemera danica > Hyallella azteca > Gammarus pulex > Sialis lutaria. The LC50 and 95 confidence interval derived from these 28d-LC10 values was 0.13 (0.02-1.50) µg/g OC. This HC5 value is approximately a factor of 3 lower than the 28d-LC10 estimate for the most sensitive 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 HC5 obtained from 28-LC10 values was a factor of 6 lower than the the NOEC for the most sensitive
population (0.79 µg/g OC) in a sediment-spiked microcosm experiment, while the HC5 from 10d-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 marine aquaculture (two aquacultures in each estuary). No significant differences were found among the 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 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 (HUFAs) contents, either between estuaries and within each estuary. In the Gilthead seabream, SFA, MUFA, polyunsaturated fatty acid and HUFA 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 final 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 should 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.

WE198
Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal

C.V. Rocha, MARE-FUCIL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCIL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 1900’s and then around 1970’s, as a result of the awareness of the negative impacts that years of intensive fisheries brought to wild stocks’ status, which contributed to the awareness of the effectiveness of aquaculture as an 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% 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 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 (HUFAs) contents, either between estuaries and within each estuary. In the Gilthead seabream, SFA, MUFA, polyunsaturated fatty acid and HUFA 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 final 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 should 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.
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorous), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a high ROS presence up to 1018 μg/L, while the highest tested concentrations contributed to the decrease of the biomass. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistance), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicuada test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

**WE201**

**Shifting in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics used in aquaculture**

N. García Bueno, C. Marin, A. Marin, University of Murcia / Ecology and Hydrology; B. González-Gaya, IMDEA Water (G84912732) / Environmental Chemistry; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

The use of antibiotics, anti-fouling paints, and fish food are all potential sources of chemical contaminants from commercial aquaculture operations such as fish farms. Indeed, aquaculture has led to increasing problems with bacterial diseases, the treatment of which requires the intensive use of antibiotics. The objective of this study was to evaluate the potential side effect of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the diatom assemblage structure and biological traits of marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Thereafter, experiments were conducted in the laboratory. Two experiments were performed. In the first one, 20 experiment field-grown marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of each single antibiotic compound for one week and then changes on chemical and biological composition were analyzed. In the second experiment, biofilms exposed to the same antibiotic concentration range were transported to field conditions after two weeks of exposure in order to evaluate their recovery capacity. In both experiments, diatoms were determined to the lowest possible taxonomic level under the microscope (Nikon Eclipse TE2000-U). The taxonomic abundance of the sampled quadrants of each replicate was averaged and referred to the area sampled to obtain the taxon density per replicate. The fine structure of diatoms was analyzed under a scanning electron microscopy (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 apollina and Cocconeis placentula. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 µg/L respectively) strongly decreased the biofilm’s coverage. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistance), diatoms identification, and photosynthetic activity assessment. Regarding the *G. aequicuada* test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

**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 quantity and nature of intracellular ROS. The oxidizing properties enable fluorescent 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 intracellular ROS production, using 3 molecular probes, were measured over 72 hours. H₂O₂/DFDFA 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**

J. Carnall, Cambridge Environmental Assessments; A. Berkeley, Scottish Environment Protection Agency; F. Ericher, CEA; G. Hughes, Cambridge Environmental Assessments

Marine fish farms运营商 in Scotland wishing to use anti-parasitic chemicals as bath treatments must first obtain a discharge licence from the Scottish Environment Protection Agency (SEPA). Discharge licences are granted by SEPA on a per-site basis, with the quantity of chemical that can be released from a particular fish farm determined by computer modelling. This computer modelling considers the location and composition of the fish farm, along with hydrographic data measured at the site and the toxicity and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. Of these, cypermethrin and deltamethrin are rapidly removed from the aqueous phase via binding to particles, and are therefore assessed using SEPA’s short-term model, which calculates projected concentrations in the chemical patch up to 6 hours after its release from the fish farm. Azamethiphos, however, remains in the aqueous phase for several days until it is broken down, and is therefore also assessed using a longer-term model, originally developed by Gillingbrand and Turrell (1999; MLA Report No 290), and recently extended by Carnall, 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 and regulatory frameworks. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.
WE206
Contamination and bioaccumulation of heavy metals in the wild and marine farmed milkfish (Chanos chanos) and mullet (Mugil cephalus) and associated health risk along the coasts of Tanzania
E.B. Mwakalanga, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; C.K. Simukoko, University of Zambia; J.L. Lyche, Norwegian University of Life Sciences; M.H. Müller, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; A.J. Mmochi, Institute of Marine Sciences University of Dar es Salaam; R.H. Mdegele, Sokoine University of Agriculture; K. Osei, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology

Concentration of heavy metals Cu, Pb, Fe, Zn, Cr, Cd, Ni, Al and As were analysed in the muscles and livers of farmed and wild milkfish and mullets from Tanzanian coast. Fish samples were collected from January 2016 to April 2016 and analysed for heavy metals by using Atomic Absorption Spectrophotometer while analytical methods of the analysis are based on the Standard Methods of the American Public Health Association. The concentration of heavy metals Cu, Pb, Fe, Zn, Cr, Cd, Ni, Al and As were measured in the muscles and livers of farmed and wild milkfish and mullets from Tanzanian coast. Fish samples were collected from January 2016 to April 2016 and analysed for heavy metals by using Atomic Absorption Spectrophotometer while analytical methods of the analysis are based on the Standard Methods of the American Public Health Association.

The concentration of Pb in the muscles of all analysed fish were above the Maximum Recommended Levels (MRLs) by 15.08, Ni (0.027-0.094), Co (0.005-0.081), Cd (0.002-0.094) 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 muscles and livers of milkfish and mullets, whereas Co and Cd had higher levels in the muscles than in the livers, 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/WHO, EU and USFDA for human consumption. Other metals were below the MRLs. The THQ for all the 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 present 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
Potent Toxic and Phototoxic Effects of Benzobicyclon on Crayfish E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; L.M. Basirico, Louisiana State University; W. Xu, C.G. Lutz, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

Benzobicyclon is the active ingredient in herbicides, BUTTE®. In 2001, various formulations using benzobicyclon as the active ingredient were approved for use in Japan. It was approved for use in the United States and registered in California as of 2016, and was first applied to rice fields in the 2017 growing season. E.N. Vebrosky

Phototoxic Effects of Benzobicyclon on Crayfish

Phototoxic Effects of Benzobicyclon on Crayfish

The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ecotropical parasitic salmon lice (Lepeophtheirus salmonis) has gradually become a major problem. A commonly used parasiticide against this crustacean is dimethenuron (DFB), which acts as a chitin synthesis inhibitor and thereby interfere with the molting stages during sea lice development. However, DFB from the fish feed may also affect non-target crustaceans such as the Northern shrimp (Pandalus borealis), which is an economically and ecologically important species in Norwegian fjords. Laboratory experiments have demonstrated that shrimp exposed to DFB through fish feed have reduced survival (ca. 60%) compared to control, in both the larval and the adult stages. Moreover, the effects of DFB exposure is more severe under future climate conditions (higher temperature). The aim of this study is to make the information on these mechanistic effects more relevant for risk assessment at the population level. We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their risk-dependent processes). The degree of exposure to potential toxicants at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

Phototoxic Effects of Benzobicyclon on Crayfish

WE208
Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea Senegalensis
G. Albellín, Universidad de Cádiz (Spain) / Toxicology Area; V. Aranda, University of Cadiz / Toxicology Area; M. Manuel, University of Cadiz / Analytical Chemistry; J. Ortiz, C. Saraquete, CSIC / Spanish National Research Council; J. Arellano, University of Cadiz / Toxicology Area

We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their risk-dependent processes). The degree of exposure to potential toxicants at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)

WE209
Comparison between results of LumiMARA and Microtox tests M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; P. Baldoni-Andrey, C. GELBER, F. Mounède, TOTAL SA

In a regulatory context of ever increasing environmental responsibility (OSPAR convention, BREF CWW), there is a need to have biomonitoring tools to evaluate waste water quality. To date, and for several decades, the standard toxicity testing tool used for rapid analysis of waste water has been Microtox®. However, recently a new tool has become available: LumiMARA®, an acute ecotoxicity bioassay which measures the inhibition of luminescence on bacteria in a similar way to Microtox®. Its main advantage is that it performs a simultaneous assay on numerous bacterial species (all in all 11 species, 9 of which are marine and include Vibrio fischeri, plus 2 freshwater bacteria) against only one for Microtox® (Vibrio fischeri, plus 2 freshwater bacteria) against only one. Using a set of narcotic substances with different hydrophobicities and two photototoxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20ºC and pH 7. Bisphenol A (BPA) at a concentration of 12 mg/l was used. Furthermore, 9 metal 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 (0.015-0.098), Co (< LOD-0.086), Cd (< LOD-0.024, Cr (< LOD-0.079) and Fe (< LOD-147.9), Pb (0.92-47.37), Cu (< LOD-15.08), Zn (< LOD-12.24), Ni (0.027-0.094), Co (< LOD-0.034) 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 muscles and livers of milkfish and mullets, whereas Co and Cd had higher levels in the muscles than in the livers, 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/WHO, EU and USFDA for human consumption. Other metals were below the MRLs. The THQ for all the 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 present 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.

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)

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in a freshwater environment may be overestimating toxicity of effluents to the freshwater compartment.

**WE210** Bioluminescent assays as tools for studying antioxidant activity and toxicity of bioactive compounds

A.S. Sachkova, Tomsk Polytechnical University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryasheva, Institute of Biophysics SB RAS

This study promotes application of the bacteria-based and enzyme-based bioluminescent assays to evaluate the antioxidant activity of bioactive compounds in oxidizers solutions. Artificial and natural carbon nanostructures – fullerene derivatives (C60, C70, C84, etc. respectively) and humic substances (HS) are used here as bioactive compounds. Fullerenoïds 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 effect of organic (1,4-benzoquinone) and inorganic (K2Fe(CN)6) oxidizers on bioluminescence inhibition test. We found the effective concentrations (ECx) of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1,4-benzoquinone were 2.5±10 M and 10 M for bacterial and enzymatic assays, respectively, while the EC50 values of K2Fe(CN)6 were 4±10 M and 2±10 M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations greater than 103 g/L and 5×102 g/L, respectively. Detoxification coefficients can be calculated to characterize changes in toxicity under the action of bioactive compounds. The values of coefficients >1 and So, the bacteria- and enzyme-based assays showed similar peculiarities of detoxification of oxidizer solutions by bioactive compounds. Results show, that low concentrations of bioactive compounds were active. Our work demonstrates a high potential of the bioluminescent assay systems, bacterial and enzymatic, to characterize and compare antioxidant activity of physiologically active compounds.

**WE211** Effect of low-dose gamma-radiation on luminous marine bacteria

Photobacterium Phosphorum

A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agroecological Technologies; D.V. Dementyev, Institute of Biophysics SB RAS / Radiobiology Lab; N. Kudryasheva, Institute of Biophysics SB RAS

The study addresses biological effects of low dose gamma-radiation. Radioactive 137Cs-containing particles were used as model sources of gamma-radiation. Luminous marine bacterium Photobacterium phosphorum was used as a biosensor to test the bioluminescence inhibition 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 4100 mGy/h). There was no noticeable effect of gamma-radiation at 0.002 g/L and 0.001 g/L, respectively, while 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 at 10° and 20° 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.

**WE212** Bioluminescent Assay for Toxicological Assessment of Nanomaterials

E. Esimbehkova, Institute of Biophysics SB RAS; E. Nemtsova, Siberian Federal University / Institute of Biochemistry and Biotechnology; Y. Kratsavuk, Siberian Federal University / Biophysical

Due to the increasing scale of production and usage of a vast number of new materials in industrial and economic activities, society is faced with problems associated with a lack of materials safety assessment regarding humans, ecosystems and the biosphere as a whole. Nowadays, numerous toxicological investigations using living organisms, cell lines, etc. are carried out 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 (C60H12F). This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminous bacteria: NADP+/FMN-oxido-reductase + luciferase (Red + Luc). A protocol based on the optical properties of CNM for correcting the results of the bioluminescent assay was developed. If the detection limit 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 > C60H12F. The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilized enzyme system was less sensitive towards CNM, equal to 0.23 mg/L. We hypothesized that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescent method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

**WE213** Delayed chlorophyll fluorescence in biomonitoring of environmental pollution

Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; E. Stravinskene, O. Kryuchkova, N. Pakharkova, Siberian Federal University

Plants have important role in biomonitoring of environmental pollution because of their high sensitivity to various pollutants which often disturb photosynthesis. The photosynthetic function of plants is therefore a good indicator to reveal the environmental pollution effects. Fluorescence of chlorophyll is widely used for quick assessment of photosynthesis condition. A prompt fluorescence that can be registered by PAM fluorimeters is most commonly used for these purposes. Recently, we have developed a more sensitive and fast indicator of the state of the photosynthetic apparatus of plants, which is based on the measurement of delayed fluorescence (DF) of chlorophyll. Delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found out that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIDF) in 24 plant samples. Simultaneously with RIDF, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIDF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorella vulgaris alga was used as a test organism. RIDF of C. vulgaris cell suspension decreased by the factor of 2 (EC50 values of 0.012 and 0.16 mg/L) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg/dm3 respectively.

**WE214** Chlorophyll fluorescence temperature curve to estimate changes of the photosynthetic apparatus of coniferous trees during the transition to a state of winter dormancy in urban ecosystems

N. Pakharkova, Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; N. Gaevsky, Siberian Federal University

The main regulating factor for the transition of plants from active vegetation to winter dormancy is the change in temperature factor and air pollution also have a significant influence. The temperature factor and air pollution also have a significant influence both during the autumn photoperiodic reaction and at different phases of winter dormancy. This research aims towards a better understanding of the responses of the Scots pine and the Siberian spruce to air pollution stress in urban and semi-urban conditions of Southern Siberia. It is well-established that during the transition from the phase of active photosynthesis to the dormant state, the chlorophyll fluorescence (CFlu) signal, measuring parenchyma of needles undergo a number of changes. Changes in the assembly of the photosynthetic apparatus are mirrored in changes of fluorescent signals emitted at different temperatures. Chlorophyll fluorescence temperature curve (FTC) is a dependence of chlorophyll fluorescence intensity on linearly increasing temperature. This curve is used for determination of the stability of PS2 and for evaluation of the structural arrangement of chloroplasts in vegetating plants. Also, based on the changes in the shape of the FTC it can be deduced whether the plant is in the state of winter dormancy or it is vegetating. The calculated ratio of the low- and high-temperature peaks (50° and 70°) of zero level fluorescence may be used to indicate the state of winter dormancy.
and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The physico-chemical properties of the soils and humic substances were determined, including methods for bioindication and bioaccumulation. The scope of this work is devoted to the development of bioluminescent enzymatic bioassay to assess the state of the environment. The problem of relation of bioassay results with intrinsic characterization of water bodies, it is necessary to isolate oil products and polynuclear aromatic hydrocarbons (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 bioindication, not only on generally accepted test facilities, but also on representative hydrobionts for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Epischura baicalensis Sars (Copepod, Copepoda) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. baicalensis accounts for up to 70% of the total biomass of zooplankton. Crustaceans Copepoda, having fat inclusions, accumulate it in their 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 luminescence test to the addition of oil products to 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 Colenus 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. baicalensis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colenus, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in ?copepoda crustaceans in fat drops was proposed.

The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay

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 assessment of the sensitivity and selectivity of bioluminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2–6.0%) were studied by the method of excitation-emission matrix (EEM) fluorescence spectroscopy. The luminescence in the spectral range 250–550 nm was examined 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 correlated 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).
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: halauxfen-methyl (Arylex® active)

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The need and the awareness of sustainable food production has increased in recent years, driven by the growing awareness of global population increase and its burden on the limited agricultural land available to sustain the required food production. This is being reflected in the choices made at all the steps of food production from field to table. The sustainable production of pasta starts by optimising agricultural practices, which includes the key component of Plant Protection Products (PPP) applied to wheat crops. The development of new Plant Protection Products in Europe is governed by the strictest regulatory framework in the world: Regulation (EC) 1107/2009 concerning the placing of plant production products on the EU market; Directive 2009/128/EC on Sustainable Use of pesticides and its national implementations (National Action Plans), and Regulation (EC) 396/2005 concerning the Maximum Residue Levels of plant protection products allowed in food. In addition, the Secondary standards coming from Food Processors and Retailers regarding chemical residues in food place increasing standards which have to be considered. The Plant Protection Industry is increasing its focus on sustainable food production not only for complying with the evolving Regulations, but also for helping the farmer to meet the Food Supply Chain needs. A good example of this new emphasis is brought by an innovative azaic herbicide, halauxfen-methyl (Arylex® active), for broadleaf weed control (LCA study); and (2) the environmental and human health impact. Utilizing halauxfen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (flour, bread, wheat germ, malt), and in pasta. Results will be presented and discussed. Therefore, the properties of halauxfen-methyl are fully aligned with increasing strict environmental requirements from regulatory authorities and the food Chain Secondary standards.

WE220 Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs

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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 Kurah, North Lebanon (34°31’N, 35°50’E) from the raw material phase until the end-of-life phases through a Life Cycle Assessment (LCA) study; and (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TBRG) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the EcoInvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainwater through their growing material, and the vegetation could reduce airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TBRG 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

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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 image of the costs and environmental impacts of various 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

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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 itself on the social and economic well-being of the people, consuming resources and, therefore, on causing a large impact on the environment. The definition of sustainability includes three main pillars: society, economy and environment. However, considering the social and economic aspects of urban metabolism, two main gaps emerge. The first one is the lack of standardisation. Indicators are used to evaluate these aspects, but different specialized organisms propose different sets of indicators. The second gap is the difficulty of comparing indicators to each other in order to evaluate which city is the most sustainable in a sample. This study aims to fill both gaps by systematically assess the sustainability of several cities in Galicia (NW Spain). To select an appropriate set of indicators, including environmental, social and economic criteria, a Leopold matrix has been constructed considering: i) the data available for the system under study, 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 (Phipps et al., 2017). Finally, a composite indicator, i.e. a sustainability index, is obtained for each city based on the three composite sub-indicators of the sustainability dimensions (environmental, social and economic criteria). Acknowledgements This work was financially supported by the Spanish Ministry of Economy and Competitiveness (project ref. CTQ2016-75136-P) and by Xunta de Galicia (project ref. ED431F2016/001). D. Sánchez-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

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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 bio remediation (bioaugmentation of the microbial population of the soil) for the uptake of heavy metals and hydrocarbons in the soil adjacent to the roads. The solutions are firstly performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, application and end of life sequence, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and methodologies used are: Acidification, Eutrophication, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

WE224
Life Cycle Assessment of Asphalt Mixtures vs Road Pavements
D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carrion, The University of Nottingham

Road infrastructures are one of the major assets all over the world. The appropriate construction and maintenance of roads promote economic growth and development of countries. Within the field of road infrastructures, road pavements construction and maintenance require particularly high energy and raw materials consumption and generate elevated GHG emissions. For this reason, great efforts are being made in the last few decades to study implementation of sustainable techniques on road infrastructure, including transport and related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and methodologies used are: Acidification, Eutrophication, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.
WE228 
Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK
S. Mohamed Yunus, University of York / Environment; A. Boxall, University of York / Environment Department; E. Igos, Luxembourg Institute of Science and Technology / Environmental Research and Innovation

Unused or expired medicines from the hospital and household waste can ultimately end up in landfills or be released to the wastewater system. Therefore, there is the potential for active pharmaceutical ingredients (APIs), from a range of medicinal products, to be present in landfill leachate and sewage effluents. Unused medicines may also be returned to the pharmacist and then be incinerated as hazardous waste. In this project, a household survey was performed to understand the typical waste generation patterns for medicines and the most disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method. However, even though when it is recognized that the energy storage technologies are necessary to reach a decarbonized energy supply. In particular, considering an transformation of the energy system with a high share in renewable energy sources geopolitical factors will shape a tailored solution for each geographical region, defining regulatory and market frameworks are common elements to identify global social impacts associated with this action plan, both tackling clean energy access has been defined as a reachable goal for 2030. In addition to the challenges for the scientific, political and regulatory globalized society, meeting energy needs in a sustainable way pose one the biggest

WE230 
Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool
C. Tomasini Montenegro, KIT, Karlsruhe Institute for Technology; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

WE232 Development of Environment Hotspots of Analysis and the consideration of availability of eco-labeling program
Y. KURAHARA, N. Isubo, Tokyo City University

In 2014, the UNEP/SETAC life cycle initiative published a guidebook regarding hotspots analysis which enables to extract important elements from the life cycle. They defined this method as “a methodological framework that allows for the rapid assimilation and analysis of a range of information sources, including life cycle based studies, market, and scientific research, expert opinion and stakeholder concerns. The outputs can be used to identify potential solutions and prioritize actions around the most significant economic, environmental, ethical and social sustainability impacts”. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEAl2 and WIO (Waste Input 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
S. Tokito, Kyushu University

The CO₂ emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the emission from China and Russia which are FTA member countries. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis which enables to extract important elements from the life cycle.
models in consequential LCA. None of the approaches presented resulted fully comprehensive, with limited uncertainty and complexity. Both approaches based on agent based modelling require a large amount of data and expertise to be used, not often available to the LCA practitioner. The weighted consequential approach has a level of subjectivity higher than other approaches. Instead, the scenario based approach using IAM has a medium level of completeness, uncertainty and complexity. However, more work has to be done in order to reach an agreement with the IAM assumptions to be used and this constitutes a major limit. The choice among the approaches depends on the objectives of the LCA and should be as complete and comprehensive as possible when climate change claims are made. Future perspectives include a comparative testing of these approaches for selected GGR and future research should develop and assess potential alternative approaches to those presented. Further research is necessary to develop the appropriate LCA methodology for GGRT.

WE235 HYBRID FULFILMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT
I. Espí Gallart, Fundacio CTM, Centre Tecnologic; I. Bezerra, L. Vendrell, Fundació CTM Centre; F. Clares, Fundacio CTM Centre Tecnologic. More often, methodologies to assess socioeconomic impact are focused just on determining just a few indicators instead impacts, which don’t use to cover the whole spectrum of socioeconomic insights. In this sense, the hybrid fulfilment-importance matrix emerges with the aim to solve these limitations and to cover these aspects. As a case study, this methodology has been applied to LIFEREACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology allows calculating in which degree the objectives have been achieved, and how the impacts and indicators affect the system. One of the main strong points is its integrated approach which allows to consider the impacts of the project during different dimensions of the project. The indicators, placed in rows, are organized in four categories: technical indicators, environmental indicators, economic indicators, and social indicators. For technical indicators, data coming from performance of the system is implemented. The indicators for the environmental category are taken from LCA studied impact categories, which are supposed to be relevant for the project. In the case of the economic category, indicators studied in the LCC study are considered. Regarding the social indicators, those listed come from sLCA study. The distribution of the columns shows two parts: the fulfilment part, and the relevance part. In the fulfilment part, three columns are deployed: Baseline status, expected results set from the goals of the new project, and current or final results. On the importance part, the added columns represent the impacts of the project, which entail technical, sustainability, economic and social insights. When the impacts are selected, its importance in relation to the studied indicators must be defined based on expert know how and opinion. This importance is set by applying a value between 0 and 3. The socio-economic scores are calculated combining the importance values with the fulfilment scores. As a case study, this methodology has been applied to LIFEREACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology has allowed to determine which socio-economic impacts have the higher contribution.

WE236 SETAC Sustainability Interest Group
D.L. Carra, Texas Tech University / Biological Sciences

WE237 SETAC LCA Interest Group (Europe)
H. Stichnothe, Thünen Institute / Agricultural Technology

WE238 Life cycle assessment of a thermoplastic starch obtained from mango kernel A. Cásado, Environmental Research Corporation / Embraára Agroindustry; P. Marques, P. Freire, University of Coimbra / ADAF-LAETA, Mechanical Engineering; P. Melo, Federal University of Ceará; M. Figueiredo, Brazilian Agricultural Research Corporation Embraára / Embraára Tropical Agroindustry Agrifood industry generates large amounts of residues with potential to be used as feedstock for bio-based products. Mango fruit annual production in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can account for more than 40 %. The mango pulp is the main product, and mango kernel, a so-called residue, is disposed of at landfill, but containing starch, oil and phenolic substances. This study assesses the environmental life cycle impacts of thermoplastic starch produced from mango kernel (MK-TPS), and compares it with fossil-based low-density polyethylene (LDPE). The system boundaries of the MK-TPS start with transportation of mango kernel residue, followed by extraction of starch from mango kernel (together with oil and phenolic substances), and production of thermoplastic. The functional unit adopted was 1 kg of thermoplastic.

A life cycle inventory for MK-TPS was implemented based on primary data gathered at a laboratory scale. Six environmental impact categories were assessed based on the ReCipe Life cycle impact assessment method. A sensitivity analysis to the allocation approach for the starch extraction process will be performed comparing mass allocation (56 % starch, 28 % phenolic compounds and 16 % oil) with economic allocation (using a range of expected market prices). Impacts based on allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial 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 bio-based product using an agricultural residue like mango kernel residue as feedstock, through a Life cycle assessment based on laboratory scale data. Future studies shall take into consideration critical aspects and improvement opportunities identified through the study on a larger scale extraction process.

Environmental monitoring of contaminants using terrestrial ecological biomonitors (P)

WE239 Geostatistically estimating spatial structures of heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany and Iceland
M. Schröder, University of Vechta / 2

Mosses are used to spatially complement the collection of atmospheric deposition by technical samplers and to validate deposition modelling results. Since 1990, the European Moss Surveys have been providing data on element concentrations in moss every five years at up to 7300 sampling sites. In the moss specimens, heavy metals (since 1990), nitrogen (since 2005) and persistent organic pollutants (since 2010) were determined. Germany participated in all surveys with the exception of that in 2010. In this study, the spatial structures of element concentrations in moss collected between 1990 and 2015 in Germany were comparatively investigated by use of Moran’s I statistics and Variogram Analysis and mape by use of Krigeing interpolation. This is the preconditional to spatially join the moss survey data with data collected at other locations within different environmental networks. The cartographic maps reveal a clear and statistical significant decrease of concentrations of most heavy metals in moss but not for nitrogen. Due to decreasing element concentrations and the unchanged application of the element concentration classification for the mapping, the heavy metals maps for the survey 2015 do not any longer depict much spatial variation. Therefore, in an upcoming study, this analysis needs to be complemented for the heavy metals by mapping percentile statistics for the whole period 1990-2015 with maps depicting the spatial structure of survey-specific percentile statistics 1990, 1995, 2000, 2005, and 2015.


Acknowledgement - The authors thank the German Environment Agency for funding.
The use of lichens as biomonitors of air quality is inexpensive and effective. To confirm spatial patterns, lichens were also collected from one old growth forest site weekly for a one year period to determine if there were detectable seasonal patterns in the mercury accumulation on lichens. We show that the association between mercury and lichens is stable over a one year period with minimal variability due to abiotic climate factors (solar radiation and temperature). The use of lichens as biomonitor of air quality is inexpensive and effective.

Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania

G. Suietočiene, P. Snilgačitis, Vytautas Magnus University

Waste disposal has huge environmental impacts including toxics, leachate and greenhouse gases. Lichens, E. prunastri (L.) Ach. and R. farinacea (L.) Ach. were used for biomonitoring of the environment, regarding to the emission of mercury and other trace metals. Mercury is a persistent pollutant present in the atmosphere, lake waters and fish is presented in the present work. Ten sites were selected from an old growth forest for the study site on the influence of industrial area on the lichen (Usnea spp.). The temporal trend of PCDD/Fs in vegetation was very similar to that of soil, with overall reductions of 4%, 30% and 2% over the period 1998–2015, 1998–2016, and 2015–2016, respectively, being statistically significant in the two latter periods. Although the concentrations of PCDD/Fs in both soil and vegetation activities collected in urban areas showed higher levels than those from rural areas, there was no direct relationship between the levels of PCDD/Fs and the distance or proximity to the plant. In addition, the comparison of PCDD/Fs profiles of chimney emissions and the corresponding samples of soil and vegetation denotes noteworthy differences in the contribution of some congeners. Consequently, there is a low potential impact of the plant on the environment, regarding to the emission of PCDD/Fs. Finally, concentrations of PCDD/Fs in soils and vegetation here reported are similar and/or below those observed in the scientific literature for similar areas.
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. asperum as bioindicator for heavy metals exposure in air pollution monitoring studies.

WE246
The relationship between lead exposure on dogs and their behavior around Pb mining area, Kabwe, Zambia
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Lead (Pb) toxicity on both of human and animals has been known and caused neurological symptoms and even death in the worst cases. Our previous study has revealed Pb exposure on domestic dogs around a Pb mining area, Kabwe, Zambia. There was a trend that Blood Lead Levels (BLLs) in dogs in sites near to the mining area were higher than those in sites far from the mining area. Moreover, the difference of BLLs in the same area among individuals was found. This difference may be attributed to some factors, and behavior of dogs could be one of the important factors. The present study was undertaken to determine a relationship between Pb exposure on domestic dogs and their behavior recorded using GPS machines around the mining area in Kabwe, Zambia. Blood samples of domestic dogs which were freely roaming in the area were collected twice before putting GPS and after a week. BLLs were analyzed by LeadCare II. GPS devices were set to log every 1 minute and 30 seconds and attached to dog collars. In total, 53 male and 48 female domestic dogs were sampled. The overall mean of BLLs before and after a week were 24.2 μg/dL and 24.8 μg/dL, respectively. There was no significant difference between BLLs before and after a week. GPS log data was averagely collected for 4.4 days and the 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 gap of BLLs in dogs between before and after a week. 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
K. Kim, H. Jeon, H. Kim, Y. Kim, Y. Choi, S. Lee, Kyungpook National University

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, methylketone, 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 earworms 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 a 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. LC50 values of sulfuric acid, methanol, methylketone, nitric acid, formic acid, and toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 μg/kg soil, respectively. These values of sulfuric acid, methanol and methyl ketone were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 g/kg soil, respectively. These values of sulfuric acid, methanol, methyl ketone, nitric acid, formic acid were measured after 7 days of pesticide exposure. Our results clearly showed species-specific differences in their acetylcholinesterase and butyrylcholinesterase activities. The activity of indicating A. caliginosa the most sensitive species to this pesticide under the exposure conditions of our study. Although CbE activity was determined in an attempt to account for these interspecific differences because the implication of this esterase activity in organophosphate detoxification, we found that CbE activity of both species had the OP sensitivity. However, an in vitro inhibition trial with ethyl paraoxon evidenced a higher sensitivity of A. caliginosa. AChE activity was measured with 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 endoecic earthworm species to assess toxicity from organophosphate insecticides, overall when these earthworms have a beneficial impact on soil fertility.

WE249
Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes
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Untreated waste water and solid waste generated by the tanning industry can cause serious environment damage, particularly to surface and groundwater. In order to avoid pollution, specific chemical, physical and biological treatments have been adopted to reduce waste toxicity, mainly 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 tannery waste and to evaluate their resistance to lead. A factorial experiment with 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 78% with Cr (III) reduced in one week. Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root accumulation was a low value and followed a bi-linear relation. 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 insecticides.
A. Le Nynenat, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, Equipe Ecologie de la Production Intégrée, Site Agroparc; M. E. Capowiez, INRA Avignon; M. Rault, UAPV/IMBE / IMBE UMR 7263, Pôle Agrosciences Apple orchards are highly treated crops, in which organophosphorus (OP), neonicotinoid and synthetic pyrethroid compounds were heavily sprayed on 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). Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root accumulation was a low value and followed a bi-linear relation. 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

WE248
Biochemical and behavioural responses in two endoecic earthworm species exposed to parathion
F. Jouli, UAPV/IMBE; J. Sanchez-Hernandez, University of Castilla La Mancha; C. Mazzia, University of Avignon / Biologie; M. Johnin, University of Avignon; Y. Capowiez, INRA Avignon; M. Rault, University of Avignon

The earthworm species Eisenia fetida is a common organism in the soil toxicity testing framework, however, recent studies have point out endoecic 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. Hence, two endoecic 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 their acetylcholinesterase and butyrylcholinesterase activities. In the context of reduced pesticide use, the development of biocontrol agents has to be promoted. This work focuses on the assessment of the resistance/tolerance to OP insecticide of the earwig Forficula auricularia, an effective generalist predator. The threshold activities of enzymes that belong to detoxification pathways involved in insecticide resistance were estimated depending on the origin of earwigs. Then, variations in those activities were assessed under environmental conditions prior and after exposure to normal application rate of chlorpyrifos. Adult earwigs were sampled in apple orchards conducted under different management strategies: conventional, Integrated Pest Management (IPM), reduced pesticide use thanks to mating.
disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathion-S-transferases (GST) and Carboxylesterases (CtEs) were studied, by measuring their activities on ear extracts. Acetylcholinesterase (AChE) activity, the molecular target of OP insecticides, was monitored as toxicological endpoint. We observed that the mortality rate of adult earwigs exposed to the authorized dose of chlorpyrifos depends on their origin. Only earwigs originating from conventional orchards, AChE activity appears to be highly inhibited in earwigs from organic or IPM compared to conventional orchards. Moreover AChE inhibition increased when earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of CtEs. Moreover, we observed that basal-activities of CtEs and GST of unexposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations supported the hypothesis of a molecular target modification in AChE decreasing to a decrease of affinity with the insecticide, and highlight the role of CtEs ensuring effective protection of AChE. Our findings suggest the acquisition of resistance to chlorpyrifos in earwigs caught in conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

WE251 Bioaccumulation of persistent halogenated organic pollutants in insects: Common alterations to the pollutant pattern for different insects during metamorphosis.

L. Yu, Guangzhou Institute of Geochemistry / State Key Laboratory of Organic Geochemistry and Guangdong Key Laboratory of Environmental Resources Utilization and Protection; X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem; L. Tao, Guangzhou institute of Geochemistry Chinese Academy of Sciences; Y. Zeng, B. Mai, Guangzhou Institute of Geochemistry Ubiquitous use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethanes (DDTs), can accumulate in organisms and become magnified along the food chain. Insects play an important role in the transformation of pollutants from abiotic to biotic media. However, few studies have been discussed the accumulation and fate of contaminants in insects. Furthermore, metamorphosis effects on the stable isotope signatures and enrichment characteristic of contaminants in insects, but the bioaccumulation pattern and mechanism during metamorphosis is not well understood. Therefore, we detected the concentrations of halogenated organic pollutants in four taxonomic insects (dragonfly, butterfly and moth, grasshopper, and litchi stinkbug), including three kinds of metamorphosis type, collected from an e-waste pollution region in South China. Stable isotopic analysis showed grasshopper have the highest δ13C values, indicating a C3-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C4-based diet preference characterized by lower δ13C values. Moreover, enrichment of the heavy N isotope during metamorphosis is observed in the dragonfly and litchi stinkbug, but the other species (grasshopper, butterfly and moth) did not show significant increases in the values in δ15N from larvae to adults. Principal component analysis (PCA) was conducted using the fraction composition of HOPs were performed to evaluate the species-specific bioaccumulation. Different species of insects exhibited different contaminant patterns, which could be attributed to their habitats and feeding strategies. For example PBDEs were predominant in the dragonfly collected from the pond, which has been seriously contaminated by electronic waste; however, DDTs significantly contributed to the total HOPs in the butterfly and moth, and in the litchi stinkbug, and their host plants also have a high DDTs concentration. In addition, common multi-linear correlations between In adult/larva and log Kow of the compound was observed for the four taxonomic insects. The ratio of larvae to adult decreased with increasing values of log Kow (log Kow = 6-6.5), then increased (6 < log Kow < 8) and decreased again (log Kow > 8). The results of this study demonstrated that a common mechanism is responsible for the fate of HOPs during metamorphosis in those insects.

WE252 Glyphosate: toxic or not toxic, this is the question.

M. Verderame, R. Scudiero, University Federico II / Department of Biology In the recent years, the potential toxicity of Glyphosate-based herbicide (GBH), a broad spectrum herbicide widely used in agricultural, industrial and urban areas, is a great matter of debate. Although classified by the EPA as “non-toxic and not an irritant” and by the EFSA as “no carcinogenic to humans”, converging evidence suggests that GBHs, such as Roundup (Monsanto), pose serious health risk on non-target wildlife. Many studies demonstrate that GBHs threaten the reproduction environmental pollution. Adult P. sicula specimens were divided in 3 groups (n=6): group 1 and 2 were exposed to pure Gly 0.1 and 1 µL/L, respectively, via gavage every other day for 3 weeks; group 3 received by gavage the same dose of tap water (100µl). The results demonstrate that both Gly doses are toxic for the liver that shows an increase of melanocytes degranulation and the appearance of nodular/cystic formations mainly consisting of collagen fibers, typical of hepatic fibrosis. The liver of Gly-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocytes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermatogenesis is slightly slower, at low dose of Gly scattered spermatocytes II fuse to form rosette-like arrangement, at high dose the anucleate rosettes increased and spermatids are detected. Gill contamination are evident in the lumen of the tubules. Alterations in the expression of estrogen and androgen receptors and aromatase are also detected. Interestingly, in females, the ovary is not affected by Gly exposure, no matter the dose. Our results suggest that Gly exposure in a terrestrial vertebrate commonly inhabiting the fields potentially exposed to GBHs causes tissue toxicity, with possible serious health implications for wild and breeding animals as well as human populations.

WE253 Concentration of perfluoralkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs.

C. dos Reis, University of São Paulo; J. Milion; M. Mazzoni, University of Insubria, DISTA / Water Research Institute; B. De Felice, Università degli Studi di Milano; F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNIR; S. Polese, Water Research Institute- CNR / Water Research Institute; N. Saino, University of Milano; M. Parolini, University of Milan / Department of Environmental Science and Policy; S. Valsecchi, Water Research Institute/Italian National Research Council./ IRSA-CNIR, Perfluoralkyl substances (PFAS) are chemicals used as surface-active agents in diverse industrial applications. Because of their incessant disposal and release to the environment, these molecules caused the contamination of both fresh and seawaters, entailing their accumulation in the biota. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the marine food chain, and the fact that they breed in remote locations. Once accumulated in birds can be transferred to the offspring via their eggs, which are considered as good indicators of environmental pollution for a plethora of contaminants. However, the information concerning the maternal transfer of PFAS in bird eggs and the variation of their concentration according to the laying order is still inadequate. Thus, the aim of the present study was to determine the levels of PFAS in three-egg clutches of the yellow-legged gull (Larus michahellis) breeding in a colony located at the Comacchio lagoon (Northeastern Italy) and their variation according to the position in the laying sequence. Eleven perfluoralkyl acids (PFAA) were analyzed in the yolk of eggs sampled at the time of deposition from 15 three-egg clutches. Independently of the laying order, perfluorooctane sulfonate (PFOS) was the main compound detected in the egg yolk, followed by perfluorooctanoic acid (PFOA) and perfluorodecanoic acid (PFDoDa). Overall, the PFDA decreased according to the position in the laying sequence, with first- and second-laid eggs showing higher concentrations compared to last-laid eggs. A similar decreasing trend was also noticed for single compounds, namely PFOS, perfluorohexanoic acid (PFHx), perfluorooctanoic acid (PFDA), perfluorooctanoic acid (PFAA) and PFDoDa, with concentrations measured in the last-laid eggs that were significantly lower compared to those from the first- and second-laid eggs.

WE254 First assessment of metal concentration in the crab Goniopsis cruentata (Lamarck, 1810 (Decapoda, Grapsidae)) from two brazilian mangroves areas with different levels of contamination.

M. Vedolin, University of São Paulo - USP; T.H. Trevizani, Universidade de Sao Paulo / Instituto Oceanográfico, M. Petti, University of São Paulo - USP; R.C. Figueura, University of São Paulo - USP / Institute of Oceanography. The crab Goniopsis cruentata is a common semi-terrestrial species in Brazilian mangroves. Its geographical range includes the western Atlantic Ocean from Bermuda to Brazil, and the eastern Atlantic Ocean from Senegal to Angola. The species is an important fishery resource for traditional communities in the same 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 yeast to associate the bioavailability 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 e 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 of the Sao Paulo State with different levels of contamination during a period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruentata to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills> hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.05). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from...
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (grain size, pH, salinity) that reduce the risk of natural capital degradation for three reasons: (i) natural capital as most costly, (ii) 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 is soaring and accounting for impacts of human activities is becoming more complicated. Here we developed a model based on regionalisation of Life Cycle Assessment (LCA) that is capable of employing a holistic perspective while taking into account natural land transformations that are related to the life cycle processes. Furthermore, our model can interpret the impacts of land transformations on the ecosystem quality. Economic values of Ecosystem Services (ES) are used as an indicator and the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in farmland and upstream life cycle upstream processes. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in farmland and upstream processes. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in farmland. The processes from $2364/year to $1587/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases 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 the 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 S. Deacon, Ramboll Environment & Health Limited; A.E. Bartram, Ramboll Environ / Product Safety, Ecology and Sediment Management; L. Alvarez, Ramboll Environ At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of corporate and financial leaders 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 learning. Recent publications, such as “Can we stop depleting natural capital?” (Cohen et al., 2017) highlight the global financial prosperity yet scientific research shows that some natural capital is in a poor state, and declining further. The report finds political and economic systems are unprepared for responding to the risk of natural capital degradation for three reasons: (i) natural capital is not being accurately measured or valued in the context of ecological tipping points; (ii) aggregate economic models are ill-equipped for seeing the dependencies between ‘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

**Product benefits and positive outcomes: valuation and beyond (P)**
including all natural capital could support greater prosperity if it were more appropriately valued and hence more efficiently used. The second is governance regimes based on scientifically informed political decisions should protect natural capital. Governance of natural capital stocks should be informed by biophysical limits, potential irreversibility, thresholds and risks to essential function. At the global level, the UN Sustainable Development Goals apply to all countries and provide a foundation for such a governance framework. We are all consumers and beneficiaries of natural capital, but it seems clear that SETAC members can also inform the debate. As environmental scientists we can contribute to developing an understanding of criticality – the tipping points for ecosystems, in particular where these relate to chemical pressures. There are opportunities to work with economists to ensure natural capital accounting and valuation is accurate and measurable, preferably quantitatively. One of the strongest themes was that we all need to improve our story telling across multiple disciplines and institutions.

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 / Faculty of 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 HEV motor. This study computes total life cycle costs of a HEV motor. The analysis considered capital and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. Reference: R. BAILEY, G., MANCHERI, N, & VAN ACKER, K. 2017. Sustainability of Permanent Rare Earth Magnet Motors in (H)EV Industry. Journal of Sustainable Metallurgy, 3, 611-626.

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet of an average Spanish. Future requirements and policy recommendations L. Batlle Bayer, Universitat Pompeu Fabra 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; F. Fullella, 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, manufacturing, 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 uncertainties of this research, the CFP of the Spanish national dietary guidelines at the National level. The proxies used to fill the data gaps were considered of good quality. However, there is a need to develop inventories for production of certain food products for which there is no inventory data available, as well as other life cycle stages, such as the wholesale & retail and the consumer phase. Furthermore, we suggest the inclusion of environmental data in food policy, for example, adding the CFP of food products and dietary patterns within the national dietary guidelines.

WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars P. Girardi, P.C. Brambilla, RSE Spa / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (a¥W 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 complexity of production processes and products combined with an increased dynamic of consumer expectations 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 the vehicle and end of life). Life Cycle Costing (LCC) is the typical tool to meet these objectives as it allows to analyze the cost structure of a specific object throughout its life cycle. Due to their convergent approach over life cycle, there are some complementarities between LCC and Life Cycle Assessment (LCA). A combined application of the two approaches could help economic actors and decision makers to find cost-effective solutions, while minimizing their environmental impacts. The study aims to monetize the environmental impacts, to be able to aggregate them with the economic costs. Responding to SCODE LCA’s enquiring about LCA 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 describes the possibilities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the LCC and LCA coupled with LCA.

WE264 Pizza: it is dangerously delicious! K. Stylianou, University of Michigan - School of Public Health / Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jollivet, University of Michigan

The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to diet-related risks. A challenge food Life Cycle Assessment (LCA) faces is that nutrition, a dominant impact pathway for health, is often neglected. At the same time, food LCA
primarily focuses on single ingredient items while a large portion of modern diets is comprised of mixed dishes, a mixture of ingredients, which often remains underexplored. We propose a framework for evaluating mixed dishes in LCA that considers nutritional health impacts and benefits and demonstrates its application on pizza. We develop a 14 marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted outcome-specific incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided \( \text{DALY}/g \). To evaluate the environmental impacts, we deconstruct pizza into “basic ingredients” using the USDA Standard Reference 28 database with a resolution of 3,200 single- and multi-ingredients that we further deconstruct. Ingredients are then linked to life cycle inventories (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 \( \text{DALY}/g \). Human health scores for pizzas range from -35 avoided \( \text{DALY}/g \) serving pizza with extra meat to 2 avoided \( \text{DALY}/g \) serving pizza with no cheese. For the environmental impact assessment, global warming estimates vary from 0.06 (pizza with no cheese) to 0.20 (pizza with extra meat) kg CO2 eq/serving, corresponding to -0.04 and -0.17 avoided \( \text{DALY}/g \) serving, respectively. When it comes to pizza, environmental emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common monetary framework that is more precise. This approach could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE265

The impact of supplemented amino acids in animal feed - a new Life Cycle Assessment approach using the Protein Quality Index as functional unit for comparing protein sources

A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH

Proteins, which are made up of amino acids (AA), are essential for human health. Most of AA can be synthesized by the body but 8 of them are called “Essential Amino acids” (EAA) because they cannot be produced by human or animal and it is crucial to get them through food or feed intake. AA are also used as supplements in animal feed, providing the option to reduce the protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all 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 nutrients (i.e. 1 kg AA) to make up proteins. Thus a functional unit that is more precise than AA is required. Our study was conducted on several protein sources in comparison with 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 PQA 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 PQA 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 introduction

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Key words: monetary valuation, framework, standard, ISO 14008. The use of monetised environmental impacts and associated aspects has substantially increased in the last couple of years. This trend is mirrored since 2016 by efforts at ISO level to develop standards on environmental costs and benefits. This contribution will present the work achieved in ISO/TC 207/SC 1/WG 7, developing ISO 14008 whose current title is “Monetary valuation of environmental impacts and related environmental aspects — Principles, requirements and guidelines”. The work started in February 2016. After five WG meetings, ISO 14008 has reached the Draft International Standard (DIS) stage in fall 2017. The comments and ballot results of this DIS will be discussed during a WG 7 meeting in June 2018. Many organizations have experience in assessing environmental aspects and related environmental impacts resulting from their activities in physical units (e.g. tons of CO2 emitted or numbers of disability adjusted life years, DALYs). To further integrate this information into the decision making process, it is useful to take the same monetary framework in ISO 14008. Monetary valuation enables comparison and trade-offs between different environmental impacts. This aim of this standard is to increase the awareness, understanding, comparability and transparency of monetary valuation of environmental impacts and related environmental aspects. To achieve this purpose, standardised and transparent documentation of the methods used to derive monetary values is essential. The multiplicity of monetary values, methods to determine monetary values, and ethical perspectives on money, requires careful consideration and prudent communication. ISO/DIS 14008 provides a framework that includes principles, requirements and guidance for monetary valuation of environmental impacts and related environmental aspects. Many methodological requirements or recommendations are intended for persons assessing monetary values. Following these requirements and recommendations enables good practice. The requirements in the reporting clause assist the user of monetary values in assessing the quality of the monetary valuation study. The presentation will give an overview of the ISO/DIS 14008 document.

WE267

The safe and sustainable loops framework for assessing residual material flows


The circular economic system was developed to foster an industrial system that is restorative or regenerative by intention and design. An obstacle in the transition to such a system is that restoration of materials by reuse or recycling is subjected to safety legislation with an origin in the linear economy. In order to combat this obstacle, a shift is required from a purely safety based assessment to a more holistic assessment focused on sustainable development. Such a holistic assessment would encompass the so-called 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 possible. Such SSL frameworks are based on 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: Substances of very high concern (SVHCs), Pharmaceutical residues, Pesticides, Pathogens, Antimicrobial resistance, Circularity and Environmental Sustainability. These were selected for the first iteration of the framework because of their relevance for assessing risks and benefits of residual material flows during the past few years. The aim of this approach is to allow a level playing field using a generic framework with modules based on lessons learned from earlier cases.

WE268

Who is being served? Considering the values stakeholders wish to sustain in decision making

S.E. Apitz, SEA Environmental Decisions Ltd

If we want our science to be part of the environmental decision process, we need to engage with stakeholders about what values they wish to sustain. In selecting the values addressed unless a special effort is made to identify and value these requirements and recommendations enables good practice. The requirements in the reporting clause assist the user of monetary values in assessing the quality of the monetary valuation study. The presentation will give an overview of the ISO/DIS 14008 document.
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 taken into account. 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, groundwaters and soils (P)

WE269 Effects of long-term exposure to increased salinity in the amphibian skin bacteria
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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 population declines 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 technique (BOX-PCR). Results of growth shown that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EC50 for growth were: 22.5g/L (8.64-36.4) for Et-LB; 30.0g/L (23.2-37.4) for Et-NaCl, and 26.1g/L (19.3-32.9) for Et-R. Though, as confidence limits overlapped, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that E. toletana increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by E. toletana to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian’s skin, aiming the improvement of these organisms tolerance to chemicals.

WE270 Impacts of agriculture brackish effluents in saline ecosystems: when the low salinity cannot be an advantage but an impact
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Salt is an important emerging factor of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and/or over-fertilization leads the existence of saline effluents that degrades water quality and constrain plant growth and crop production. However, in saline wetlands salinity is not undesirable, but a proxy parameter to maintain the singularicity of the ecosystem. In these environments the existence of a diversity of habitats is closely related to gradients of soil salinity and moisture, with extremely saline sites, brackish sites, wetter sites and drier sites. While agricultural saline effluents may salinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This work reports changes in ecosystem structure and diversity in a saline wetland adjacent to the Mar Menor saline lagoon (SE Spain). Species cover, soil salinity, and the groundwater level were monitored in two 2-years periods with a difference of 13 years between them. The results indicated an elevation of the water table throughout the 13-year period, which was attributable to brackish water flowing from areas with intense agriculture. This matter led to an increase of flooding periods, a decrease of soil salinity in the more 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 colonization pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.

WE271 Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?
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The effect chemicals on populations and communities have long been noted to vary between different studies although the mechanism(s) for this variation is unclear. Research has examined variability associated with chemical and physical environments (e.g. bioavailability, co-occurring contaminants) and ecotoxicological and physiological (e.g. temporal and spatial variability in species’ sensitivity). Less consideration has been given to ecological mechanisms including those mediated via indirect mechanisms such as competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using ‘sensitive’ communities collected from a low salinity site (~80 μS/cm) and ‘tolerant’ communities (collected from a high salinity site ~1600 μS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 μS/cm) and salinity treatments (500, 1000, 2500 and 5000 μS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbes) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether this 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
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Increases in salinity, or the total ionic content, of water can be toxic to freshwater species, as can shifts in the balance of major ions (Ca2+, Mg2+, Na+, K+, HCO3-, SO42-, Cl-), or increases in the Ca2+ and Mg2+ content of water alone (i.e. water hardness). Although anthropogenic salinization of freshwater is increasing, virtually no water quality guidelines (WQG) exist for regulating these individual ions or their mixes. While some are used to protect quartzose or Ca-rich species there were no potentially toxic concentrations via effluent, produced waters, and saline run-off from various human activities, e.g. coal mining, oil and gas extraction, the use of Ca- and Mg-based road de-icers, and agriculture. Thus, developing a water hardness based WQG for the protection of aquatic life is warranted. Using Canadian protocols for WQG development, we attempted to derive a WQG for water hardness. Relevant data collected for this project is included in the WQG, however, current literature offered several challenges and major data gaps that hindered WQG derivation. Moreover, the background variation of water hardness throughout an exemptual regulatory region of interest also did not support WQG development using traditional methods. These challenges and limitations will be discussed in the context of similar regulations from other jurisdictions, the need to consider additional, practical limitations of regulating water hardness, or major ions in general, recommendations for improved data consistency, and potential regulatory options.
WE273
Prioritization of water quality stressors according to their relative impact on ecological quality of rivers using large-scale field data: salinity first?
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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 micro pollutants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchical partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, SPEAR %) as response variables. Secondly, individual taxon responses were related 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 together account for 50% of the variation of aquatic invertebrates at the catchment scale. A full understanding of salinity effects is essential to derive good ecological quality of rivers and land use planning in regions with high salinity exposure.

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 water organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 504 mg/L and proposed for discharge to a stream with endangered mussels necessitated derivation of acceptable potassium limits (as there are no current water quality standards for mussel toxicity). 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 oxygen guideline 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 acceptable potassium and associated ions should be considered to protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE275
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input. Management measures in the northern Venice Lagoon (NE, Italy)
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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 part due to lack of ecological connectivity, favouring self-regulation processes, between lagoon and mainland. In the past, the project area was occupied by reedbeds in large amounts, now significantly receded due to increasing of lagoon water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour 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 serially deployed experiments and synthetic solutions (e.g., NaCl/CaCl2) of systemic salinities. Recent growth of freshwater mussels and salinity risks for the production of the most representative crops grown in the Alqueva irrigation area (South Portugal)
M. Potes, M. Iakunin, G. Rodrigues, Instituto de Ciências da Terra; P. Alvarenga, the Alqueva irrigation area (South Portugal)
Fialho, A. Lima, Instituto Politécnico de Beja; A. Penha, H. Novais, the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE276
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity
P. Srikhumusuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renshaw, University of Strathclyde / Civil and Environmental Engineering
Effluents (produced and flow-back waters) from the petroleum industry have been between land-based and marine activities, particular in regions, because they are not recondensed into natural and wetlands, which have similar salinity. Water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour 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 serially deployed experiments and synthetic solutions (e.g., NaCl/CaCl2) of systemic salinities. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was expected to have a higher survival than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and toxicity. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. Although the study was conducted in the Mediterranean region, the results suggest that bacterial and inorganic 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 2017 and 2018, drought conditions occurred 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 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 (ECw), was conducted throughout 2017, on water samples collected on four platforms sited in the reservoir. Water quality for irrigation was evaluated considering both the Portuguese regulations and the FAO guidelines. Sodium adsorption ratio (SAR) and soil salinity (ECe) were estimated, in order to assess potential sodium-related soil permeability and crustng problems, as well as, potential yield reductions in the most significant crops of the Alqueva perimeter. Higher ion concentration related with the negative water salinity. We selected water salinity of approximately 389 mg/l. 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 level 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 (composition and/or portion of diet) is one of the standard refinement parameters which intend to add realism to higher tier risk assessments. Publically available dietary data are often used to refine PD in wildlife risk assessments; however, such data are often variable and/or not representative for the specific risk assessment scenario. Besides such literature data, specifically registration-relevant PD field studies can be conducted. PD values gathered from such studies are based on faecal samples, study for their inclusion in toxicity tests. In these studies samples (or parts thereof), are investigated visually by microscope and food items are identified based on comparison with comprehensive reference data libraries and collections of potential diet items. For plant material, the results are mainly presented on a fairly basic taxonomical level and are often related to wildlife risk assessment defined diet fractions which have different default residue levels, especially for different groups of vulnerable plants only). However, this is rather time-consuming and imprecise. Recently, RNA sequencing technologies 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 shape, behavior, and ecology are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge in putative molecular endpoints and to evaluate some genes as biomarkers, a Real-Time PCR array 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 path processes, mainly related to toxic effects selected 42 of these genes with 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 Economia y Competitividad, CICYT (SPAIN), CTM2015-64913-R.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis
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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 increase in the future. Understanding the impacts of this changing environmental condition in zooplankton communities is crucial, as alterations in the zooplankton communities can affect entire marine ecosystems. Here, we focus on the potential effects of an increase in temperature on the calanoid copepod species, Temora longicornis, the dominant zooplankton species of the southern part of the North Sea. Since responses to environmental stress are genome-driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide us with new insights on how exposure to increased sea water temperatures may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea.

WE282 Landscape 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 techniques 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 concerning how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more descriptive methods. We chose the freshwater mussel Anodonta anatina as our model organism. Being a stationary filter feeder, it shows promise for use in exposure studies under both laboratory and field conditions. Furthermore, it is the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vinnie å (southern Sweden), on a location free from point source pollution. After two weeks of acclimatization to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1, 10 and 100 µg Cu/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 different treatments of the same gene, and (ii) between genes in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation
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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 of chemical compounds, higher-tier studies (e.g., field studies) are crucial as a validation criterion in environmental risk assessment trials, while their ecological relevance is increased when complemented by pertinent information at lower-tier studies (molecular level). Therefore, the main goal of the present study was to validate the mode of action of a commercial fungicide formulation in *F. candida* under a many real field exposure scenarios, by targeting specific molecular biomarkers retrieved from a previous laboratory and exposed *F. candida* analyzed data of survival and reproduction effects in *F. candida* exposed to a commercial formulation of the fungicide chlorothalonil (40% Bravo®500) in a natural agricultural soil under laboratorial conditions, organisms were now exposed under field conditions for 4 days to the same concentration as for laboratory exposure (copper at 75% reduction on reproduction) and the Predicted Environmental Concentration (5 mg a.i./kg). Invertebrates were previously cultured in laboratory and simultaneously 12 replicate soil cores per treatment (including control) were collected from the field and defaunated. The cores were placed back in the field and 220 organisms (10-12 days old) were added per replicate core. Field contamination was made by spraying after a 3 hours acclimation period to the field by the organisms. RWA was extracted from each pool of organisms using the TRIZOL® methodology. According to previous laboratory “omics” results with the same set of specific genes were selected for a targeted gene expression analysis by qRT-PCR, corresponding to key genes of affected biological pathways including glutathione metabolism, oxidation-reduction, body morphogenesis and reproduction. This work contributes with a set of molecular biomarkers which can be used to develop a more effective set of tools to assess the early effects of such fungicide formulations in a real scenario of soil contamination.

WE284 Proteome response of *Chironomus riparius* under exposure to the neurotoxic insecticides Spinosad and Indoxacarb

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The development of quantitative methodologies in proteomics opened new doors for their potential applications within environmental sciences. Since proteins are the functional units of cells, the proteome of an organism at a given time and at a given condition reflects its current state. In this sense, any protein profile changes in response to toxicants may reveal their molecular targets and/or specific stress-response mechanisms, and thus can be used as potential early warning biomarkers of toxic exposure. In this study, the potential of proteome changes as an early warning indicator for pesticide exposure in *Chironomus riparius* (Meigen) was evaluated using as model compounds two neurotoxic pesticides with distinct modes of action, spinosad and indoxacarb. *Chironomus riparius* third-instar larvae were exposed to three concentrations of each pesticide and iTRAQ methodology was performed to relatively quantify protein expression changes between exposed and non-exposed organisms. For each pesticide, the proteins expression triggered different responses at the proteome level. Changes caused by spinosad were more noticeable than for indoxacarb exposure. Our results revealed a general decrease in the expression of globin proteins with the increase of spinosad concentration. Additionally, for spinosad, a significant decrease in the expression of an actin and a cuticle protein were also observed. Moreover, correlations between proteomics data and the development of toxicological biomarkers, both in terms of molecular weight and both on previous pesticides. Our results suggest that protein profile changes have the potential to be used as early warning biomarkers of pesticide exposure, providing an interpretation of molecular pathways of toxicity behind the organismal response, therefore supporting the risk assessment of pollutants. This work contributes to the growing knowledge of sub-lethal effects of pesticides in invertebrates and their molecular targets. *Chironomus riparius*, a model organism in aquatic toxicology, is also presented as a promising model organism for environmental proteomics. 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).

WE286 Assessing Cu impacts on freshwater diatoms: biochemical and metabolomic responses of *Tabellaria flocculosa* (Roth) Kützing

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Metals are a recognised threat to aquatic organisms but the impact of metals such as copper (Cu) on benthic freshwater diatoms is poorly understood, even if diatoms are commonly used as water quality indicators. Our study aimed to elucidate the copper (Cu) bioavailability and effects on *Tabellaria flocculosa* (TFLO), isolated from a Cu contaminated stream, was exposed to 0.3, 6 and 10 µg Cu/L, and the tolerance level and the cellular targets were studied using biochemical, physiological and metabolic approaches. Cu was already toxic to *T. flocculosa* at concentrations common in environments which are usually not considered to be contaminated (0.3 µg Cu/L), and toxicity increased with Cu concentration. Strategies to cope with Cu varied with the level of Cu stress. Under Cu impact, the metabolome of *T. flocculosa* changed significantly, especially at high concentrations (6 and 10 µg Cu/L). Cu toxicity was counteracted by increasing extracellular immobilization (EPS, frustulin), antioxidant (SOD, CAT) and detoxifying (GSTs) enzymes activity and low molecular weight antioxidants (GSH). These mechanisms were induced by a higher energy production (ETS activity, use of sugars and lipids). At the highest Cu concentration (10 µg/L), these metabolic processes were especially enhanced in an attempt to restrain the oxidative stress generated by high intracellular Cu concentrations. However, these mechanisms were not able to fully protect cells, and damage in membranes and proteins occurred. Moreover, the decrease of hydroxylamine and unsaturated FA and the increase of saturated FA, 2-palmitoylglycerol, glycerol and diterpenoid compounds should be tested as new specific markers of Cu toxicity in future studies. This information can support the prediction of diatom behaviour in different Cu contamination levels, including highly impacted environments, such as mining scenarios, and may assist in environmental risk assessment policies. https://www.dropbox.com/s/8thlsed1zix3mws/graph%20%20Cu%20fitter.tif?dl=0

WE287 Non-targeted approach to identify metabolic perturbations in gill-head bream liver and brain exposed to benzophenone-3

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Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation. The extensive use of BP-3 has led to its ubiquitous occurrence in the aquatic environment, causing an ecotoxicological risk to aquatic organisms. Although some studies reported adverse effects on both fish and invertebrates, further research needs to be done in order to assess its molecular and physiological effects, and modes of action. Therefore, in the present work, we investigated metabolic perturbations in juvenile 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:chlororm (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 changed at different dosing periods, we performed a 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 use of metabolomics to assess molecular mechanisms of toxicants. Keywords: Benzophenone-3, gill-head bream, non-target metabolomics

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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 effluent water industry, and the embroyogenesis of embryos from respective fish. The effluent was diluted by a factor of 1/25. The fish (10 males and females) were exposed to the effluent, and males and females were kept separated for 7 days at 28 ºC 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 twice a day 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 chlorormethanol/water (3: 2: 1). The extract
obtained was prepared for gas chromatography. For the exposed fish, there was a significant reduction in egg production, 65%. A high percentage of the eggs presented dark staining, which are not viable. Chromatography analysis revealed significant changes in the amino acid, sterol and fatty acid profile in both tissues, liver and gonads. The results showed a strong impact on the metabolism, egg production and embryo development for the studied fish, which point to the alteration of their reproductive capacity.

**WE289** Developing biomarkers of sewage effluent exposure in the freshwater amphilid Gammarus fossarum

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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 Elgg, Switzerland in September 2017, using standard kick-net method. This stream flows through an industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential intersexuality phenotypes. The RNA samples have been sequenced by Illumina Genome Analyzer. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between transcriptomic and metabolomic data will be performed, in order to get a deeper 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

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The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KE) 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* to toxic insults, applying a multi-omics approach in a high-throughput genome-wide scaling multi-omics technologies. The approach towards achieving this end was a suite of untargeted (direct-injection 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) toxicaents. 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

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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: environmental conditions; acetylcholinesterase activity, induction of micronuclei (MN), DNA strand breaks (i.e. Comet assay) and measurement of protein profile (i.e. proteomics using LC-MS). The clearance rate shows that the mussels exposed to all treatments containing 32 μg/L Cu have a significantly decreased feeding capability compared to controls, regardless of singular or binary exposure. This was in contrast to the comet assay results which suggests a specific oxidative stress response. A combination of treatments and the highest binary mixture (32, 25 μg/L Cu and Pb, respectively). Mussels exposed to 25 μg/L of Pb showed an increase in acetylcholinesterase activity, this treatment was significantly higher than both the highest copper binary mixtures. The analysis of protein profile is in process which should provide the potential functional effects of exposures of these two environmentally relevant metals, either alone or in combination. Furthermore, once this study has determined the chemical interactions between binary metals and the mussel’s proteome this could pave the way for further omics being performed and adapted for the ability to create early warning environmental indicators, not only for the environmental health but also for human health.

**WE292** The Identification of Toxicological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii

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Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanism prevents accurate predictive risk assessment. Adverse outcome pathways (AOPs) offer a framework for collating mechanistic data from a diverse range of methodologies, including *in silico* and *in vitro* approaches, for use in regulatory decision making. The aim of this work was to develop and test a more comprehensive experimental design, for the targeted characterisation of key events in the toxicological response of *Chlamydomonas reinhardtii* upon herbicide exposure, thereby contributing to the development of a quantitative AOP. Here we present how an initial hypothesis for an AOP was created from available 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 toxicokinetic markers of the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thiorodoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoue accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later times. A clear decrease in expression of key enzymes of the pathway 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 phytoue desaturation inhibition leading to growth inhibition and population decline.
WE293 Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)

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Poly(cyclic aromatic hydrocarbons) (PAHs) are a class of ubiquitously distributed environmental pollutants that mainly originate from petrogenic and pyrogenic sources such as combustion of fossil fuels and other organic material. Various PAHs, including benzo[a]pyrene (BaP), have been demonstrated to cause a wide range of effects in exposed wildlife, including alterations of immune responses, impaired development and reproduction, as well as mutagenesis and carcinogenesis. Most studies to date, however, have used 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).

WE294 SETAC OMICS Interest Group

B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxification: from mechanisms to risk assessment (P)

WE296 Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications

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Daphnia magna is used in toxicoology 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 are not directly involved in 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 ChIP-MS and ChIP-seq 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 of the species, while 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. Acknowledgements: funding from the Norwegian Research Council (NRC) project 222628 (CERAD).

WE297 Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution

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MicroRNAs (miRNAs) are a class of small non-coding RNA. These 20-24 nucleotides-long sequences associate with the 3' untranslated region (3'UTR) of target messenger RNAs (mRNAs), and post-transcriptionally regulate the expression of numerous genes by mediating translational repression or mRNA degradation. In mammals, more than 50% of miRNAs 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 E. coli infection and environmental toxicants. The first aim of the present study was to identify miRNAs in the European eel Anguilla anguilla by using next generation sequencing. We identified 210 evolutionarily conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla's transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may provide a sensitive and specific alternative to transcript and protein biomarkers. The comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicology mechanisms involved between environmental factors and diseases aetiology.

WE298 Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)

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The susceptibility 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% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos originating from parents who were exposed to copper during embryogenesis were significantly more tolerant to copper when compared to controls. This copper tolerance was shown to be still present in the F2 generation, but not the F3 generation. Our data supports the hypothesis that exposure to low levels of copper during early life has the potential to reduce the susceptibility of a vertebrate model across generations. We hypothesise that the multigenerational tolerant phenotype observed was caused by parental adaptive responding to altered copper handling and/or 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 toxicology (P)

WE299 Do global warming increase bioaccumulation of copper nanoparticle in
We present a long-term exposure with uptake and toxicity upon mixture effects of nanomaterials. A review of the existing literature on mixture effects of nanomaterials (NM) and chemicals in environmental organisms was conducted in order to evaluate the current state of knowledge. More than 120 studies were assessed to explore the relationship between changes in contaminant and NM uptake, bioconcentration, and toxicity. The specific aim of the review was to describe more specifically the interactions that have been observed and to classify the most common mechanisms. As the literature evaluation demonstrated, the existing evidence for interference of NM-chemical mixtures exposure with uptake and toxicity is rather diverse. Based on the observations made, we could discriminate at least 7 different categories to capture the evidence ranging from no changes in uptake and toxicity to an increase in uptake and toxicity upon mixture exposure to chemicals and NM: (1) increase in accumulation and toxicity (2) increase in accumulation and no change in toxicity (3) increase in accumulation and decrease in toxicity (4) no change in accumulation and toxicity (5) no change in accumulation and decrease in toxicity (6) decrease in accumulation and increase in toxicity However, we assume that these observations were caused by different underlying mechanisms and processes, hence we developed a process oriented, tiered approach considering (1) Adsorption / Interaction between NM and chemicals, (2) Uptake of NM by organisms, (3) Desorption of chemical inside / outside the organism, and (4) Toxicity. The tiered approach in the elucidation of specific mixture effects. The tiered approach results in a consistent terminology to unambiguously describe the different mechanisms of mixture effects that may occur in environmental organisms. Acknowledgement - DK was partially funded by the German Federal Ministry for Education and Research (BMBF) in the frame of the DaNa2.0 project (Data and knowledge on nanomaterials), grant no. 03X0131.

WE301 Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study

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Carbon based manufactured nanomaterials (C-MNMs) are promising materials in nanotechnology. Although both fullerenes and carbon nanotubes have been detected in aquatic organisms, there is a lack of data on their bioaccumulation, potential for toxic effects and the food web transfer of anthropogenic pollutants. Most effect studies performed until now dealt with waterborne exposure of single species for short time periods in the laboratory. Here, we present a long-term experiment under environmentally relevant conditions. In particular, the Trojan horse effect has been investigated in this study, in order to obtain more data on the interaction between nanoparticles, other pollutants and biomass. In principle, pollutants can become more bioavailable by adsorption to carbon-based nanomaterials. In addition, a spatial transfer of contaminated nanoparticles from the water phase to the sediment could increase the exposure to benthic macroinvertebrates but might also reduce the effect on the planktonic organisms. An outdoor freshwater mesocosm study was conducted with C60 fullerenes and the biocide triclocarban (TCC) using twelve outdoor ponds with a water volume of 3 m³. In addition to uncontaminated controls, both substances were tested alone and in combination. The aim of this mesocosm study is to investigate long-term effects of C60 fullerenes on the community level and to assess their potential to affect the toxicity of TCC. In this outdoor mesocosm study direct and indirect effects on single species as well as on community level endpoints like diversity were evaluated. The taxonomic groups of interest were copepods, zooplankton (e.g. Daphnia species), and macroinvertebrate species (e.g. chironomids, mayflies, oligochaetae, leeches). Different sampling techniques were used in order to include macroinvertebrates living on and within the sediment as well as hatching insects. In this presentation the results of the mesocosm study will be presented. This work has been supported by the German Federal Ministry of Education and Research (BMBF) as part of the NANO-transfer project.

WE302 Nano silver based products and environmental challenges: toxicity and accumulation in a marine sentinel species

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The use of nano silver (AgNP) based products as antimicrobial agents is undergoing a rapid increase in terms of production due to its biocidal properties. Here we studied the impact of AgNP-based commercial products named NanArgen (Nanotek S.A.) on a common marine bivalve sentinel species as the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were in vivo exposed for 96h to NanArgen product containing 20-40nm AgNP, according to the manufacturer, at two different concentration (1 μg and 10 μg/L) using natural sea water (NSW) as exposure media. Lysosomal membranes stability (NRRT) and micronuclei frequency (MN) were measured in mussel’s hemocytes. Catalase (CAT) and glutathione-s-transferase (GST) activities were measured in digestive gland as well as the content of malondialdehyde (MDA) and metallothioneins (MT). Effect on multi xenobiotic resistance (MXR) phenotype was assessed by measuring efflux ABC transporters also in vitro using mussel’s gills. Total Ag was analyzed in exposure waters after 24h and in mussel’s soft tissue after 96h. DLS analysis as well as TEM have been also performed on NanArgen formulation in NSW. A significant increase in lysosomal destabilization and MN frequency was observed in hemocytes of mussels exposed to both concentrations of NanArgen. Furthermore, MT content was significantly higher in digestive gland of mussels exposed only to 10 μg/L while oxidative stress parameters did not show any change compared to controls. A slight negative effect on MXR functionality is observed in vivo. The specific aim of the review was to describe more specifically the in vivo toxicity and accumulation of muscle in the high temperature group was higher than that of control group on day 7 of uptake phase, but there were not significant difference. For one day of depuration phase, the copper accumulation of the 30° group was significantly higher than of 26 and 287 °C (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.
observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NR, are important effects that may compromise the fitness of the organisms, since they may cause a delay in the metamorphosis, leading to a longer exposure period of tadpoles to the chemical and to an increase in the time to reach adult and reproductive stage. The higher activity of LDH, at 0.002 µg/mL, may suggest that tadpoles activate first (at low concentrations of Au-NR) a detoxification pathway in response to the exposure. Furthermore, an enhanced reactive oxygen species (ROS) may have led to the inactivation of catalase and the induction of AChE-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 indicate that Au-NR may induce several sublethal effects in tadpoles of X. laevis and impair their fitness. Furthermore, since the effects occur at very low concentrations (as low as 0.002µg/mL) it should be classified as "extremely toxic" (EC20 < 0.1 µg/mL; CEC, 1996), suggesting a high environmental risk.

**WE304**

**Interaction of the biocide triclocarban and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation**

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The disposal of various plastic nanocomposites containing multiwalled carbon nanotubes (MWCNT) is a matter of current concern, due to their potential aquatic toxicity. The release of MWCNT into the aquatic environment due to degradation of the polymers is inevitable. Changes in their properties might happen by several abiotic influences, like weathering by sunlight radiation. MWCNT undergoed thereby structural changes compared to their pristine state, like formation of hydroxyl and carboxyl groups on the surface of the MWCNT. As a consequence, weathered MWCNT (wMWCNT) have altered agglomeration- and sorption properties compared to pristine MWCNT like triclocarban (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 the 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 led to 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 from 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 PROM-TO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

**WE305**

**Comparative assessment of the interactive effects of Carbon-based nanomaterials and Benzo(a)pyrene on zebrafish embryos**

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This study aimed to assess the ecotoxicological consequences related to the interaction of Benzo(a)pyrene (B(a)P) with two CNMs with different physico-chemical properties, namely carbon nanopowder (CNPW) and fullerene (C60). This interaction was investigated in this aim to: (i) determine the effective sorption of the hydrocarbon on CNMs was quantified. A thorough evaluation of chemico-physical interactions between the two CNMs and B(a)P has been performed. Embryos were exposed to CNPW, C60 and B(a)P alone and their combination. The uptake of CNMs and B(a)P and their localization in embryos were assessed by immunofluorescence and electron microscopy. To evaluate the toxic effects of interaction of B(a)P with CNMs, a set of biomarkers of genotoxicity and oxidative stress was applied. Proteomics analysis also allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. Overall results showed that the different physico-chemical properties of the two CNMs influenced their interactions with B(a)P and generated distinct toxic effects. Indeed the adsorption on CNPW modified the accumulation of B(a)P, which followed the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B(a)P. Instead, C60 doped with B(a)P is more prone to sedimentation and less bioavailable for the embryos compared to C60 alone. The integrated results from biomarkers and proteinomics showed that different stress responses were caused by the interaction of CNM and B(a)P due to their unique combination. The CNPW doped with B(a)P mainly mirrored the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B(a)P seems to induce a cellular response similar to B(a)P alone. The study highlighted that in the aquatic ecosystems complex interactions are established between pollutants and CNMs which could elicit unexpected ecotoxicological effects.

**WE306**

**IN VITRO TOXICITY OF MODEL ZnO 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 and 25 µg/mL), with a positive control, from a stock solution of ZnCl2 (10 and 25 µg/mL); 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, with maximum values (>50%) of cell death after exposure to ZnO NPs 50 µg/mL. Furthermore, hemocytes treated with sub-lethal concentrations of ZnO NPs (5-25 µg/mL), 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 nanotoxicology; an increasing number of studies are aiming to investigate the effects and mode of action of engineered nanomaterials (ENM) in this way. However, a systematic synthesis of the outcome of these studies in order to identify common responses between ENM and organism groups has not yet been performed. We therefore established a computational analysis pipeline with the aim to re-analyze relevant transcriptomic datasets in a consistent manner. The pipeline allows a re-mapping of array probe sequences, followed by established statistical analysis and thus improves data set comparability. Differentially expressed genes (DEGs) are determined by comparison between treatment and untreated samples (pFDR ≤ .05).

**WE308**

**Zinc toxicity to A549 cells and Daphnia magna changes after iron oxide nanoparticles exposure**

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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 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 taking also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45g/L and 0.52 g/L for the A549 and Daphnia magna experiments, respectively. In A549 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 48h in terms of IC₅₀ (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 IC₅₀ for Zn was 0.070 g/L in control and 0.085 g/L in the presence of 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 microscopy images showed that ha-IONPs were uptake by ha-IONPs were uptake by the cells during the experiments. Thus, even if adsorbed on ha-IONPs, NMs 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 EC₅₀ value for Zn increased from 0.23 mg Zn/L to 1.13 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 aggregation 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, with applications likely to be more widespread in the near future. However, despite the large amount of work carried out, their toxicity in most areas of science and industry. Nevertheless, the incorporation of these NMs into products inevitably leads to their release into the aquatic environments. In a previous study we assessed the cytotoxicity of tubular-shaped carbon nanofibers (CNFs) and graphene oxide (GO) on fish hepatocytes (derived from topminnow fish, Pogonophorid lucida) and macrophages (derived from carp leucocytes, Cyprinus carpio L.). In general, the observed IC₅₀ values after 72h exposure were higher than 100 µg/mL with some exceptions in the case of CLC cells. In the present work we focussed on the uptake and intracellular fate of these NMs. Cells were exposed to three different concentrations (non-toxic, low toxic and relatively toxic) 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 hepatocytes 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 order to predict their effects and to elucidate the mechanisms behind the uptake and toxic potential of these compounds. GO sheets were present within vesicles as well as free in the cytoplasm of both cell types. Understanding the behaviour of these NMs in order to predict their effects and to elucidate the mechanisms behind the uptake and toxic potential of these compounds.

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⁻¹yr⁻¹ (Gottschalk et al., 2009). In order to understand the toxic effects of TiO₂-NPs in two freshwater alga species, we tested different concentration levels of nTiO₂ in 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 (P2S, primary particle size of 21 nm) and Cd in single and co-exposure for 72 h 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 synergetic inhibitory effect of 80 % of reproduction, twice as high compared to nTiO₂ alone. As Cd is known to induce intracellular calcium signalling 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 or a Ca²⁺ channel blocker interfere with the same effects under SSR. 2) The mode of action of nTiO₂-Cd-agglomerates will be 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 cadmium 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 propidiumiodid and hexokinase will be tested. First results will be presented. Angelstorf et al., 2014, Environ. Toxicol. Chem., 33, 2288-2296. Gottschalk et al., 2009. Environ. Sci. Technol., 43, 9216-9222. Samet, Abstract SETAC Brussels 2017. Thévenod 2009. Toxicol. Appl. Pharmacol., 238, 221-39.

WE311 Influence of temperature and salinity on toxicity of zinc oxide nanoparticle on the marine copepod Tigriopus japonicus
W. Lai, The University of Hong Kong; M.M. Yung, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science; Zipf, W. (ZnO NPs) are ranked as the 5th most prevalent nanomaterials (NMs) in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-care products, from which ZnO-NP can be easily leaked. 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·H₂O (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 & 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 x 3 factorial design. Preliminary results showed that increase in temperature and salinity could increase aggregate size of ZnO-NP and ZnO-Bulk, but reduce their ion dissolution rate. At 25 °C, similar to previous studies which suggest that ZnO-NP is less toxic than ZnO-Bulk, it is expected that ZnO-NP will be more toxic than ZnO-Bulk under the same conditions. If C. elegans NR was then exposed to ZnO-NP at a toxic level at 22 PSU, where the dissolution rate of Zn²⁺ was the smallest. ZnSO₄ was the least toxic compound, implying that Zn²⁺ were not the only contributor to the observed toxicity. Higher toxicity of 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 in the environment from which it 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 (Au-NR) ranging from 8 to 90 µg mL⁻¹, for 72h. At the end of the assay, 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
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Influence of warming and acidification on copper nanoparticle bioaccumulation in medaka (Oryzias latipes) embryos

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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 pH level. The medaka embryo was followed for four consecutive days at nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5). Results showed that the temperature and pH did not affect the accumulation of CuNPs, respectively. When combined with temperature and acidification factors, Cu accumulation of group 30°C/6.5 was increased significantly than that of groups of 26°C/6.5, 26°C/5.5, and 30°C/5.5. However, it revealed that there was no significant evidence of warming and acidification on increased Cu accumulation of medaka embryo. Therefore, we concluded that there was no influence of Cu accumulation in medaka embryo when warming and acidification occurs in the future.

Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalgae

R. B. Ogunjimi et al., Gallop, G. Barker, University of Bristol

Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in technology in the last decade have increased the production of 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 suggest 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 environmental conditions, and this fact has to be considered when assessing the potential impact of ENMs in marine environments.

Comparative toxicity of silver nanoclusters and titanium dioxide nanoparticles using medaka

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Silver nanoparticles and titanium dioxide nanoparticles are representative nanoparticles for the acute and chronic toxicity studies due to the multiplex properties of human life. Hence, environmental fate and unintentional ecological effects and/or toxicities have been concerned and many studies are reported using model organisms. We have been investigating fish toxicity and ecological risk of silver nanoclusters (SNCs, 0.40 nm) using medaka model. SNCs have embryonic (at 0.5 mg/L of SNCl) and larvae (at 5 mg/L of SNCl) 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, SNCl exposure (at 5 mg/L) did not exhibit significant lethality; however, it was observed that SNCl exposure (at 0.05 mg/L) disrupted immune system and reduced tolerance to infective bacterial (Edwardsiella tarda). In SNCl exposure, we resulted that silver chloro-complexes, which were made of dissociated silver ion from SNCl, should be essential toxicants of SNCl exposure. On the other hands, titanium dioxide nanoparticles (TiO₂-NP, Φ = 90 nm) are well-known causing oxidative stress by UV radiation; however, there are some reports that TiO₂-NP does not have significant toxic effect to fish other than...
hypertrophy of gill mucus. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. 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 against 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
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Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique physicochemical 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 genecotoxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of single short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The SOS-Chromotest is one of the most commonly used bacterial tests. It is based on the induction, by genotoxic compounds, of a bacterial SOS repair system conjugated to the b-galactosidase gene and the subsequent measurement of the enzyme expression. In this work, genotoxicity studies on the basis of the RAPD-PCR and SOS-Chromotest assay were performed for aluminium oxide nanoparticles (nanoAl$_2$O$_3$). L. Manusadzianas, B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany, Laboratory of Aquatic Ecotoxicology; B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany, Laboratory of Aquatic Ecotoxicology

WE321
Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure
E. Padilla, Institute for Environmental Sciences / University Koblenz-Landau; C. Venancio, Department of Biology / I. Lopes, University of Aveiro / Department of Biology / I. Lopes, University of Aveiro

Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure. For this, neonates of D. longispina were exposed to a control and to three concentrations of n-TiO$_2$ in aquatic cultures: 0.625, 0.0625 and 0.00625 mg L$^{-1}$ n-TiO$_2$ (corresponding to the EC$_{50}$ for D. longispina). Results showed that n-TiO$_2$ spiked with water, n-TiO$_2$ spiked with food, and n-TiO$_2$ spiked with food and water could induce genotoxicity a greater extent than the same compounds in their macroform.

WE319
Effects of Copper Oxide Nanoparticles and Arsenic on the Whole-Life Cycle of Rice (Oryza sativa japonica)
J. Liu, M. 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. Toxicants 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 comparison with As throughout the whole life cycle of rice plants. No significative effect was observed on the seed germination, but both nCuO and As had a significant main effects on the fresh weight (FW) of rice straw and the number of rice panicles (NP). The interaction of the two toxicants was also significant on both FW and NR. 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/mL) 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. AMARIEJ, Universidad de Alcala; K. Boltes, University of Alcala / Chemical Engineering; P. Letón, University of Alcala

Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in a wide range of services and industries. Subsequently, they can be released into the environment and finally end up in water bodies. That may suppose a potential risk to aquatic environment, exerting toxic effects at the level of cells/tissues or the whole organisms. The present 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 developing concentration-dependent effect and changes induced due to the presence of Ibuprofen (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 $\zeta$ potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of 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 nanoceria toxicity of SNCs and TiO$_2$ when exposure occurs via the two routes: waterborne and dietary exposure routes. For this, neonates of D. longispina were exposed to a control and to three concentrations of n-TiO$_2$ in aquatic cultures: 0.625, 0.0625 and 0.00625 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 reproduction (after 21 days of exposure). In case of D. longispina, we observed that 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 significative 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 (2.5±0.32 mm) than the ones in the control (3.0±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±1.69 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.
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuumal (99.5%) and cytoplasm (86.7%) fractions of the cells of *Nitellopsis obtusa* were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplasm and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytoplasm. The data on Cu accumulation dynamics within the compartments after cell exposure to rCrO₃ 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. Katsumiti, M.P. Cajaraville, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE. In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are prioritary pollutants and main constituents of the water accommodated fraction (WAF) of petroleum. Graphene nanoplatelets can adsorb organic compounds thus being potentially useful in oil spill remediation. However, they could also act as vehicles of organic contaminants to aquatic organisms (“Trojan horse” effect). This study aimed to evaluate the “Trojan horse” effect of graphene nanoplatelets. This work was funded by the EU H2020 (GRACE project grant 679266), Spanish MINECO (project NACE, CTM2016-75280-R). Adsorption of PAHs from naphthenic North Sea crude oil WAF using in vitro toxicity assays in hemocytes of marine mussels. Two approaches were tested to obtain graphene nanoplatelets with adsorbed oil compounds: filtration and centrifugation. Hemocytes were exposed to a wide range of concentrations of GO, GO-NP and GO-PVP with and without adsorbed oil compounds and to a series of WAF dilutions. After 24 h exposure, cell viability (MTT assay) and ROS production were assessed. Centrifugation (270g for 30 min) successfully separated WAF solution from graphene nanoplatelets with adsorbed oil compounds. This procedure was thus used for in vitro toxicity testing. WAF decreased cell viability and increased ROS production in hemocytes starting at 25% WAF. GO, GO-PVP and rGO-PVP nanoplatelets were moderately toxic to mussel hemocytes and produced a significant increase in ROS production. In exposures to graphene with adsorbed oil compounds, hemocytes viability decreased at similar concentrations as in exposures to nanoplatelets alone. However, ROS production increased in hemocytes exposed to lower concentrations of graphene with adsorbed oil compounds (10 mg/L) compared to nanoplatelets alone (25 mg/L), indicating that adsorbed oil compounds increase nanoplatelets toxicity. In conclusion, a protocol to obtain graphene nanoplatelets with adsorbed oil compounds was established. Nanoplatelets with and without adsorbed oil compounds showed similar cytotoxicity to hemocytes but the ones with adsorbed oil compounds increased ROS production earlier, indicating that graphene nanoplatelets may act as “Trojan horse” carriers for 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 IT10-13) and University of the Basque Country (UIF 11/37).

**WE324** Multigeniceral effects of titanium dioxide and silver nanoparticles on *Daphnia magna*: gene expression and morphological changes in the presence or absence of aged nanomaterials

L.A. Ellis, The University of Birmingham / GEES; E. Valsami-Jones, University of Birmingham / School of Geography Earth and Environmental Sciences; I. Lynch, University of Birmingham / Geography Earth Environmental Science. Recent studies have investigated nanoparticle (NP) 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 the pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO₂) nanoparticles (NPs). Particles were either pristine or aged, uncoated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular effects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in the presence of environmental cues such as natural organic matter changes the pathways and/or severity of changes observed (3) if the ageing of particles make them more or less toxic; (4) if long-term low dose exposure (25 days, EC₂₀ concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F₀ generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F₁–F₃ generations. We also observed differences in gene expressions compared the control populations, supporting that AgNP and TiO₂ do have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of consequent histological accumulation of the TiO₂ and AgNPs supported the assumption that NPs manifest themselves as particulates. We were also able to see some recovery in the F₃ generations that had their subsequent parent generations removed from exposure. The influence of biomolecules secreted by the organisms in response to the presence of NPs, and the influence of humic acid containing microalgae 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 including: 1) the salinity, 2) dissolved oxygen and 3) temperature of the overlying water column, and 4) the percent sediment moisture and 5) percent organic matter of the aquatic sediment. A main effects-model was implemented in order to assess the impact of environmental variables on the concentrations of ten PAHs and three toxicity indicators in freshwater and marine sediments. A backwards, step-wise linear regression analysis of variance (ANOVA), generalized linear model (GLM) was performed to determine significant effects of measured environmental parameters. The most important environmental variables affecting the concentrations of the measured compounds were those describing the characteristics of the aquatic sediments. The percent moisture of the sediment was the most important environmental parameter, significantly affecting eight of the ten organic pollutants and all three toxicity indicators. Percent organic matter of the sediments was the second most significant parameter, accounting for the variability in concentration for five of the measured pollutants. Temperature was significant for three of the PAHs and TEQ, and in every instance it had a negative effect on concentration. Dissolved oxygen of the water column was a significant variable on the concentration a single organic compound. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physiochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. The current research suggests that sediment organic matter is the primary driver of PAH 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. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physiochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. The current research suggests that sediment organic matter is the primary driver of PAH 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.
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stresses such as desiccation and chemical pollution.

**WE327** Synergy effects of fluoxetine and variability in temperature lead to proportionally greater fitness costs: A multigenerational test

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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 stresses. Yet, in spite the growing interest in understanding how organisms respond to global change, the joint fitness effects of water pollution and increased variability in temperature remain unclear. Here, using a multigenerational design, we test the hypothesis that exposure to high concentrations of fluoxetine, a human medicine commonly found in freshwater systems, causes greater lifetime fitness costs when associated with increase variability in temperature. Although flightless and warm temperature traits often exposed to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time, when both stressors acted together the costs were disproportionately greater. The combined effect of fluoxetine and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9 % decrease in population growth rate. Interestingly, fluoxetine and variability in temperature had no effect on the probability of survival. Freshwater organisms are among the most imperilled ecosystems, often faced to multiple human induced stressors. Our results indicated that freshwater organisms face greater fitness risk when exposed to multiple stressors at the same time, when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

**WE328** Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination

F. Coppola, Department of Biology & CESAM - University of Aveiro / Biology

B.M. Henriques, CESAM - University of Aveiro and CINMAR University of Porto / Department of Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; E. Figueira, University of Aveiro / Biology CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry

Several studies already described the impacts caused by metals in estuarine species, including mussels, but very scarce information is available regarding their effects in a global warming context. Moreover, increased temperature can not only 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 °C in the absence or presence of Hg (17 °C; 17 °C Hg), after which mussels were exposed during 28 days at 21 °C in the absence of Hg or kept for the same period at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg), and biomarkers related to mussels’ metabolic and oxidative stress 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 °C) and control temperature (17 °C), with a tendency to reach control values (observed in mussels exposed the entire experiment to 17 °C in the absence of Hg).

**WE329** Impacts of ocean warming and BDE-209 contamination on the energy budget of juvenile white seabream (Diplodus sargus)

P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seafood Upgrading; C. Figueiredo, M. Baptista, MARE Marine and Environmental Sciences - University of Porto; A. Morvan, CMA / Division of Aquaculture and Seafood Upgrading; C. Camacho, IPMA, LP.; M. Santos, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading; R. Rosa, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre

Climate change and chemical contamination are global environmental threats of growing concern for the scientific community and regulatory authorities. Yet, the impacts and interactions of both stressors (particularly ocean warming and emerging chemical contaminants) on the physiological responses of marine organisms remain unclear and require further research. In this context, our main goal was to study, for the first time, the effects of warming (+5 °C, i.e. 24 °C) and accumulation of a polychlorinated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.5±0.2 g total weight), 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 seabream (50.6-67.8%), 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 viscoseromeric 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 growth and energy budget of marine species. Future studies are needed to better understand and forecast their ecological effects, in order to implement potential mitigation measures.

**WE330** Transgenerational effects of pesticide on vector mosquito Culex pipiens under global warming

T. Tran, L. Janssens, KULeuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology

Recent transgenerational studies have showed that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4°C increase) and the pesticide chlorpyrifos on life history traits and antipredator behaviors of the vector mosquito Culex pipiens using a heat, chemical transgenerational approach. Pesticide induced stronger reduction in offspring development responses in copepods exposed to predator cues and copper exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhodomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment.

**WE331** 1 + 1 = 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper

T. Lode, Marzieh Haschek, Christiana M. Titelman, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Norway / Department of Biosciences; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, three spine stickleback) and copper (20 µg Cu L⁻¹) on the marine copepod Acartia tonsa nauplii. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent sensitivity. Potential importance of pedigree was also tested by comparing offspring from different females. Individual nauplii from egg-bearing females (8 randomly picked individuals per females’ clutch) were incubated individually and exposed to one of the four treatments: control, kairomone, copper or kairomone + copper. The experiment ran for 13 days (313 hours) with daily exchange of exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhodomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment. A
WE332 Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain
J. Alvarez-Regol, A. Peltalver Alcál, M. Tercero Gómez, H. Conesa Alcaraz, O. Martínez Oró, Escuela Técnica Superior de Ingeniería Agronómica. 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. Gonzalez-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation succession were studied in abandoned mine tailings and in adjacent agricultural environments. The tailings were: A) Without plant colonization; B) With grassland (PoA-Festuca); C) Forest sites (Pinus sylvestris); D) Agricultural soils; E) Forest sites (Tsuga heterophylla); F) Agricultural soils; G) Forest sites (Picea abies); H) Agricultural soils. Soil properties measured were: pH, organic C and N, C/N ratio, total N, C and P, total metals concentrations, plant biomass, soil microorganisms, and chemical and biological parameters. Soil pH, temperature, activity of invertebrates and decomposition were measured in situ. The highest degree of plant diversity was found in forest sites, followed by grassland, forest sites, agricultural soils and forest sites. The lowest organic C/N ratio was ≈20 in P+MS, DP+MS, PF 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 generally higher in C (>32) than in P (10 to 20). An antagonistic effect on plant growth was observed in forest sites, due to the presence of microbial biomass (indicator of micro-organisms population) following the same pattern than CEC. Total metal(oids) concentrations (mg kg⁻¹) widely varied within the tailings, without a clear pattern related with plant colonization (e.g. Pb: 5400-14600; Zn: 8600-18000; As: 200-12000). Water soluble metalloid(oids) (µg kg⁻¹), the most toxic fraction, were generally higher in S (e.g. Pb:4600; Zn:210000). Tea bag adsorption composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than PF, PF and P. Feeding activity was (% of holes fed: P=42%, P=39%, S=31%, P+MS=21%, F=88%, DP+MS=79%). Total and soluble/available metals concentrations cannot be considered the only factors related with the activity of invertebrates. Field studies including physical, chemical, and biological parameters must be considered together to obtain realistic information for understanding soil ecosystem functioning and recovering.

WE333 Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions
A. Bifani, A.A. Solhaug, Norwegian Institute for Water Research; S. Vold, IMDEA Water Institute; M. Vigh, IMDEA Water Institute / Earth and Environmental Sciences 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 non-target organisms (fish, crustaceans, aquatic plants) and aquatic invertebrates. The current study evaluated the effects of imidacloprid (the most used neonicotinoid) and a mixture of five neonicotinoids (imidacloprid, acetamiprid, thiacloprid, thiamethoxam, and clothianidin) on freshwater macroinvertebrate and zooplankton communities. The experiment was performed using lentic mesocosms in Central Spain under Mediterranean conditions. This study demonstrated that the Concentration Addition (CA) model for the prediction of the toxic effect of mixtures of chemicals with the same mode of action may be applied to describe the short term effects of complex communities and not only individual organisms. However, some of the recorded indirect effects and the recovery of some populations showed slight differences between the imidacloprid and the neonicotinoid mixture treatments. This was attributed to the different dissipation rates of some of the test compounds included in the mixture as compared to imidacloprid. Therefore, it may be concluded that the CA model provides an accurate prediction for short-term effects at the population and community levels but requires the inclusion of other lines of evidence (e.g. ecological modelling results) to predict long-term effects and recovery. Some aquatic insect taxa (Chironomidae) were found to be highly sensitive to neonicotinoid concentrations under Mediterranean conditions. The lowest calculated NOECs from this study are below 0.2 µg/L for imidacloprid and for the neonicotinoid mixture, indicating that the current water quality criteria proposed by regulatory agencies and recent scientific publications (0.2 µg/L) may be underprotective for lentic aquatic ecosystems under Mediterranean conditions. However, due to the high variability of the results at the low test concentrations, the hypothesis must be confirmed by performing more specific tests.

WE334 Multiple stressor effects of ionising (γ) radiation and non-ionising (UV) radiation on Daphnia magna (Lemna minor) L. Xie, NIVA - Norwegian Institute for Water Research; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; O.C. Lind, K.A. Solhaug, B. Salbu, Norwegian University of Life Sciences / Toxicology and Risk Assessment In nature environment, aquatic biota is facing to the ionizing radiation emitted from natural processes like nuclear medicine, weapon tests, and natural occurring radionuclides where phenomenal of efflux of radioisotopes may end up in surface waters, e.g. via wastewater treatment plant effluents. There, UV-B (310-400 nm) and UVC (200-310 nm) may trigger the formation of free radicals in aquatic organisms. The objective of the present work was to study the combined effect of low-dose γ-radiation (13.2, 20.3 and 47.1 mGy/h) and UVR (UVB 0.5 m2/W) in the aquatic plankton duckweed (Lemna minor) using a combination of genomic, functional and adverse toxicity endpoints. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days’ exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency, PSIII inhibition, NPO and ROS formation were observed for the high γ-radiation dose (47.1 mGy/h). Antagonistic effects on Fv/Fm, pigments content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h). Mitochondrial oxidative stress−related parameters like respiratory control (PCO), OXPHOS and ROS were also studied to elucidate the mode of action (MOA) and to identify the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combined study with radiations and chemicals are currently on going.

WE335 Natural organic matter determines the potential of titanium dioxide nanoparticles to mitigate pesticide toxicity in presence of UV light S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; V. Gerstle, F. Meyer, R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment Nanoparticle-based technology has evolved to a global industry with a tremendous economic potential. Since 2006, the investment in nanotechnology increased from estimated $1.18 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 increment use, nTiO₂ will end up in surface waters either via direct release or via wastewater treatment plant effluents. 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 2.60 W/m²) on the toxicity of nTiO₂ to Daphnia magna, a common water flea. 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 2.60 W/m²) on the toxicity of nTiO₂ to Daphnia magna, a common water flea.
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 increased (up to 2.3-fold, e.g. 0.00 W UV/m²). Depending on pesticide type and factor combinations we observed both positive and negative effects of UV radiation on the toxicity of the selected pesticides. A general prediction on the combined effects of nTiO₂, NOM, and UV on the toxicity of pesticides seems currently difficult. Rather, physicochemical properties, such as pesticide structure, solubility, adsorption, and degradability seem to be crucial for the interaction with nTiO₂, NOM, and UV-A, and the ultimate pesticide toxicity.

WE336
Effects of inorganic sunscreen formulations on the algal symbionts of reef building corals, Symbiodinium spp., and their combined toxicity with ocean warming
A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Hennige, The University of Edinburgh / School of Geosciences; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences
Between 4,000 and 6,000 tons of sunscreens annually are washed from the skin by swimming or diving, and directly released into the aquatic environment, posing a potential threat to coral reef ecosystems. Titanium dioxide nanoparticles (nTiO₂) are common UV filters in cosmetic products, and in typical sunscreen formulations they are dispersed in an oil phase, a mixture of emulsifiers and emollients which can reach up to 20% of the product content by weight. In order to assess the impact of inorganic sunscreen on corals’ endosymbiotic algae (Symbiodinium spp.), three nTiO₂ with different sizes and surface coatings were dispersed in an oil phase to mimic commercial available sunscreen formulations. Two Symbiodinium phytophytes, 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 treatments showed negative effects on all endpoints studied, and the toxicity is enhanced with simultaneous heat stress. Results indicate toxicity is not dependent on the type of nanoparticle and it is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Released oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance against 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 algae growth decreases and shorter released time of the sunscreens, posing a potential threat to coral reef ecosystems. The increased ROS production following sunscreen exposure, in addition to the reduction of photosynthetic activity, provide evidence that exposure to these types of sunscreens may exacerbate bleaching response in corals and pose a risk to coral reef ecosystems in a changing ocean.

WE337
Metallothioneins as an indicator of metal exposure in a naturally mineral enriched aquatic environment
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The Marico River in the Northern Region of South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations mainly from natural sources occasionally exceed environmental quality guidelines or toxic concentrations. Macrophotobiont corals 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 correlations between metal concentrations in water, sediment and macroinvertebrates and concomitant MT levels. This was done by sampling macroinvertebrates, water and sediment from eight sites in the Marico River and tributaries. Water and sediment samples were prepared and analysed with an ICP-MS to determine 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 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 (Kartmazoov, Kuz/minster,Ismalov Park) with respectively significant increased of metal bioaccumulation. This comparison was done based on cardiac activity monitoring in monitored groups of snails under thermal treatment (20-50min, 50±0,5°C). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazoov, Kuz/minky) differed in low thermostereses from those of the reference side and Ismalovsky Park demonstrated in dynamics of HRs. The regularity of cardiac activity rhythm, increased HR variability in mollusk, which lived in polluted areas, was performed in Sevastopol Bays using salinity change test. Possible links between chemical pollution by dioxin (in terrestrial snails) and heavy metals contents in mollusk’s tissues (in marine mussels) and peculiarities of HR recovery after thermal or salinity loads were discussed.

WE339
The effect of temperature on toxicity of cypermethrin on Daphnia magna
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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 in environmental quality standard.

WE340
Pattern oriented food web modelling of metal mesocosm datasets
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The risk assessment of metals has a long history and over time a large collection of
ecotoxicity data has been accumulated. The most informative tests performed for the ecological effects of toxicants are mesocosm studies: controlled experiments where the effects of toxicants on model communities are studied for extended periods of time. Mesocosm studies are cost- and labor-intensive but offer a unique insight into realistic ecological effects of toxicants: they address not only direct effects on sensitive species, but also indirect effects resulting from ecological interactions (e.g. competition, predation) between sensitive and less sensitive species. Typically, the effects occurring in mesocosms are 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. When the effects of multiple contaminants on biological systems 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 Rudipatidus philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Biomarker and Shell weight indices
E. Campanaro, ISPRA Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernardello, R. Boscolo Brusà, G. Franceschini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Virno Lamberti, ISPRA Institute for Environmental Protection and Research Rudipatidus 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 mussels 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 mussels. In this context, some issues could arise especially when comparing different sites in a long-term 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.

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 tuna account for a large proportion of methylmercury exposure in many countries (almost 40% of U.S. population wide intake between 2010-2012). Methylmercury is a potent neurotoxicant, particularly for children, and has been associated with impaired cardiovascular health in adults. We have developed a new mechanistic model for methylmercury bioaccumulation in marine food webs (BAM). The model is driven by methylmercury concentrations in seawater and ocean biogeochemical conditions (temperature, dissolved organic carbon, productive status). Here we apply this model to investigate the magnitude of changes in methylmercury concentrations expected from decadal oscillations in seawater temperature in the North Atlantic. We compare the magnitude of these changes to those occurring in the Pacific Ocean and discuss how climate related variability is likely to affects exposures of humans and wildlife to methylmercury. Our results suggest changes in tissue burdens driven by oscillations in seawater temperature are similar in magnitude to those that have been achieved by reductions in emissions in the North Atlantic.

WE344 Chemical stress on aquatic communities under semi-arid conditions: towards an improved multimetric approach
Combined effects of chemical pollution and water scarcity are one of the most important threats to aquatic ecosystems in (semi-)arid regions of the world. The low dilution potential of chemicals (urban, industrial and agricultural) discharged in aquatic ecosystems under water scarcity conditions could lead to devastating toxic effects. Moreover, a large proportion of aquatic bodies in these regions are known to have a high hydrological variability in a temporal scale. In this sense, communities naturally adapted to this condition are expected to respond differently to chemical stress than those adapted to more constant water flows. The aim of this study was to evaluate the combined effects of multiple stressors on aquatic ecosystems in scenarios that are characteristic of (semi-)arid regions. In particular, this study focused on identifying the main stress factors that are influencing aquatic communities in the semi-arid region of Madrid (central Spain). Sixteen sites were selected in the watershed of the Tagus River (Madrid, Spain) and sampled in three campaigns (spring, summer and fall). Hydrological and physico-chemical parameters of aquatic ecosystems were monitored, together with concentrations of metals and organic contaminants (pharmaceuticals, home-care products, pesticides). With respect to organic contaminants, the results from a screening analysis revealed the presence, at detectable levels, of 100 compounds in water samples. A group of 42 contaminants were selected for quantification due to their high toxicity (aquatic organisms and frequent detection). Complex mixtures of pharmaceuticals, as well as highly toxic pesticides were identified. Through a multivariate analysis including pollution data, flow variability and related physico-chemical parameters, the main stressors and possible differences at
a temporal and spatial scale were evaluated at a taxonomic and at a biological trait level. Significant responses to multiple stressors from some invertebrate taxa and functional traits (feeding habits, reproduction and respiration) were determined. Based on these results, suggestions for a biological vulnerability multimetric index, which considers more site-specific conditions, will be presented.

WE345 Long-term effects on transplanted caged-freshwater bivalves Diplodon chilensis 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 chilensis is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantation of caged D. chilensis to different sites in the Chimehuin river (reference site (S1), downstream from an aquaculture facility (S2), and downstream from an open dump and from the sewage treatment plant (S3)) after 3, 6, 9 and 12 months of exposure. We combined the antoxidant response, oxidative damage, ROS production and energetic status, with water and sediment analysis (phytic-chemical and biological variables, and organic matter content). Phyto-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total coliform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In D. chilensis, glob 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), GH5 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. chilensis, which is especially significant during period of their highest metabolic activity (autumn 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 and natural events. In this study the influence of extreme events on a semi-arid river system in South Africa was investigated. Significant results were obtained from the analysis of the following: water quality, species diversity and a combination of stressors. The influence of extreme events on the system have been determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined. The occurrence of extreme events is determined.

WE347 Growth, 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 drought periods are predicted to increase in frequency and severity in many regions under future climate scenarios, and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on Hordeum vulgare under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in 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 all of the parameters was achieved for the well-watered plants 24 h after heat wave treatment after one day-recovery period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by heat wave treatments compared to control conditions and revealed an importance 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?
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The frequency and severity of heat waves is increasing as a result of climate change. Extreme events like heat waves may have strong effects on plants not only leading to water stress but also drought stress. Therefore, they are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperature and drought stressors. Results of this study showed that elevated CO2 protects plants against heat waves damage. The damage caused by heat waves to plants is reduced by elevated CO2 concentrations. This effect is due to a combination of factors, including increased water use efficiency, decreased stomatal conductance, and increased photosynthetic efficiency. The benefits of elevated CO2 concentrations in agriculture and forestry are well documented, but there is limited evidence for their effects on wild plants. Further research is needed to understand the mechanisms by which elevated CO2 concentrations protect plants against heat waves damage.

WE349 Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities - a microcosm study
A.A. Sanchez, IMDEA Water Institute / Aquatic Ecolotogy; I. López, L. Nozal, IMDEA Water Institute; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecolotogy Water scarcity and chemical pollution are two of the main groups of stressors causing ecological impairment in freshwater aquatic ecosystems of (semi-)arid regions. Predictions about human and climatic pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the near future. In line with that, advances in ecological risk assessment recognizes the stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperatures and droughts. Twenty-seven microcosms were stocked with pond water, sediment, and a homogeneous plankton assemblage. Three environmental scenarios were simulated: 20°C and 28°C without desiccation, and 28°C with desiccation. The experiment was performed in triplicate with three insecticide treatments (Control, Low and High Concentration) in each environmental scenario. The insecticide was applied twice, with a 10 day interval between applications. Test units without desiccation were refilled twice per week with distilled water. Test units exposed to drought stress were not refilled and allowed to desiccate. After that, these units were refilled up to the initial level and maintained for two more weeks. Lufenuron concentrations in water and sediments were periodically measured, together with water quality parameters (DO, pH, T, EC and nutrients). Zooplankton composition was determined on a weekly basis, and the isolated and interactive effects of temperature, drought and lufenuron were evaluated using suitable statistic techniques. Effects were assessed at the community and at the
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
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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-occurrence of species. The aim of the study was to examine the influence of elevated temperature and CO2 on the effects of phenoxy herbicide to spring barley (Hordeum vulgare L.) and common lambsquarters (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms 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
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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, populations, there may be a development of resistance 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. Populations of aquatic invertebrates may persist several physiological aspects of time, depending on whether it is underpinned by purely ecological or evolutionary processes and on the ability of the ecosystem of recruiting diversity and the structure necessary to cope with new environmental conditions. In order to assess these hypotheses we have studied the effect of long-term adaptation vs. acclimation in a two phase community level experiment with natural phytoplankton communities from a pristine and an agricultural catchment. Using a controlled experimental setup, phytoplankton communities were germinated from sediments with and without herbicide exposure (Isoprotron, nominal concentration – 12 µL/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 (Diuron combined to higher temperatures). Our results showed that sugarcane pesticides impair several physiological aspects of tadpoles of R. schneideri and E. nattereri. Our data also showed that herbicide stress may alter the stressor concentration thresholds, leading to decreased lethal concentrations of insecticides are known to pose at risk of amphibians to commonly used pesticides, mainly in tropical areas.

WE352 How sugarcane and high temperatures are contributing to amphibian declines in Brazil? Morphological, biochemical and molecular approaches
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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 anurans and 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 sulfluron) 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 Lethibates catechu. The levels and metamorphosis genes expression (dio2, dio3, thi2, tra, tfb and klf9) were mostly upregulated in these groups, showing disrupting effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on L. catechu and its effects were also pronounced at high temperatures. Native tadpoles of Rhinella schneideri and Eupemphix nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone and sulfluron, respectively. Sulfuric acid and clomazone altered antioxidative (SOD, CAT, G6PDH) and biotransformation enzymes activities and induced lipid peroxidation with temperature associated responses in tadpoles of both species. Clomazone also increase carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulfluron or clomazone in R. schneideri and E. nattereri. Our results also suggest that temperature influence their antioxidant defences in 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. Bah, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / LUX 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. In a stress experiment where we applied 4 different concentrations of the same herbicide (Diuron combined to higher temperatures). Our results showed that sugarcane pesticides impair several physiological aspects of tadpoles of R. schneideri and E. nattereri. The effects of herbicide stress may alter the stressor concentration thresholds, leading to decreased lethal concentrations of insecticides are known to pose at risk of amphibians to commonly used pesticides, mainly in tropical areas.

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. Beukle, Enviresearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology
Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
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 parameters 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 parameters covering a range of physico-chemical properties and uses, were modelled in freshwater systems 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
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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 and relevancy. In this respect, pollutants with high occurrence frequency and concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior effluent micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indices such as occurrence frequency and chromatography peak area was applied for the ranking. WWTP effluent samples were taken in september, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (QExactive+ Orbitrap). Within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high ranks, about 20 micropollutants were orthogonally confirmed and roughly quantified. The quantified micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatories (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antistainmates (diphenyldraine, fexofenadine), antihypertensive agent (ibersartan, valsartan), antipsychotic (aripiprazole, clozapine, risperidone), antiinflammatories (acetaminophen, ibuprofen) and 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 > ibersartan > fluconazole > dephnyldraine > 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 concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior effluent micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indices such as occurrence frequency and chromatography peak area was applied for the ranking. WWTP effluent samples were taken in september, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (QExactive+ Orbitrap). Within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high ranks, about 20 micropollutants were orthogonally confirmed and roughly quantified. The quantified micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatories (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antistainmates (diphenyldraine, fexofenadine), antihypertensive agent (ibersartan, valsartan), antipsychotic (aripiprazole, clozapine, risperidone), antiinflammatories (acetaminophen, ibuprofen) and 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 > ibersartan > fluconazole > dephnyldraine > 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.

WE357 Effects of water browning on zooplankton physiology and fitness driven by food characteristics in a long-term enclosure experiment
L. Miguez; LieCN (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E. Sperfeld, University of Oslo / Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences; S.A. Berger, J.C. Nejstgaard, Leibniz Institute of Freshwater Ecology and Inland Fisheries / Dept. Experimental Limnology; M.O. Gessner, Leibniz Institute of Freshwater Ecology and Inland Fisheries

ECotoxicological assays using Daphnia species are generally performed under optimal food and light conditions. However, results of such assays may not adequately reflect stress responses in the wild, since the ability of organisms to cope with adverse conditions critically depends on the amount of available energy. One type of potential stressor, that is often assumed as negligible in short-term testing in cultivation, is terrestrial-derived dissolved organic carbon (tDOC) that causes browning of lakes and streams, but long-term effects of tDOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term tDOC exposure affects the physiology and life-history traits of the water flea Daphnia longispina, and whether any observed effects are reversible. Daphnids were collected from a long-term, large-scale enclosure experiment conducted in a clear-water lake in northeastern Germany, where a natural plankton community was exposed to a standard source of tDOC (HuminFeed®). The physiological state of daphnids in the enclosures was followed after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favour of oxidative damage, but this response was no longer observed after 36 days. Daphnids and water from the enclosures sampled again after 10 weeks were used to assess survival and reproductive performance under laboratory conditions. Both survival and reproduction were related to seston characteristics and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed higher fitness (assessed as growth and reproduction) than daphnids kept in clear water (A). This unexpected outcome is explained by higher seston 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 from the respective enclosure. However, the tests remained negative, as 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. Chariton, Macquarie University / Molecular Ecology and Toxicology

Natural systems are threatened by a variety of different anthropogenic stressors. These are often considered in isolation, but in reality most are found in combination and have the potential to interact with different outcomes. Urban systems such as estuaries and harbours are commonly exposed to chemical (e.g. contaminants), physical (e.g. built infrastructures and topological (invasive species) stressors. It is important to understand the interactive threats posed by these stressors. Here we use a systematic literature review to explore selected urban stressors and their potential interactions under current environmental conditions. We link the interactive effects to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are connected across systems we have the ability to identify current patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.

WE359 Ecology or reproducibility crisis? - Lessons from a laboratory scale tri-trophic test system
V. Riedl, Environment Department, University of York / Environment Department; A. Agatz, IBACON GmbH / Environment Department; R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; R. Ashauer, University of York / Environment

Concerns, 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 instance, replication, standardization and reproducibility are of great importance to consider when estimating the importance of potential stressors that are changing in the environment. 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 in 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, easy 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 conditions and stressors in life or during acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cayman (MRS10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 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 non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. Sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquaculture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those greater tolerances and assess if non-genetic (epigenetic) mechanisms (DNA methylation or histone modifications) are involved.

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem
S. Joachim, INERIS-UMIR SEBIO / CIVS; V. David, INERIS; K. Notti, Société Waterlife SRL; C. Novais, Polytechnic Institute of Leiria / MARE-IPILeiria; H. Queau, N. Delorme, Istrea Lyon / UFR MALY Laboratoire Ecotoxicologie; K. Soosy, Université de Liège ULG; P. Baudoin, C. TURIES, INERIS / INERIS UMBR SEBIO ECOT; A. Catteau, A. Baldo-Nilles, INERIS; M. FOURAGE, Unamur; O. Geffard, Istrea / UFR MALY Laboratoire Ecotoxicologie; J. Porcher, INERIS / INERIS UMBR SEBIO ECOT; A. Geffard, Université de Reims Champagne Ardenne; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicology METO.

Owing to their ecological importance, freshwater probes provide important services which leads to a strong societal demand concerning the preservation of their quality. They are the receptors of many contaminants emitted by human activities and more specifically Polywaste treatment plants effluents. Water resources of the Meuse watershed are used on both sides of the French-Belgian border which involves a coherent and joint management. In that framework, the DIADEM project suggests developing and spreading out a cross-border multidisciplinary approach to improve the diagnosis and the chemical and biological (biomarkers) monitoring of freshwater probes using the Meuse river as a case study. In the past, results from chemical surface water monitoring of the Meuse has revealed the occurrence of numerous substances and more particularly pharmaceuticals. Overall, the project suggests coupling chemical and biomarkers analysis on caged organisms (a crustacean, a mollusk, a moss and a fish species) with predictive mathematical population models. In order to calibrate and validate these models, a lotic mesocosm experiment was set up. Five substances were chosen: diclofenac, carbamazepine, naproxen, paracetamol and ibesartan. An environmental realistic mixture M of the five substances was tested along with MX10 and MX100. The study was carried out in twelve 20 m long lotic channels. The mesocosms were set up with artificial sediments, macrophytes, periphyton, benthic and pelagic invertebrates, decomposers and one fish species (Gasterosteus aculeatus), zebra mussels, Fontinalis antipyretica and Gammarus fossarum were also caged in the mesocosms. After 3 months of stabilization, treatment lasted 5 months. Periphyton biomass, macrophyte biovolume, zebra mussel biomarkers and growth, G. fossarum survival, reproduction and growth, F. antipyretica biomarkers and growth, zooplankton and invertebrate abundance and diversity, and fish individual physiological responses responses were then measured biweekly.

WE362 Relationships between aquatic toxicity, chemical hydrophybicity and mode of action: log kow QSRAS revisited

Quantitative structure toxicity relationships (QSRAS) between chemical hydrophybicity and toxicity have been shown for nearly 100 years in both mammals and fish, typically using the log of the octanol-water partition coefficient (kow). The current study reassessed the influence of mode of action (MOA) on aquatic toxicity-log kow relationships using a comprehensive database of curated and standardized acute toxicity and consensus log Kow values, and weight of evidence classifications. Log kow QSRAS were developed as linear regressions of log acute toxicity and log kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad; 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ionosomeregulatory/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 QSRAS 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, Eurosinos Regulatory AG

Apart from delivering relevant toxicity data, standard lower-tier toxicity studies on aquatic organisms also provide valuable additional information for higher-tier testing strategies for risk assessments for plant protection products. While typically only the standard endpoint (e.g. 96-hour LC50) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of effects, 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 (SSD) for use in pesticide risk assessment
L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; G. Schmidt, BASF SE

EFSA’s guidance document for the risk assessment of edge-of-field aquatic organisms (EFSA, 2013;11(7):3290) recommends the use of species sensitivity distributions (SSD) as a second-tier approach for the aquatic risk assessment of plant protection products. For macrophytes, the hazardous concentration to 5% (HC5) of tested species can be attained by deriving a species sensitivity distribution (SSD) composed of effective concentrations to a 50% effect on the growth rate of primary producers (ErC50). Various probability distributions are available for the derivation of a SSD (e.g., lognormal, loglogistic) as well as publicly-available tools (RIVM’s ETX, MOASAIC, SSD from the University of Lyon, US EPA’s SSD
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 EC, for various x were estimated from a field experiment and used to derive a Species Sensitivity Distribution. The other example concerns a more “classical” approach where a limited number of taxa was used and regression model was tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The merits and caveats of both approaches will be discussed and a protocol for evaluating and documenting statistical and biological significance of a NOEC study design will be presented.

WE367 α-Dominance versus β-Prominence
F. M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
The NOEC or an equivalent regulatory set ECx value are key endpoints to assess if a target species or a group of species is challenged by a chemical in the environment. The assessment takes place in a multispecies context, e.g. in non-target arthropod (NTA) field studies. To date most ecotoxicologically faunistic NTA field studies follow a hypothesis test design. Few examples can be found that address ECx-finding by extrapolation from a regression model, such as the SSD-curve.

There are two risks associated with hypothesis tests: the producers' risk and the consumers' risk. The former is known as Type I errors that lead to false positives, i.e., frequencies α, whereas the latter is known as Type II errors that lead to false negatives, i.e., frequencies β. This contribution challenges the dominance of α and underscores the prominence of β when it comes to consumer safety. After all, a false positive result in a regulatory context implies a potential economic loss (re-testing, lost market share, lack of appropriate protection agents), whereas a false negative result implies a risk to environmental health. Statistical insignificance (P > α) is an important tool to reach biologically and statistically valid results. Where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, 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. As a result, sigmoidal concentration-response shape was more the exception than the rule, as also reported in the literature for such omics data. In this context, we will discuss and explain why these non-sigmoidal trends lead to several issues regarding the derivation of toxicity values. In particular, the derivation of ECx makes sense only provided an asymptotic response level is observed at high exposure concentrations and, in the case of non-monotonic trends, requires the definition of a maximal amplitude of the response. Alternatively to EC, the Benchmark Dose (BMD) has been proposed in the field of ecotoxicology for setting toxicity values. The BMD approach as mentioned in EFSA guidance proposes two options. The first one considers a x-fold change of the control response which seems hazardously sensitive to the signal level (if the control response is zero, so will be the x-fold change). The second option defines a critical response level accounting for the standard deviation of data (control response + SD). We will illustrate why this feature makes it more robust and usable whatever the concentration-response model.

WE369 Calculating the true ECx/LCx for non-linear models
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect ECx 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 maximum effect (e.g., mortality) is not the same as the effect at control. The NOEC is the threshold at which 0% 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, Abbott’s correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of these approaches cannot 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 regarded that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to control as how it is defined. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE370 Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect ECx 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 maximum effect (e.g., mortality) is not the same as the effect at control. The NOEC is the threshold at which 0% 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, Abbott’s correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of these approaches cannot 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 regarded that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to 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.
WE372 Aquatic higher-tier exposure testing of pesticides - from complexity to simplicity

G. Eck, E. Eschenbach, Eurofins Regulatory AG

Field exposure of pesticides is usually characterized by time-variable substance entries into water bodies resulting in complex exposure patterns which often significantly deviate from the constant exposure in standard ecotoxicity tests with aquatic organisms. As an appropriate risk refinement option higher-tier exposure testing is proposed in the current EFSAs guidance document for aquatic risk assessments providing the possibility to define ecotoxicologically relevant test conditions patterns and meaningful link to FOCUS exposure modelling outputs. Studies designed to reflect realistic exposure often result in lower effects. However, FOCUS exposure patterns are frequently challenged in regard to their representativeness for the variety of possible field scenarios and hence are generally not accepted as valid refinement option by several EU Member States. Besides, it is often difficult to generalize various critical patterns of different FOCUS scenarios for a proper test design alignment and incorporation of varying patterns 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 toxicology data is required to develop meaningful test designs and strategies. Generating simplicity from complexity rather than matching exactly the FOCUS modelling exposure pattern is proposed as potential solution to concerns on representativeness as well as practicability for ecotoxicology testing and finally acceptability in a regulatory context. The poster will present examples for the generation of reasonable test designs and strategies that are considered to meet objections towards higher-tier exposure testing as adequate means for refinement of aquatic risk.

WE374 Critical aspects of higher-tier laboratory exposure testing with different aquatic organisms

G. Consier, Eurofins Agroscience Ectotox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins Agroscience Ectotox GmbH / Aquatic Ecotoxicology

Aquatic exposure testing. The aim is to higher-tier risk evaluations proposed in the current EFSAs 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 is proposed in the current EFSA guidance document for aquatic ecotoxicology testing and finally acceptability in a regulatory context. The poster will focus specifically on TCE’s non-carcinogenic effects, including mutagenic effects, as well as substances with potential carcinogenic effects and the choice of allowable risk level. Ho wever, the point estimates used to calculate DNELs are by design overestimated estimates that when combined lead to a phenomenon termed “compounded conservatism”. The consequence of this phenomenon is DNELs that likelihood 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 all available data and information that is not 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 protectiveness of a chemical’s DNEL. This work will demonstrate how PRA is used to calculate DNELs using trichloroethylene (TCE) as an example. The presentation will focus specifically on TCE’s non-carcinogenic effects and incorporate the variability and uncertainties associated with dose-response modeling, physiologically-based pharmacokinetic modeling, assessment 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.

WE375 Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!

M. Tenderel, Fraunhofer IME / Ecotoxicology; B. Weber, D. Warnecke, RIFCON GmbH; Goldbeckstr Hirschberg Germany

Refined exposure tests can be used to transfer more realism into standardised exposure scenarios. Where scenarios fail, it is critical to consider what causes this failure to progress from theoretical to more practical exposure scenarios. For example, the FOCUS procedure of several pulse applications may have an impact and possible distortion on derived DNELs and to directly calculate PEC/PNEC side. 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.
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 occurs in the field, is significantly shorter than in the standard laboratory experiments. However, to avoid the challenge is to often to cover exposure that is 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 a typical laboratory exposure 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. 

Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage. 

Optimisation of a chronic toxicity flow-through system may pose a significant challenge, especially when assessing thyroid disruption. To account for these challenges, we will present data on a twofold strategy including A) test systems and B) exposure conditions. An Experimental data of newly established (sub)chronic test systems, which are suitable for measuring Tier 2 and Tier 3, were used. The evaluation of biological effects was based on evaluated include, for example, oestrogens, cyclopids, nematodes, ophiuroida and amphipods, with a focus upon experimental conditions, suitability of standard toxicity testing endpoints and experimental validity. Subsequently, data on selected test systems under flow through test conditions simulating pulsed dose exposure scenarios will be given.

Invertebrate Test Systems and the Application of Realistic Exposure Scenarios

A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Aquatic Toxicology

According to recent and proposed guidance of the European Food Safety Authority (EFSA) current aquatic toxicity test systems should be critically reviewed, adjusted in regards of realistic (e.g. pulsed) exposure and complemented by establishing new test systems. To account for these challenges we will present data on a two-fold strategy including A) test systems and B) exposure conditions. An Experimental data of newly established (sub)chronic test systems, which are suitable for measuring Tier 2 and Tier 3, were used. The evaluation of biological effects was based on evaluated include, for example, oestrogens, cyclopids, nematodes, ophiuroida and amphipods, with a focus upon experimental conditions, suitability of standard toxicity testing endpoints and experimental validity. Subsequently, data on selected test systems under flow through test conditions simulating pulsed dose exposure scenarios will be given.

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

S. Pavlovsky, M. Dammann, S. Champ, BASF SE; M. Mathis, M. Fort, Fort, Environmental Labs, Inc.

The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay - AMA) represents a Tier 1 toxicology test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (1956) Xenopus laevis to different concentrations of the test substance (peak) for 21-days and the following endpoints are measured: mortality, hindlimb length (HLL), body length (snout to vent - SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid disruption. Recently, the relevance of the suitability of hindlimb length (HLL) normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between limb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≥ NF stage 60 from the > NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r²=0.315-0.275, 0.553). Negative or no correlation between hindlimb length and body weight was found in the 8 studies examined without late stage development (r²=0.347-0.156, 0.429, 0.564). For the censored studies, correction between HLL and SVL or body weight was found in 1 of the 2 studies (r²=0.452, 0.511). In each of the 10 studies, no asynchronous development was consistent with the absence histopathological findings in the control. The degree of HLL differentiation relative to other morphological markers of developmental stage determination 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.
Difficult Substances and Challenge for the Algal Growth Inhibition Test According to OECD Test Guideline 201

S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Peither, J. Schreitmüller, Innovative Environmental Services IES Ltd

Chronic toxicity tests with fish are required for the risk assessment of plant protection products, pharmaceuticals and chemicals (depending on their damage and characteristics of the chemical). As chronic standard toxicity test the fish Early Life Stage (ELS) test following the OECD Guideline (GL 210) has to be conducted, in certain cases this test system can be extended to an OECD GL 229, 230, 234 or to a full life cycle test. All these tests include the evaluation of sublethal effects on the test fish. This extension is recommended in case an influence of the substance toward the endocrine system (and finally the reproduction) cannot be excluded.

The OECD guidance document on aquatic toxicity testing of difficult substances and mixtures (23) provides some hints how the “standard testing” with such difficult test items should be conducted, but due to the numberless combinations of characteristics of these different substances, some innovation is required to find the best test design for the individual chemicals. We show examples for the toxicity testing of difficult test items starting with the investigation of the characteristics of the test item in the respective test water (water solubility, stability in water, photolysis effect, adsorption, storage conditions) and then to determine the toxicity, the testing itself and finally the choice of the most suitable evaluation method within the various possibilities of calculation and interpretation of the results. In this presentation we focus on the testing of algae, but many aspects can be transferred directly to acute and chronic toxicity testing with daphnids or fish. This is important as in daily business in most cases a package of aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the data and the most appropriate is clearly not a priori known.

Volume and distribution as well as possible advantages for the combination of soil core and slide trap sampling would then increase the possibility of a robust evaluation of treatments. One advantage of activity based sampling method for soil microarthropods would be the slide traps which were presented at SETAC 2016 by Dehelean et al. 2016. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling and will present first results from the comparison of soil core and slide trap catches. Römkke, J., Schmelz, R., Knaibe, S., 2009: Field studies for the assessment of pesticides with soil mesofauna, in particular enchytraeids, mites and nematodes: Design and first results. Soil Organisms, 81:

237-264 - Stefan-Bodgan Dehelean 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

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Copepods play an important ecological role on marine ecosystems and may be an 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 classification of zooplanktonic particles 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

SETAC Europe 28th Annual Meeting Abstract Book 410

L. Mariani, CNR-IRSA / Irsa, F. Savorelli, ARPA EMR; B. Di Lorenzo, ISPRAP Institute for Environmental Protection and Research; F. De Luca Picione, ENEA; M. Francese, Shoreline, Trieste; E. Di Capua, Regional Agency for Environmental Protection, ARPA Toscana; E. Giacco, university of genoua; s. manzo, ENEA / SSPORT-PROTER-BES; P. Musolo, Università degli Studi di Napoli Federico II; A. Mazzolla, Regional Agency for Environmental Protection, ARPA Sicilia; D. Pflug, Regional Agency for Environmental Protection, ARPA Emilia-Romagna; L. Pane, University of Genova; G. Sansone, Universita Federico II Napoli; V. Bellaria, ISPRAP Institute for Environmental Protection and Research; G. Shirlir, Regional Agency for Environmental Protection, ARPA Toscana

The necessity to develop appropriate methods for the assessment of water quality and effluent toxicity was recognized by environment protection organisations and indicated by legislation like the EEC Water Framework Directive (2000/60/EC) and the new Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006), both require data from ecotoxicological tests by using algae, crustaceans, and fishes. Some tests procedure have already standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were indicated more frequently than marine ones. In particular, the lack of specific acute toxicity methods on Mediterranean fish species have involved the adaptation of procedures available for freshwater fish (OECD, 203, 1992). In order to standardize the acute toxicity method for European sea bass (Dicentrarchus labrax L., 1758) larvae (species widespread in Mediterranean sea), two intercalibration exercises were conducted by 7 Italian laboratories, according to ISO/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories received sea bass 24h-48h and replicates (2-3) to be tested. These characteristics allow this species to be a potential biological model on experimental studies.

During the testing of difficult substances, this presentation also intends to underline the fact that most of the laboratories' experience, has been affected by the different 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 conditions) and then to determine the toxicity, the testing itself and finally the choice of the most suitable evaluation method within the various possibilities of calculation and interpretation of the results. In this presentation we focus on the testing of algae, but many aspects can be transferred directly to acute and chronic toxicity testing with daphnids or fish. This is important as in daily business in most cases a package of aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the data and the most appropriate is clearly not a priori known. The analytical possibilities are introduced and discussed as well.
The biogeochemical cycles of several lanthanides (LnS) are being progressively disrupted by their increasing use in industrial sectors such as high-tech applications and clean energy generation. Except for a few hotspots located close to industrial waste water discharge points, LnS concentrations remain essentially low (i.e., in the μg/L range or lower), but the paucity of available data has fostered research on their possible effects on biological organisms. Getting reliable information on the ecotoxicological potential of LnS is also important in view of the possible opening of mining activities in response to the current monopoly of Ln production by the People’s Republic of China. In this context, testing LnS ecotoxicity following established standard protocols must consider the peculiar chemistry of these elements if meaningful results are to be obtained and used to establish regulatory limits. After addition to ecotoxicological media, typically in the form of soluble chloride salts, LnS can rapidly form complexes with phosphates or carbonates or undergo hydrolysis. Due to the low solubility of LnS-phosphates and LnS-carbonates, precipitation may occur, forming LnS solubility and reduce to a fraction of the expected value the concentrations to which organisms are exposed. The presence of possible Ln-containing precipitates can further complicate the interpretation of the corresponding biological responses. In this contribution, we use thermodynamic speciation modeling to examine the equilibrium theoretical speciation of LnS in standardized ecotoxicological media for algae, susceptible to LnS, and aquatic macroinvertebrates, e.g., daphnids or freshwater fish. We also tried to evaluate the possible contribution of soluble vs. poorly soluble species and potential colloidal precipitates in ecotoxicological test media. While thermodynamic modeling does not allow to predict the time of occurrence of LnS precipitation, it still provides useful indications as to the potential exposure conditions likely to be experienced by organisms in standard ecotoxicity tests.

WE387
Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media
D.A. Vignati, CNRS / LIEC UMR7360; F.G. Acanfora, University of Salerno / Department of Chemical and Biology; G. Cornelis, Swedish University of Agricultural Sciences / Soil and environment; M. Carotenuto, University of Salerno / Department of Chemical and Biology. We compared the predictive capability of several equilibrium thermodynamic models (e.g., MINTEQ, NAPHEPP, EAWIPPEL) to estimate the toxicological impact of LnS species in test media. We also tested the suitability of the different LnS species for ecotoxicological tests that this is meaningful if the LnS concentrations reported in published literature studies, attempts are also made to model the fraction of added Ln predicted to occur in precipitated forms. Finally, depending on the availability of the appropriate complexation constants, the predictions for laboratory media are compared with those for natural waters where the presence of dissolved organic matter can cause important differences in comparison with laboratory conditions. We present the procedure used for eventual toxicological studies and highlight cases where actual exposure conditions could be experienced by organisms in natural aquatic systems.

WE389
Is that an effect? The importance of using all relevant data in mesocosm studies
J. Ashford, Cambridge Environmental Assessments; A.C. Brooks, Cambridge Environmental Assessments / Department of Environmental Science; A. Lawrence, Cambridge Environmental Assessments / Regulatory Ecotoxicology; M. Allen, Cambridge Environmental Assessments / Aquatic Risk Assessment; C. Cossu, CNRS / LIEC UMR7360; F.G. Acanfora, University of Salerno / Department of Chemical and Biology. In long-term multispecies studies, such as mesocosms, a complex statistical analysis is required to decipher the data and determine whether a test-item effect has occurred. It is sometimes the case that regulators and applicants have differing opinions as to what the no observed effect concentration (NOEC) or no observed adverse effect concentration (NOAEC) should be, based on the accompanying data analysis. This poster describes the problems encountered by the laboratories when testing a highly volatile, rapidly biodegradable, hydrophobic, non-polar narcotic substance like limonene under chronic conditions, how these were countered by the monitoring team and after a series of discussions and eventual implementation of different sampling methods, eventually the test results were viewed as accepted and lead to the chronic category 1 classification. The conclusions and recommendations made are intended for the EU regulations are currently ongoing.

WE390
Evaluation of the environmental risk assessment procedure according to Directive 2001/18/EC for Gene Modified Organisms used as medicinal products
H. Weigt, Fraunhofer Institute for Toxicology and Experimental Medicine ITEM / Chemical Risk Assessment; E. Weber, Fraunhofer Institute for Toxicology and Experimental Medicine ITEM; M. Batke, Hochschule Emden/Ler; S. Schwanbeck, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; A. Bittner, Fraunhofer ITEM / Chemical Risk Assessment. The deliberate release of genetically modified organisms (GMOs) including GMos
used as medicinal products, e.g. gene therapies, into the environment is regulated by directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001. An integral part of the directive regulates the provision of information on the GMO and, based on this, the risk management with regard to the environmental effects of such releases. As regulated by this directive, a publicly accessible database (the "GMO Register") of the Joint Research Center of the EC (http://www.gmoinfo.jrc.ec.europa.eu/default.html) contains information about all GMOs as used under the Directive. As of 07.11.2016, there were 238 entries of medicinal GMOs in the "Summary Notification Information Format (SNIF). SNIFs are prepared as a summary document of the confidential environmental risk assessments (ERA) by the respective Sponsors of clinical trials in the EU and evaluated during the clinical trial application by the national competent authorities. The Enterprise, in turn, 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 Adenosivirus, 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 herein. The primary purpose of this work has been to examine environmental and aquatic bioaccumulation, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

**WE391** PBT evaluation 20 years on: is it time to reconsider the technical progress made in risk assessment methodology? P. Thomas, C. Durou, CEHTRA SAS - / - 

In the EU, the ecotoxicological dataset for a chemical is used for the purposes of prospective risk assessment (PRA) and of PBT assessment. While the PRA aims at determining the use conditions and risk management for which the environment is safe, the PBT assessment aims at identifying chemical for which effects on the long-term are considered unpredictable and that environmental exposure is difficult to reverse. The scope of this poster is to discuss, in the light of technical and scientific progress: For which PBT-Like and certain PBT chemical, PRA can now be carried out. The justification of the numerical criteria behind the identification of PBT chemical and PBT property. Unpredictable effects are fundamentally linked to uncertainty in: Assessing accurately a chemical's potential to amplify along the food chain, and Whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/PvP/B criteria were originally designated. The numerical criteria were established in the late 1990s by OSPAR. Although the primary basis has been to examine environmental and aquatic bioaccumulation, use by the EU (TC NES) from the early 2000’s expanding the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPa when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such chemicals (e.g. concentrated sulfuric compounds) were non-typical and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to anticipate amplification along a food chain but may be of limited meaning for other chemical classes. In the US, B is defined as a BCF of >5000 which is the BV criteria in the EU while perhaps the only meaningful way to determine B is to consider bioaccumulation in the food chain which has no legal relationship with the B criterion. Further questions can be posed of the true meaning of the half-life cut-off values for P and vP in terms of environmental persistence and the meaningfulness of using a standard mg/L cut off basis for T blanketing all MoAs.

**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 Notingham, Association of Retired Environmental Scientists ARES; D. De Zwart, DiZ Ecotox / Centre for Sustainability Environment and Health; J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; N. van Straalen, 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 Straal-phenalden convolution integral. The tool estimates the addition of toxic pressure to the ambient toxic pressures in local, regional and continental EU environments, expected from the UVCB mixture. It is proposed that ‘safe use’ is demonstrated sufficiently well by showing that the UVCB under study is expected to contribute negligibly to ambient toxic pressure in the environment. The proposed ‘safe use’ calculation method has been tested in a relatively well studied UVCB mix and illustrates its potential with the outcomes of test calculations.


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 pollen and evaluation of HPG. However, in 2017, the new OECD guideline (no. 245) was introduced, in which the methodology of chronic toxicity testing was changed compared to the EFSA document. Changes occurred in the way of dealing with bees – there is no access to distilled water and pollen, and no evaluation of HPG. It is a significant change, because according to the literature (the literature is divided into two groups, studies of 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. Dér, Department of Biology, University of Osijek / Department of Biology; D. Hackenberger, Geonatura; B. Hackenberger, Department of 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 we re-exposed to different concentrations of ZnCl₂ and our studies were performed in one transparent plastic Petri dish in prepared solutions of the test compounds 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 pollen and evaluation of HPG. However, in 2017, the new OECD guideline (no. 245) was introduced, in which the methodology of chronic toxicity testing was changed compared to the EFSA document. Changes occurred in the way of dealing with bees – there is no access to distilled water and pollen, and no evaluation of HPG. It is a significant change, because according to the literature (the literature is divided into two groups, studies of 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.

**WE395** The validation of analytical methods in ecotoxicology I. Pedall, A. Rastall, A. Sagner, M. Faupel, Rifcon GmbH

The validation of analytical methods (regulated by SANCO/30299/04 rev 4) used in support of ecotoxicological studies has become an important aspect of the
registration process for plant protection products. When Regulation (EC) No. 1107/2009 came into force, adherence to the SANCO/3029/99 rev 4. Guidelines became obligatory. This has resulted in serious implications for the registration process because ecotoxicological studies may well now be rejected on the basis of inadequate analytical methodology or incomplete analytical data although the studies have previously been accepted. Here we give an overview of current requirements and provide a checklist that can be used to evaluate analytical methods in ecotoxicological studies.

WE396 A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFSAS 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. EFSAS Aquatic Guidance (2013) aims aquatc 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 swim-up fry were added over 2 hour static exposure phases on Days 0 and 14. The study duration for organisms starting as ‘eggs’, ‘alevins’ and ‘swim-up’ fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coordination). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both > 95%. The design allowed the direct comparison of the sensitivity of each life stage to identical pulsed exposure profiles. Free-feeding ‘swim-up’ fry was the most sensitive exposed life stage, based on clinical signs, feeding and slightly reduced growth. Swim-up of exposed alevins was delayed at high treatment levels. Exposed eggs were unaffected.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a 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 its bulk form. Recently, SiO2 in nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-cake agent in food industry, or owing to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up fry. There were two 72 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] Barki TK, Sahu B, Swan V. 2008. Nanosilica—from medicine to pest control. Parasitology Research. 103:253, [2] Torney F, Trewyn BG, Lin VSY, Wang K. 2007. Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nature Nanotechnology. 2:295. Acknowledgement - The authors thank the Swiss National Science Foundation (project 168187) and the Adolphe Merkle Foundation for the support and funding of the study, and Laura Rodriguez-Lorenzo for her precious advice and suggestions.

WE398 Occurrence of fullerene aggregates in Mediterranean rivers: Two cases of study
J. Sanchis, IDAEA-CSIC / Water and Soil Quality Research Group; R. Milacic, Jozef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAEA-CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry
Fullerenes are carbon nanomaterials that have many potential applications in nanotechnology and that can be generated in some combustion processes. Since their environmental effects and behaviour are uncertain, fullerenes are considered emerging contaminants and during the last years they have been included in some analyzes. Recently, some laboratories have reported the presence of fullerenes in water systems. In order to assess the environmental risk of fullerenes it is important to enlarge the dataset and to characterize the concentrations of these nanomaterials in different rivers. In the present work, C60 fullerenes, C70 fullerenes and five functionalized derivatives were determined in water and sediment samples from two Mediterranean rivers. The first case of study was located in the Sava River (Souteeastern Europe), where more than 30 samples were studied in two sampling campaigns. In the second case of study, samples of estuary water, wastewater, river water and coastal water from the Ebro River delta were analysed. In both studies, C60 was the most ubiquitous compound and it was detected for the first time in the marine environment, although its concentrations were below the ng/l order in all the cases. The exotic fullerene C66PCBM was also detected and environmental samples 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-Globauqa and by the Spanish Ministry of Economy and Competitiveness through the project Integra-Coast (CGL-2014-56530-C4-1-R). It has also received funding from the Generalitat de Catalunya (Consolidated Research Groups “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefaniei, Alina, et al. Analytica chimica acta 882 (2015): 1-12. [2] Feix, A., et al. ENVIRONMENTAL SCIENCE & TECHNOLOGY 2014; 48(21): 1255-1263. [3] Piñol, G., et al. Environmental Science & Technology 2017; 1: 589-598. [4] Feix, A., et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, Josep, et al. Environmental science & technology 50.2 (2015): 961-969.

WE399 Occurrence, fate and behaviour of fullerene 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, C60(N,N-arylalkylpyrpyrrolidinyl), C60(6,6)-phenyl C60, C60(thienyl C60(6,6,6)-phenyl C60, C60(7,7,7)-phenyl C60) in waters, soils and sediments combines an active extraction (UAE) followed by 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/mg·g/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 epoxide and dimers. Finally, the kinetics of generation of each transformation product will be well presented.

WE400
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

M. Surette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments is currently incompletely characterized. A recent study investigating the importance of surface coatings using simplified, synthetic mediums has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is unknown whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether an ENM’s engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. 'n 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 time was measured to determine the rate of aggregation. The first observation was the rapid evolution of TiO$_2$ nanoparticles (TiO$_2$ NPs) in a natural environment according to the life cycle impact assessment method (CICIA) and the removal kinetic and efficiency during activated sludge stage.

Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

Y. Skuce, Scottish Water Horizons Ltd; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical devices, and energy storage. As the technology evolves, and ENPs are more widely used, we can expect to see increasing input of ENPs into WWTPs. Therefore the increased use and potential toxicity of ENPs poses a challenge for WWTPs due to their potential harmful effects towards activated sludge. The extent to which WWTPs can remove ENPs from the sewage must also be explored, to determine not only optimal outflow into receiving waters but also accumulation within the activated sludge itself. To this end we focused on the activated sludge treatment, as the majority of ENPs can remain in wastewater stream throughout preliminary and primary stages. We investigated a range of ENP digestion and analysis protocols to determine the most reliable procedure for ENP analysis from activated sludge. From this, we developed an analytical method involving H$_2$SO$_4$-HNO$_3$, microwave assisted digestion coupled with ICP-OES to measure ENP concentrations. Following this, using laboratory microcosms we assessed the kinetics of ENP removal by activated sludge. The kinetic design we adopted provided different ENPs-activated sludge contact times. ENP concentrations were then analysed in both effluent and settled fraction. Similarly to previous reports, high and quick TiO$_2$ removal rate (>80% and >99% after respectively 5 and 60 min) during activated stage treatment have been found. However, the dynamics of TiO$_2$ removal involved in the removal of ENPs from sewage by activated sludge remain not fully understood, but results of laboratory test and site samples indicate ENPs are rapidly captured-associtated with activated sludge. Following this, we exposed activated sludge to repeated cycles of ENP exposure indicative of the cycling of activated sludge in a WWTP. During each cycle, ENPs were efficiently removed. As consequence of this exposure, the significant enrichment of activated sludge biomass with metal based ENPs can result in a secondary hazard, as ENPs rich biomass acting as a “sponge” can accumulate high concentrations of ENPs, which may be released when recirculated within the wastewater treatment or when applied to land. A similar approach is now being adopted to investigate the fate of mixture of ENPs and ENPs from real products within the activated sludge treatment.

Fate factor of engineered TiO$_2$ nanoparticles in aquatic and terrestrial natural environments

A. Schulz, University of Strasbourg (UdS); G. Quaranta, Université de Strasbourg / CNRS / EOST/LHYGES; S. Lawcznik, University of Strasbourg / LHYGES

Engineered TiO$_2$ nanoparticle is 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 (LCA) is a powerful method that is able to characterize TiO$_2$ 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 TiO$_2$ nanoparticles (TiO$_2$ ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO$_2$ NPs in water, soil and sediment near a production site in Vieux-Thann (68) to determine parameters which contribute to the fate of TiO$_2$ NPs and secondly, to compare the model results with the empirical data. The model results showed that TiO$_2$ NPs concentration in sewer with time is significantly different from the other kinds of water from previous studies. As well as experimental attachment determination in the previous steps are used to calculate a fate factor of TiO$_2$ ENPs in a natural environment according to the life cycle impact assessment method (CICIA). During the study, it was found that TiO$_2$ ENPs are strongly influenced by the engineered surface coating, even after interacting with a complex, natural medium.

Assessing the fate and transport of engineered TiO$_2$ nanoparticles in sewer pipes through a dynamic multimedia model (SWNano)

K. Kim, Seoul National University / School of Chemical, Biological, and Environmental Management; C. Araujo, Consejo Superior de Investigaciones Científicas / BIOFUND; R. Surette, University of Strathclyde / School of Chemical, Biological, and Environmental Engineering; R. Skuce, Scottish Water Horizons Ltd; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

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have produced undesirable effects in many marine organisms. Marine phytoplankton is vital in marine ecosystems, as microalgae are at the bottom of the food web and, therefore, any change in microalgae population will have an important impact into the rest of food web. The direct mechanism of NPs toxicity is the physical damage in cell membrane through adsorption of NPs onto the cell leading to NPs uptake, bioaccumulation and toxicity in different organisms. Therefore, the hypothesis of this work is that microalgae lacking of cell wall will be more resistant to the toxic effects of NPs than those with a typical cell wall. To test this hypothesis two microalgal species, Dunaliella salina, lacking cell wall, and Chlorella autotrophica, with a typical cellulosic cell wall were chosen. Species were exposed to ionic (AgNO₃ and Ce(NO₃)₃) and NPs (Ag NPs and CeO₂ NPs) forms of Ag and Ce over 72 h and the following responses were assessed: cell density, cell viability, cell size, cell complexity, autofluorescence of chlorophyll a, active chlorophyll, effective quantum yield of photosystem II and reactive oxygen species (ROS). Metals in both forms (NPs and ionic) caused negative effects in cell division, inherent cell properties and physiological mechanisms of both microalgae. The general trend was a decrease in active chlorophyll, effective quantum yield of PSII, and cell density and an increase in cell complexity and percentage of intracellular ROS. For both microalgal species, Ag was more toxic than Ce and ionic forms of both metals were more toxic than NPs. Contrarily to our hypothesis, D. salina, despite not having a cell wall, showed to be less sensitive to metals than C. autotrophica. Therefore, the cell wall of C. autotrophica seems not to suppose higher protection preventing toxicity of NPs. The higher resistance of D. salina against the metals and metallic NPs tested might be related to: (i) its ability to stock-dispalts, the measured z-averages ranged from 600 nm (CPO-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 solution, the measured z-averages ranged from 600 nm (CPO-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 active NPs in both species and cell wall, 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 µg/L), CPO-27-Ni (Ni, 235 µg/L) and HKUST (Cu, 143 µg/L). Uio-66-COOH caused a 100 % increase in 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 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 included in the R. subcapitata toxicity tests.

Tracking Physicochemical Changes of PAHs in the Presence of TiO₂ Nanoparticles by Assessment of Biological Responses

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Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent environmental contaminants with diverse physicochemistry and toxicity. In contaminated aquatic environments, PAHs frequently accumulate in sediments or are sorbed to particulates in the aqueous phase. Some PAHs are photocative and have photo-induced toxicity, but little is known about interactions between PAHs and nanoparticles. Engineered nanoparticles (NPs) can behave as particle agglomerates that participate in sorption/desorption reactions in the aqueous phase, and some NPs (e.g., TiO₂-NPs) also have photocactivity. Aqueous-phase interactions between PAHs and TiO₂-NPs are of interest because they are becoming more environmentally relevant (i.e., as NPs are increasingly released into the environment), and because investigations of sorption/desorption processes, in the context of photoactivation, can provide important new information on physicochemistry of both PAHs and NPs. Previous work conducted by our research group has found that some of PAHs onto photo-active NPs promotes photo-catalysis of PAHs thus altering PAHs bioavailability and toxicity under UV-A radiation. In these experiments, bioavailability (cytochrome P4501A cyplA gene expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of aromatic and benzo[a]pyrene to NPs in water. Our objective is to investigate PAH/TiO₂-NP sorption under UV-A and the consequent photocatalytic decomposition of PAHs in the presence of either polycyclic aromatic hydrocarbons (OPAHs) and their bioactivity. Various combinations of PAH/TiO₂-NP preparations will be exposed to UVA, and changes in gene expression of genes involved in Phase I metabolism (cytochrome P450 cyplA and cyplB) and Phase II metabolism (gst, ephx, gsh) and epoxide hydrases 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 and product bioavailability during sorption processes will provide novel insight into these processes tested directly within the environmentally relevant aqueous phase.

Toxicity of TiO₂ nanoparticles to freshwater chironomids - pointing out the relevant endpoints

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In the environment, nanomaterials are present in a number of chemical forms, exhibiting specific interactions, mobility, biological availability and potential toxicity. Both ecotoxicologists and pathologists have expressed their concerns regarding the potential negative effects of nanomaterials in live systems and the environment. The present study was carried out in order to assess the influence of TiO₂ nanoparticles (in the form of human white food colorant E171) toxicity on the freshwater midge Chironomus tentans. The safety and consequences of the intake of this form of E171 TiO₂ for human health are not yet 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 of E171 TiO₂ per 1 kg of sediment were used to assess sublethal effect (morphometric changes of mentum, mandibles and wings). The mortality and emergence ratio was affected by a higher nanoparticulate TiO₂ 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 mentum teeth to narrow and elongate and the mandibles to widen after the first inner tooth, with a rise in the TiO₂ concentration. The present study revealed most suitable endpoints in the case of TiO₂ 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-TiO₂ monitoring together with geometric morphometry.

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 death, in higher and lower eukaryotes, such as growth and reproduction. Most toxicological studies, however, only cover a limited timescale of the organism’s life stage, rather than the whole lifespan, or even across generation. Therefore, knowledge on multigenerational effects is lacking. The current study was conducted in order to determine whether the six generational exposure to sub-lethal concentrations of either ionic or nanoparticulate silver (AgNP) could induce alterations in sensitivity to Ag exposure using the nematode C. elegans as a model. Further, changes in susceptibility to other metals and the role of ROS as well as metabolic changes were investigated. Exposure to sub-lethal concentrations revealed increased susceptibility to toxic Ag, while
AgNPs tolerance increased. Results show that adaptation development may occur after just a few generations. Subsequent exposure to paraquat, a known ROS inducer, indicated the involvement of ROS defense mechanisms. Therefore, changes in glutathione redox potential and sod-1 gene expression were measured, employing the genetically encoded fluorescent biosensors Grx1-roGFP2, and the reporter strain Sod-1:-gfp, respectively. Further, effects of the AgNPs on the central metabolism and implications on energy production are investigated by measuring the metabolic footprint of AgNPs using the GROPE and PE255.

Findings of this study will aid to further improve the understanding of the toxicity of nanoparticles, as well as contribute to our knowledge about the behavior of C. elegans in response to toxicants. Acknowledgements: Karl Andreas Jensen and Sofridur Lohne. This work was supported by the Norwegian Research Council funded NanoCharm (221394/ED4) and NorNanoReg (239199) projects, and the EU NANOReg project grant agreement n° 310584.

WE409 Effect of silver nanoparticles layer on soil surface to terrestrial species
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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 exposure sources of nanomaterials. This study focused on the simulation of exposure scenarios of nanomaterials landfills, and set the aim to investigate different toxic effects derived from different scenarios. Silver nanoparticles (AgNPs) were selected as test nanomaterials and 3 different particle sizes 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 micromoss experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because the root surface of soybean was most larger than AgNP were entrapped on 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 (2016R1A2B3010445).

WE410 Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight
Y. Song, Korea Institute of Ocean Science and Technology; W. Shin, S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group; S. Eo, Korea Institute of Ocean Science and Technology
Production of nano- and micro-sized plastics through weathering of plastic surface by photo-oxidation was regarded as one of major input sources of secondary nano- and microplastics. Its fragmentation process according to exposure duration and size of plastic particles differs. In this study, 4 different exposure scenario 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 micromoss experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because the root surface of soybean was most larger than AgNP were entrapped on 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 (2016R1A2B3010445).
from a Lake Dosed with Nanosilver

C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Engineering; K. Newman, J.D. Martin, Trent University / Water Quality Centre

Bench-scale tests have shown that silver (Ag) accumulates in the tissues of fish exposed to silver nanoparticles (AgNPs). However, these experiments cannot replicate the complex biogeochemical processes and trophic interactions in natural aquatic ecosystems. This study was conducted as part of whole lake addition project in which a total of 15 kg of AgNPs was added over two ice-free field seasons to a small lake (i.e. Lake 222) in the Experimental Lakes Area in Canada. Both yellow perch (Perca flavescens) and northern pike (Esox lucius) accumulated Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a significant increase in Ag concentration was observed in liver of 5.1 μg/g wet weight. In perch, the highest concentrations of Ag were observed in gill tissue. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 μg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake in the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish to piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are 3 orders of magnitude greater than the concentrations in water.

WE417

Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata

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Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomediatric, 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 severity 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 oocytes to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation

(Exo)toxicity tests for hazard evaluation of recycling materials and waste (P)

WE418

Biobests for Hazardous Waste Classification (HP14): benchmarking Limits for Tolerable Ecotoxicity.

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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 always sufficient to perform a chemical classification. This paper focuses on the development and implementation of the chemical evaluation as step 1 biobests in steps 2 (acute aquatic tests on eluate fractions) and step 3 (acute 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 biobests results against waste materials that were proven to be toxic in step 1, and it was conclusion that LID4 as TE was a suitable option for our data set. The main conclusions were: The proposed set of biobests is essential for proper HP14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of biobests. LID 4 is proposed as TE
for steps 2 and 3 (to be further evaluated for a larger data set). Both aquatic and terrestrial tests are needed for complete HP14 evaluation. This study was funded by OVAM, the Flemish Waste Agency! The kind help of the technicians Guy 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 / Chimie Ecotoxicology Lab, C. Martin, FCBA / Gironde In Europe, the classification of waste is carried out by an assessment of the hazardousness of the waste using data of known waste composition according to the properties of danger. This classification can be based only on the waste composition if the available data are sufficient and relevant. This method is based on the sum of characteristics of each waste compound with 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: Ecotoxicity for the environment (HPI4). Test strategies will allow wood wastes to be recovered or recycled.

WE420

QUALITY STANDARDS FOR URBAN WASTE FERTILIZERS: PUTTING ECOTOXICITY IN THE PICTURE S. Chelinho, CFE - Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies only on physico-chemical and biological analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I; theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed municipal solid waste (group II) were selected and tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the highest and lowest toxicity were observed in the two UWF from group I. Among soil organisms the range of sensitivities was: E. andreii > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridissima > R. subcapitata > C. vulgaris > H. incongruens > 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 promoted.

WE421

Chemical and Ecotoxicological Assessment of Reclaimed Asphalt for their Subsequent Use V. Janke, M. Buckova, R. Lichinsky, J. Hegrova, J. Huzlik, K. Effenberger, Transport Research Centre Reconstruction and repair of the road infrastructure is a source of the reclaimed asphalt, which is suitable to continue to use. It is also necessary to deal with the environmental impact of these materials within their ongoing life cycle, except testing their mechanical properties. Currently, the environmental impact tests of recycled asphalt are performed in crushed condition, according to the leachability test of granular materials with grain size Scenedesmus subspicatus, Sinapis alba, Daphnia magna were carried out in aqueous extracts. The results were compared with the legislation and were evaluated in terms of the content of the monitored substances and the type of test material.

WE422

Leaching tests - a useful tool for the environmental impact assessment of construction products N. Bandom, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgens, BAM Federal Institute Materials Research and Testing; U. Schoknecht, BAM Federal Institute for Materials Research and Testing Construction products and waste materials used for construction can be in contact with the environment and may release potential harmful compounds. Information on the total content of these substances in the product is not sufficient to assess its environmental impact since it does not consider realistic exposure conditions. Concerning the pathway to soil and groundwater by contact with rain or seepage water leaching tests are available. The aim of this presentation is to show exemplary results of existing leaching methods and underline the strength and weaknesses of this kind of test with selected examples of our work: Concrete roofing tiles with terrabuyn 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 terabuyn. Concerning the assessment of this leaching data it is important to notice that the eluate concentration do not represent necessarily environmental concentrations. Thus, the concentration in the leaching test cannot simply be correlated to environmental quality 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 recontamination: you don’t need to measure everything, just the right things I. Dryganiak, Texas Tech University / Department of Civil Environmental and Construction Engineering; Cis Boonen, Wilfried Dumortier is highly appreciated. Water quality is of central importance for steps 2 and 3 (to be further evaluated for a larger data set). Both aquatic and terrestrial, in order to evaluate one of the 15 existing properties: Ecotoxicity for the environment (HPI4). Test strategies will allow wood wastes to be recovered or recycled.

WE424

Development of active capping materials for oil spill contaminated sediment remediation L. Schütz, Norwegian Geotechnical Institute; P. di palma, IRSACNR; C. Riccardi, INAIL; E. Eker, s.e. hale, Norwegian Geotechnical Institute; p. viotti, Università La Sapienza; M.P. Papini, Università La Sapienza / Chemistry Petroleum is extensively used for making oil-based chemical and energy; its daily
consumes is on average 20 million tons and this is not predicted to decrease. The increasing use of the petroleum is inevitably connected to an increase in oil spills. Oil spills can occur for many reasons including human error or equipment failure and whenever an oil spill occurs it can represent a worldwide environmental problem. Effective remediation strategies are required. The aim of this study is to develop different sorbent materials for the active capping of oil spill contaminated sea-sediment. The experimental investigation was performed on an oil spill contaminated sea-sediment. Different sorbent materials were tested for the active capping: a commercial Activated Carbon (AC) Carbonatia, an organophilic clays (OC) CETCO Inc. and a biochar (BC). The sorption properties of the materials were first investigated in aqueous solution by performing equilibrium tests (isotherm) using a mixture of polycyclic aromatic hydrocarbons (PAHs) as target contaminants. The bioavailable concentration was assessed by using polyethylene (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 polydiallyldimethylammonium chloride (PDMA) as passive samplers. The PAH profiles in the different capped 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. The results indicated that biochar can be a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE425**

**Pb**-**Tissue** **Concentrations** and **Benthic Community Impacts at a Carbon Amendment Pilot Study in the Intertidal and Subtidal Zones of San Francisco Bay**

C. McCarthy, CH2M / Environmental Services; C. A. Irvine, RBH / 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 release of chemicals, including polychlorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments alternatives were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PAC™ or Sediment™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Previous site investigations indicated that biochar lead to a decrease of the bioavailable PCBs to the bent-nose clams (Macoma nasuta) in shallow intertidal sediments when aided by mechanical mixing. This study assessed the effectiveness of AC placements without mechanical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analysis were used to demonstrate that biochar can be an effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**Comparisons** were made between baseline, reference, and post-amendment conditions (8 and 14 months post-placement). PCB tissue concentrations in Macoma sp. were measured in situ (field) and ex situ (bench-top) after 28-day exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and then retrieve the sediment and exposed organisms for chemical analyses was a challenge. Modifying a chamber design used in previous studies by 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 (4 months before 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. Diaz-Ortiz, Leitat Technological Center

The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) in metal toxicity and bioavailability was assessed in an acid (A) and an alkaline (B) mine waste before and after incubation under different simulated field conditions (irrigation versus drying 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 wastes mixed with uncontaminated Lufa 2.2 natural soil containing waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and internal tissue metal concentration in surviving earthworms were measured. No signs of toxicity and no significant effects on survival of the organisms were observed in alkaline mine waste B. In contrast, exposure at time 0 to untreated acid mine waste A caused a 71% of mortality. The addition of biochars decreased toxicity in mine waste A and Cd internal concentrations in surviving organisms, indicating a lower metal bioavailability. Over time survival in the untreated acid mine waste increased in both original and body metal contaminated mine waste B. No significant differences observed 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 lead 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 Earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diaz-Ortiz, Leitat Technological Center

The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailable fraction and risk of exposure. Survival of E. crypticus exposed to mine waste was determined in pore water solution in an in vitro assay and internal tissue concentration was measured in surviving organisms. Treated and untreated mine wastes 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 (LC90) and reproduction (EC50) were recorded after 21 days in all treatments at each dilution concentration. Results showed no significant effects 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. Over time, 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. Addition 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; A. R. Taylor, University of California Riverside / Environmental Sciences; D. Schelenk, University of California-Riverside / Environmental Sciences. Passive sampling (PS) has been widely used to assess the bioavailability of DDT residues (DDXs) in a historically contaminated soil after biochar amendment monitoring. PCB tissue concentrations were reduced to model the long term (≥12 months) behaviour of various cap configurations with a biochar amendment. This study assessed comparisons were made between baseline, reference, and post-amendment conditions (8 and 14 months post-placement). PCB tissue concentrations in Macoma sp. were measured in situ (field) and ex situ (bench-top) after 28-day exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and then retrieve the sediment and exposed organisms for chemical analyses was a challenge. Modifying a chamber design used in previous studies by 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 (4 months before AC deployment).
Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction

L.S. Trine, Oregon State University / Chemistry / Environmental and Molecular Toxicology; E. Brothers, Environmental Protection Agency / Ground Water & Ecosystems Restoration Division; S.L. Massey Simonich, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced from the incomplete combustion and pyrolysis of organic matter, and are among the major contaminants in soils. Steam enhanced extraction (SEE) is an in-situ thermal remediation technique that uses the addition of steam to soils to subsurface to increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on formation of PAH derivatives during SEE of PAHs. Polar PAH derivatives are more mobile in the environment than PAHs, and some are more toxic than corresponding PAHs. There is an urgent need for analytical methods that can accurately quantify PAH derivatives in complex matrices, to better understand the chemistry occurring during SEE, and how it interferes with the remediation of soils.

In this study creosote-contaminated soil from the Wyckoff/Eagle Harbor Superfund Site in Washington, USA was thermally treated with laboratory-scale SEE. Soil pre- and post-SEE, effluent collected during SEE, and pre- and post-SEE leachate samples (mimicking rain runoff and groundwater) were collected and analyzed with gas chromatography mass spectrometry (GC/MS). Low PAHs, polar PAHs, and MW302-PAHs (n=97). Most of analyzed PAHs were quantified in all pre-, post- and effluent samples. PAHs decreased significantly, while polar PAHs increased in mean concentration post-SEE soil. Mass balances were estimated for different PAHs, and some were above 100%, indicating the potential formation of PAH derivatives during SEE. These findings suggest that SEE pilot and treatability studies should include PAH derivatives to risk assessments to assess the full effectiveness of SEE and prevent underestimation of potential risks. A quantitative risk assessment will be performed by calculating B(a)P_{eq} concentrations and estimated lifetime cancer risk (ELCR) ingestion estimates. Developmental toxicity testing will be conducted with dechlorinated zebrafish (Danio rerio) embryos (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-leafate 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.

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 and oil are complex mixtures composed of hydrocarbons. Low molecular hydrocarbons are readily biodegraded in the natural soil system. Diesel includes recalcitrant hydrocarbons to the natural degradation and may act as potential and actual sources of harmful human and ecological effects. The purpose of the study was to evaluate serial surface foam spraying technology, which avoids disturbing the soil, to deliver chemical oxidant and oil-degrading microbes to unsaturated soil. Hydrogen peroxide was used as an oxidant and surfactant for bioremediation. All oxidants were applied to the surface soil by surfactant foam spraying. Surfactant foam would be a good media to spread remediation agents to the surface of contaminated sites with less labor or energy. Surfactant foam was sprayed once onto diesel contaminated soil for oxidation of soil total petroleum hydrocarbon (TPH). Periodic bioaugmentation foam was sprayed every three days for biodegradation of soil TPH. Foam spraying employing oxidation-bioaugmentation serial application significantly reduced soil TPH concentrations to 550 mg/kg from an initial 7470 mg/kg. Application of hydrogen peroxide by foam spraying increased the infiltration of hydrogen peroxide into the unsaturated soil. The easy and even infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodegradation. Fractional analysis of TPH showed C18-C22 present in diesel as biodegradation recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodegradation alone only reduced the recalcitrant fraction by 25%. (This work was supported by National Research Foundation of Korea (NRF-2015R1D1A1A01050966)).

Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and depolytronization

S. Oh, University of Ulsan / Department of Civil and Environmental Engineering; Y. Seo, University of Ulsan / Civil and Environmental Engineering; T. Seo, University of Ulsan / Department of Civil and Environmental Engineering

High performance biochar synthesized via co-pyrolysis of polymer and rice straw (RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with RS-derived biochar, the sorption of 2,4-dichlorophenol (DCP), 2,4-dibromophenol (DBP), and 2,4-difluorophenol (DFP) to polymer/RS-derived biochar was significantly enhanced by changing properties of biochar due to polymer residues, probably via hydrophobic sorption and electron donor-acceptor interactions. Removal of polymer residues and increasing aromaticity of polymer/RS-derived biochar at elevated pyrolysis temperatures affected the sorption capacity of halogenated phenols. Surface charge of biochar and depolytronization of the halogenated phenols accounted for 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.

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. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX)

Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its multiple benefits for agriculture, including increasing crop production, improving soil structure, enriching soil nutrients, and reducing chemical inputs. BC has been used in agriculture and horticulture to improve soil quality and plant growth, and its use has been promoted for its environmental benefits, such as increased soil carbon sequestration, reduced nutrient leaching, and reduced runoff. The use of BC in agriculture is expanding, and its potential benefits for soil management are well recognized. However, the potential environmental impacts associated with BC application, such as leaching of nutrients and heavy metals, need to be carefully evaluated to ensure sustainable and environmentally sound practices.

Preparation and characterization of composites of type clay / polymers and their use in the removal of contaminants organisms of aquatic environments

M.S. Rodrigues, Instituto Federal do Maranhão; L. Aquiári Vieira, Universidade Federal do Maranhão; A. Costa Filho, S.G. RIBEIRO, Universidade Federal do Maranhão

Clays have been used by mankind for many years due to its easy to obtain, its high capacity to retain water and nutrients, and its plasticity. Clays have been used in agriculture, construction, and environmental remediation. However, the use of clays as a soil amendment has limited conditions. BC has received extensive attention because of its multiple benefits for agriculture, including increasing crop production, improving soil structure, enriching soil nutrients, and reducing chemical inputs. BC has been used in agriculture and horticulture to improve soil quality and plant growth, and its use has been promoted for its environmental benefits, such as increased soil carbon sequestration, reduced nutrient leaching, and reduced runoff. The use of BC in agriculture is expanding, and its potential benefits for soil management are well recognized. However, the potential environmental impacts associated with BC application, such as leaching of nutrients and heavy metals, need to be carefully evaluated to ensure sustainable and environmentally sound practices.
The fibers. However, not only enchytraeid worms (Eisenia fetida) were affected, the treatments was high, possibly also because it was difficult to achieve a homogenous mixture as possible. Bauxite residues are the by-product of the aluminum 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 application, using bauxite residues seems to be a promising, cost-effective and non-resource intensive option. However, there are still few studies evaluating the long-term success of the rehabilitation programmes and most of them do not consider ecotoxicology. The present study aims at assessing the success of rehabilitation strategies for bauxite residues considering the ecotoxicological risk of TE to organisms that live in the rehabilitated areas. 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) does not always correlate with the concentrations measured in the bauxite residues, 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 complex matrix, such as bauxite residues, and to provide a more realistic assessment for the organisms living there. Our data clearly show that the chemical total concentrations measured in the bauxite residues do not predict the bioavailable (potentially toxic) fraction of the TE, therefore bioassays should be taken into account when fixing the rehabilitation goals or assessing the rehabilitation success of a contaminated area.

Ecotoxicity 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. Song, University of Helsinki / Department of Ecological Science; 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 deposited in the sewage sludge during waste water treatment and ends up in green spaces and agricultural fields. In this study, we explored the accumulation and effects of polyester fibers in soil in a lab experiment. Polyester 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 0.17% and 0.5%, 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 fetida. 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 were affected. The decrease in the reproduction of F. candida was not related with the fiber concentration in the soil. As the accumulation of 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 Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms M.G. Piester, 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

Nowadays, the ecological impact of microplastics in freshwater is not well understood [1]. Here we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. PPC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and the potential degradation process of PHB in a MilliQ water by nano track 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 (75-100 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; toxic effects showed a dose-dependent relationship, and the potential effects in a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.


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. Lagarde, Université Catholique de lOuest / UBL, Mer Molecules Santé; f. Martin, Université Catholique de lOuest / UBL, Mer Molecules Santé; P. Decottignies, B. Cognie, Université of the West / UBL MMS Angers; F. Akcha, R. Sussarellu, J. Rouxel, IFREMER / Laboratoire décotoxicologie; P. Decottignies, C. Bignuc, Universite de Nantes / UBL MMS Nantes; A. Chatel, Catholic University of the West / UBL, Mer Molecules Santé; C. Mouyssou, Université Catholique de Joueix / UBL, Mer Molecules Santé; M. Tamayo-Belda, Universidad Autónoma de Madrid / Biology; R. Rosal, Universidad de Alcalá; M. Tamayo-Belda, Universidad Autónoma de Madrid / Biology

Since the early 1970s, the occurrence of floating plastic has been reported in marine waters with great accumulation in gyres. In recent years, the presence of plastic debris <5 mm called microplastics (MPs) which result mainly from macroplastic’s fragmentation has also been reported in aquatic ecosystems even in remote areas. Some studies have reported the appearance of MPs and their effects in release of organisms. However, it appears necessary to investigate their potential toxicity especially at environmentally relevant concentrations. The aim of our study was to evaluate the bioaccumulation and toxicity of polypropylene (PP) and polyethylene (PE) fragments towards the blue mussel Mytilus edulis. These polymers were selected according to a previous study conducted in situ in the Region Pays de la Loire, France. MPs were exposed in laboratory during 10 days at two environmentally relevant concentrations of 0.008 and 10 µg/L (9 and 11.250 particles/L respectively) (Desforges et al., 2014), and to a higher concentration of 100 µg/L (112 500 particles/L) of each MPs type. The exposure was followed by 10 days of depuration in clean seawater (without MPs). MPs fragments were prepared in the laboratory from commercially available products by milling; characterized in terms of size, shapes and they were counted. Following exposure, tissues and biodeposits (faeces and pseudofaeces) were chemically digested and analyzed for MPs recovery using infrared micro-spectroscopy. Regarding potential toxic effects, detoxification and oxidative stress mechanisms through measurement of enzymatic activities of Glutathione-S-transferase (GST), Catalase (CAT) and superoxide dismutase (SOD) were evaluated as well as markers of the immune system and DNA damage. Results showed the presence of PE and PP particles in digestive glands of mussels exposed to the highest concentration tested (100 µg/L of MPs), and in biodeposits MPs were observed at all tested concentrations. Significant increases in SOD and CAT activities were observed in the digestive glands of mussels of exposed to 0.008 and 10 µg/L and in gills from mussels exposed to 100 µg/L of MPs that could be indicative of an oxidative stress. This study brings new results on the potential subtle effects of MPs at environmentally relevant concentrations of MPs.

TH004 Effects of zebrafish exposure to high-density polyethylene and poly styrene 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 & The Bernal Institute; A. Boullemant, RioTinto; L. Poizat, Alteo-Alumina

Nowadays, the ecotoxicologic impact of microplastics in freshwaters is not well understood [1]. Here we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. PPC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and the potential degradation process of PHB in a MilliQ water by nano track 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 (75-100 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; toxic effects showed a dose-dependent relationship, and the potential effects in a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.

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 controlled mixture of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microparticles (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing to generate a comprehensive list of differentially expressed genes (DEGs). In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microparticles affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

**TI005**

**Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palaeonemon varians**

**M. Weidung**, University Duisburg-Essen; **R. Saborowski**, L. Gutow, Alfred Wegener Institute for Polar and Marine Research

Microplastics (< 5 mm) have become ubiquitous in waters. The smaller they are the easier they can be taken up by aquatic organisms. Once ingested they can cause various harmful effects. This study investigates the effects of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaeonemon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescence microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the supramesenteric tissue and the midgut gland. Decreases have been observed for 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.

**TI006**

**Microplastics in the sub-surface layers of the South Atlantic Ocean**

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Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the ocean surface when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and tend to concentrate on the ocean surface when examining microplastic pollution. During this study, the 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 reactions 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.

**TI007**

**Effects of dietary microplastic exposure on fish intestinal physiology**

**G. Asmonaite**, A. Berzina, L. Meita, University of Latvia / Institute of Environmental Biotechnology; **P. Sobral**, MARE

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 microplastic debris for a variety of aquatic animals, including fish. Large plastic items are known to physically block the intestinal passage, exert physical damage, impair food uptake and/or cause false satiation. Whereas, the biological effects resulting from ingestion of smaller micro-sized particles or microplastics (MPs) are considerably less documented and potential (negative) consequences on the alimentary tract are largely unknown. To address this, we designed a study aimed at assessing how ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MPs cause inflammatory responses and disturb intestinal barrier and transport functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS particles/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 environmental conditions (PS-contaminated). The exposure to Polystyrene and Polyethylene microplastics affected the liver transcriptome in a dose-dependent way, decreasing difference appeared between natural and synthetic particles. The uptake and distribution of particles in the digestive organs was monitored as potential difference (TEP; mV) and short circuit current (CSC; µA) together with uptake rate of H2-lysine. Overall morphology was observed using histology. Gene expression analysis of immune related genes (TGFβ, TNFα, IL-8, IL-10, IL-17, IL4/13A) and tight junction proteins (Occludin, ZO-1, Tricellulin) was performed to examine if PS particles and chemical contaminants induced inflammation in intestinal tissue. The innate immune response (lysozyme stability and complement system) in blood plasma was evaluated to assess the presence of systemic inflammation. The findings of the study indicated no or minor functional effects on fish intestinal tissue inflicted by particle exposure. Signs of inflammation were detected and were accompanied by upregulation of tight junction proteins, suggesting activation of intestinal homeostasis in response to PS MPs exposure.

**TI008**

**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 / Dep. Science and Environment Engineering; **P. Sobral**, MARE - 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 and irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in fish, in this case Solea senegalensis, using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (< 200 µm and 300-500 µm) and two concentrations of each (562 and 56 MPs per day) and other without MPs (control), making a total of five treatments. Sixty-day laboratory assays were conducted, in duplicate, and the test pellets were provided to fish once a day. After 14, 30 and 60 days, fish were monitored from each treatment and sacrificed. The liver and stomach 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 acetylcholinesterase. Histopathological analyses were also performed in the digestive tract to assess the presence of MPs and possible histopathological effects.

**TI009**

**Nanoplastic impacts on physical, biochemical, and nutritional characteristics**
of Pacific whiteleg shrimp

Y. Chae, Konkuk University; D. Kim, Konkuk University / Department of Environmental Health Science; Y. An, Konkuk University / Department of Environmental Health Science

Because of enormous amounts of plastic wastes in marine environment, the concerns about marine pollution and ecological damages on marine organisms have increased. Especially, among these plastics, the ingestion of small sized plastic particles like microplastics (<5 mm in diameter) or 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 (Liopeneaus vannamei) exposed to nanoplastics. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with nanoplastics (44 nm diameter) and their physical (length, weight, water contents, body mass index), biochemical (catalase, CAT; glutathione s-transferase, GST; superoxide dismutase, SOD; fecal microbiota viability), and nutritional (crude lipid, crude protein, amino acids, and fatty acids) changes were assessed after exposure. In results, nanoplastics attached on the filter and ingested to mussels entered the bodies of shrimps and affected the health and 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 (2016R1A2B3010445).

TH100
Brood Pouch-mediated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis

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Polyplastic debris is ubiquitously distributed in aquatic environments and are considered an emerging contaminant in benthic 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 accumulated 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 uptake experiment of 10 days was conducted using Dhaphnia longispina 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 Nano-plastic ingestion in blue mussel larvae

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A large number of aquatic species have been found to ingest microplastics in the field and in laboratory studies. Benthic invertebrates seem to be especially exposed to this form of pollution and the blue mussel Mytilus edulis is one of the species that has been investigated most in this respect. Studies have not only shown that the mussels ingest microplastics but have also reported diverse adverse effects on a cellular to a physiological level. However, the work has so far only focused on adult mussels and it is unclear how blue mussel larvae interact with and are affected by plastic particles in the micrometre and nanometre size range. 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 to quantify 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. Egression 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 nanoplastics on the Mediterranean mussel M. galloprovincialis

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The contamination of marine environments by microscopic plastic debris is a current threat to the fitness of the exposed biota, and even higher concerns are risen on its potential fragmentation to the nanoscale. In the framework of the JPI OCEANS project PLASTOX, we investigated the chronic effects induced by a 21-day exposure to 1.5, 15 and 150 ng/L of polystyrene microplastics (MP, 3µm) and nanoplastics (NP, 50 nm) on the fitness of the mussel Mytilus galloprovincialis. To do so, we employed a multibiomarker approach encompassing immunological responses (lysozyme and phagocytosis), lysosomal endpoints (lysosomal membrane stability and neutral lipids), oxidative stress (catalase activity, malondialdehyde and lipofuscin content) and detoxification (glutathione S-transferase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is a known general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP; however, only in MP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by either MP or NP treatments. Catalase levels were used as general marker of the immune system efficacy. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 150 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was noted only at 15 ng/L NP. Biomarker data were integrated in the Mussel Expert System (MES), which estimates the stress level induced on mussels by calculating a A-E scaled 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 was increased. Overall, results show that both polystyrene MP and NP induce a chronic stress syndrome in mussels by affecting lysosomal integrity and generating pro-oxidant conditions. However, the two particle types can differentially alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.

TH103
Effect of catonic amino (PS-NH2) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses

I. Varo, CSIC / Spanish National Research Council / Biology, culture and pathology of marine species; A. Petini, CSIC / Spanish National Research Council; E. Fabbri, University of Siena / Physical, Earth and Environmental Sciences; E. Arneodo, University of Siena / Physical, Earth and Environmental Sciences; E. Brunetti, CSIC / Physical, Earth and Environmental Sciences; L. Coruf, University of Siena / Physical, Earth and Environmental Sciences

The accumulation of plastic litter on beaches and open oceans has been identified as a major threat 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 caticonic 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 on sub-lethal suspensions of PS-NH2 (0.1, 1, and 10 µg/L) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carbofixoxyesters (ChE), 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 effect on PS-NH2 (at 0.1 and 1 µg/L) on the expression of genes related to metabolism, biosynthesis and embryogenesis during the development of brine shrimp was also investigated. Genes included HSP26, HSP70, mitochondrial uncoupling protein 2 (UCP2), chaperon-containing TCP (TCP) and late embryogenesis abundant (LEA). Acute exposure to sub-lethal suspensions PS-NH2 caused a significant decrease in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for LP. A significant up-regulation of HSP26 and HSP70 was observed in nauplii exposed to 1 µg/L of PS-NH2 as well as the modulation of TCP, the latter not significant. This supports the results obtained from biomarkers, suggesting a stress response and potential

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apoptotic pathway following PS-NH2 exposure. On the contrary, no significant effect on gene expression related to the brine shrimp’s metabolism (UCP2) was observed, and LEA was significantly modulated only at the lowest concentration tested. These findings indicate that stress-related responses are taking place in exposed nauplii after acute exposure to sub-lethal suspensions of PS-NH2, and confirm the general concern about PS-NH2 and their ability to represent an ecological treat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

**TH014**

The impact of nanoparticles on Antarctic krill Euphausia superba

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Under current climate change scenarios, Antarctic krill (Euphausia superba) is facing multiple stressors, which could affect its abundance and distribution. Microplastics have been recently reported in Antarctic waters, representing an additional potential impact on krill population. In this study we investigated the effects of model 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°S, 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 c-fos gene induction in new findings reported for the first time. The incorporation of microcrustaceans has 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 controls. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FP properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

**TH015**

Exposure to nanoparticles as a potential stressor on Mytilus galloprovincialis

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Physical and chemical 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 cationic PS-COOH and anionic PS-NH2 on gene expression and cell metal accumulation in the gills of this model species. NPs (0.1 µm diameter, 20 µm (mean diameter) with an irregular shape were used as model microplastics. Different sizes, shape (particles, fibres) and polymer compositions (polystyrene and polystyrene microbeads, polyster microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was ~10–300 µm. Chemical body burden was measured after exposure to determine bioavailability. n

**TH016**

The role of microplastic size and type on PAH sorption and bioavailability to copepods

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It has been proposed that microplastic (MP) may act as a vector for a wide range of chemical pollutants already present in the environment. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous pollutants in the environment, known to cause adverse effects to a variety of marine organisms. Most PAHs have relatively high polymer-water partition coefficients, meaning their potential for sorption to, and transport by, 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 accurate determination of PAHs remaining from adsorbed compounds or fragments that have disolved from the MPs into the exposure media. Here, we investigate the sorption kinetics and present adsorption isotherms for three model PAHs (fluoranthene, phenanthrene and 1,3-dimethylphenanthrene) to a range of different MPs in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying sediment solubility (two different orders of magnitude). In the case of the hydrophobic 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 (polystyrene and polystyrene microbeads, polyster microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was ~10–300 µm. Chemical body burden was measured after exposure to determine bioavailability. n

**TH017**

Limited influence of microplastics on the effects of an endocrine disruptor on the African clawed frog (Xenopus laevis)

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Microplastics are ubiquitous in freshwater ecosystems. Besides physical effects of the mere microplastic material itself, chemical effects by associated contaminants are discussed as potential threat to aquatic organisms, in particular after ingestion. Anthropicrogenic hormonal active substances, so called endocrine disruptors (ED) cause a change of gender and development of vertebrates like fish and amphibians but also humans. Tadpoles are not only vulnerable to ED, but potentially also to particulate contaminants like microplastics because they filter the surrounding water unspecifically during the first phase of their development. Until now, it is not clear if microplastics have negative impacts on amphibians and if they alter toxic effects of chemical contaminants like ED. This study focused on potential effects of microplastics on larvae of African clawed frog Xenopus laevis. Microplastics are ubiquitously distributed in freshwater ecosystems. Besides physical effects of the mere microplastic material itself, chemical effects by associated contaminants are discussed as potential threat to aquatic organisms, in particular after ingestion. Anthropicrogenic hormonal active substances, so called endocrine disruptors (ED) cause a change of gender and development of vertebrates like fish and amphibians but also humans. Tadpoles are not only vulnerable to ED, but potentially also to particulate contaminants like microplastics because they filter the surrounding water unspecifically during the first phase of their development. Until now, it is not clear if microplastics have negative impacts on amphibians and if they alter toxic effects of chemical contaminants like ED. This study focused on potential effects of microplastics on larvae of African clawed frog Xenopus laevis. Microplastics are ubiquitously distributed in freshwater ecosystems. Besides physical effects of the mere microplastic material itself, chemical effects by associated contaminants are discussed as potential threat to aquatic organisms, in particular after ingestion. Anthropicrogenic hormonal active substances, so called endocrine disruptors (ED) cause a change of gender and development of vertebrates like fish and amphibians but also humans. Tadpoles are not only vulnerable to ED, but potentially also to particulate contaminants like microplastics because they filter the surrounding water unspecifically during the first phase of their development. Until now, it is not clear if microplastics have negative impacts on amphibians and if they alter toxic effects of chemical contaminants like ED. This study focused on potential effects of microplastics on larvae of African clawed frog Xenopus laevis. Microplastics are ubiquitously distributed in freshwater ecosystems. Besides physical effects of the mere microplastic material itself, chemical effects by associated contaminants are discussed as potential threat to aquatic organisms, in particular after ingestion. Anthropicrogenic hormonal active substances, so called endocrine disruptors (ED) cause a change of gender and development of vertebrates like fish and amphibians but also humans. Tadpoles are not only vulnerable to ED, but potentially also to particulate contaminants like microplastics because they filter the surrounding water unspecifically during the first phase of their development. Until now, it is not clear if microplastics have negative impacts on amphibians and if they alter toxic effects of chemical contaminants like ED. This study focused on potential effects of microplastics on larvae of African clawed frog Xenopus laevis. Microplastics are ubiquitously distributed in freshwater ecosystems. Besides physical effects of the mere microplastic material itself, chemical effects by associated contaminants are discussed as potential threat to aquatic organisms, in particular after ingestion. Anthropicrogenic hormonal active substances, so called endocrine disruptors (ED) cause a change of gender and development of vertebrates like fish and amph
Arctic), a range of different virgin polymer pellets (LDPE, PP, PS and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SMPD canister, with the various plastic types placed in reusable, empty teabags made of PP, placed separately in nylon netting. Sampling was conducted 1 week, 1 month, 3 months, 6 months and 12 months after deployment. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, PBDEs and PCDDs were measured 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. Analytical chemistries using GC/MS/MS and GCxGCxMS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common phenolic antioxidants (phthalates, organophosphate esters, biphenyls) 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. Albenedín, Universidad de Cádiz (Spain) / Toxicology Area; I. Cabrera-Pozo, University of Cádiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quiroga, University of Cádiz / Environmental Technology; J. Arellano, University of Cádiz / Toxicology Area.

In the last three decades, different components from personal care products have arrived at aquatic ecosystems because these products are not biodegraded or removed in wastewater treatment plants. Some of the personal care products contain plastic microbeads such as exfoliating shower gel, toothpaste and make-up. Creams commonly used and available in supermarkets of our area were used by these assays. The microspheres available in these samples were separated and chlorpyrifos was added to the microspheres. The particles were identified by Fourier transform-infrared spectroscopy (FT-IR) microscopy using a PerkinElmer Spectrum 100. The spectra are recorded in reflection mode in the spectral range 4000-650 cm⁻¹ by adding 128 scans at a resolution of 4 cm⁻¹. The particles were identified by comparing the FT-IR absorbance spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity tests. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12 h light/12 h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ± 0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5–80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (aceton). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers in marine life to determine exposure to organophosphate pesticides in general, there are two type of ChEs presented in fish, acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE). The AChE was analyzed on the head homogenate of juveniles, after this crude was inhibited with iso-Ompa, which is a specific inhibitor of BuChE. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH020 Are microplastics inhibitory to Daphnia magna and are they significant vectors for hydrophobic organic chemicals? C.K. 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 a recent study aiming at increasing our understanding of microplastic serving vectors for hydrophobic pollutants. This study investigated: i. the amount of regular and irregular shaped microplastics ingested and egested 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 organic pollutants. The particles were identified by Fourier transform-infrared spectroscopy using a PerkinElmer Spectrum 100. The spectra are recorded in reflection mode in the spectral range 4000–650 cm⁻¹ by adding 128 scans at a resolution of 4 cm⁻¹. The particles were identified by comparing the FT-IR absorbance spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity tests. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12 h light/12 h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ± 0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5–80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (aceton). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers in marine life to determine exposure to organophosphate pesticides in general, there are two type of ChEs presented in fish, acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE). The AChE was analyzed on the head homogenate of juveniles, after this crude was inhibited with iso-Ompa, which is a specific inhibitor of BuChE. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH021 Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Trefiliev, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; R. Barroso, J. Quiroga, Univ. of Gothenburg Sweden; G. Asmonaite, 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 environments 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 showed 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) exposed to an experimental feeding study with commercially available control and spiked particles (250µm) was conducted. Two types of synthetic polymeric particles (PE and PS) and non-plastic polymer particles (silica), which were selected as reference material, were used. Selected particles were loaded with three model compounds (benzo[a]pyrene, ethynyleradiol and chlorpyrifos) having distinct toxicological mode of action and different lipid solubility. Using different experimental diets: control diets (negative control), diets with clean particles (PE, PS, silica), diets containing, particles spiked with a chemical mixture (PE-mix, PS-mix, silica-mix) and, finally, diets loaded with only chemical mixture (chemical control) were developed. During the experiment, fish were fed daily (6 % of body weight and 5 % particles) for a period of two weeks. Gene expression of well-established biomarkers (CYP1a, ERα, and AChE) were then quantified at mRNA level in the liver and gut. Acetylicholinesterase (AChE) 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-plastic particles, while PE contaminated particles showed more pronounced changes and carried out transfer of chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.

TH022 Dietary exposure to polystyrene microplastics contaminated with environmental pollutants induce hepatic biomarker responses in fish G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; Barroso, J. Quiroga, Univ. of Gothenburg Sweden / Department of Biology and Environmental Sciences.

In the field of microplastics (MPs) research, polystyrene (PS) particles have become reference material not only for investigating the uptake of the particles, but also for assessing biological effects. There is a growing body of (eco)toxicological information, suggesting that PS MPs, in a range of nano- to micro- meters (<50µm), have a potential to impact aquatic organisms. On the other hand, there is evident lack of toxicological information in regards to bigger size ranges of these MPs (>50µm), at sizes, detectable in the environmental matrices. We conducted an ongoing study aiming at increasing our understanding of the adverse effects resulting from dietary exposures to PS particles ranging in size 50-250 µm. In this study, rainbow trout (Oncorhynchus mykiss) were exposed diets, enriched with PS particles (10mg of PS MPs/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 MPs largely exceeded sizes relevant for biological uptake, it provides an opportunity to study particles’ role as vector for environmental pollutants. Three different experimental diets, containing PS, (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, GLO1, GLO2, SOD) and enzymatic assays (GR, GST, GS, GPx, CAT). Additionally, mRNA levels of established biomarkers (CYP1a, ERα and β, AR, MT, VEGf) 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.

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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 Nanopoly styrene and the Co-Contaminant Tributyl tin on the Nematode Community Structure in Sandy Sediments**

A. Catarino, A. Homer, Heriot-Watt University / ILES; L. Duran Suja, Heriot Watt University; T. Durand, University of Plymouth / Centre for Environment, Fisheries and Aquaculture Science; M. Al Sid Cheikh, ISMERUQAR; A. J. Sweetman, Lancaster University / Lancaster Environment Centre; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Nanoplastics (PS ≤ 1µm) may result from larger plastic debris released in the environment and can pose a risk to marine organisms and ecosystems. The risk of NPs can be exacerbated because toxicants sorbed to NPs may be transported to and become more bioavailable in organisms. It is likely that NPs are the most abundant plastic particles present in marine environments, and as in the case of microplastics, they are expected to accumulate in benthic ecosystems. However, there is no indication on the impact of NPs on benthic meiofauna assemblies. 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 nanopoly styrene (nPS) and nPS with the sorbed co-contaminant Tributyl tin (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 (1L) and the exposure took place for up to 2 months. Core samples of sediments were taken every week from the following treatments: 1) Control sediment, 2) Sediment with spiking TBT (0-100 ng/kg) and 3) Sediment with nPS (0-12 mg/kg) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth (OPD) was determined by measurement of the oxygen saturation in the sediments using a microprofiler equipped with oxygen microsensors. Changes in the nematode community structure were measured by assessment of changes nematode diversity (nematodes identified to genus) and dose responses analysed according to nPS, and all the concentrations in the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

**TH024**

**Nanop anolystyrene Induces a Decrease in the Oxygen Uptake of Zebrafish Larvae Enab led by Sorbed Benz(a)Pyrene Bioavailability**

A. Catarino, A. Homer, Heriot-Watt University / ILES; M. Clement, Polytex Chic Sophia; M. Taït, 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

Sorption of B(a)P to nPS was confirmed and expression was measured by quantitative reverse transcription PCR (qRT-PCR) after RNA extraction from whole larvae. Sorption of B(a)P to nPS was confirmed using analytical chemistry techniques [gas chromatography–mass spectrometry (GC-MS)]. Preliminary dose-response analysis showed that nPS, B(a)P and nPS with sorbed B(a)P induced a decrease in MO, by zebrafish larvae, indicating a higher energetic cost of physiological functions maintenance. The expression of cytoP450A was up to 9 fold change in the highest concentration of nPS (45 µg/ml) with sorbed B(a)P, whereas this gene did not express when larvae were exposed just to nPS, indicating desorption of B(a)P. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the effects and risk of NPs and their co-contaminants within a more environmental relevant scenario.

**TH025**

**Impacts of exposure to microplastics alone and with adsorbed benzo(a)pyrene on biomarkers and scope for growth in marine mussels M. galloprovincialis**

J. Hatfield, N. González-Soto, University of the Basque country UPVEHU; A. Katsumiti, University of the Basque country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; F. Solan, University of the Basque country UPVEHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; A. Orbea, University of the Basque country UPVEHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE

Because the relative surface area of MPs and NPs become available to biota and enter into the food web, effects of NPs on marine biota could have a significant impact on ecosystems. MPs and NPs are increasingly present in the coastal environment of the Basque Country (UPVEHU) and at the Mesocosm shelf (EPOC / LPTC UMR 5805 CNRS; M.P. Cajaraville, University of the Basque country UPVEHU; M.P. Cajaraville, University of the Basque country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE. Due to their hydrophobicity and relatively large surface area, microplastics (MPs) can act as carriers of hydrophobic pollutants in the ocean and may facilitate their transfer to organisms (so-called “Trojan-horse effect”). This study examined the effects of different levels of biological organisation (0.5–4.4 µm) of benzo(a)pyrene (BaP) on mussels Mytilus galloprovincialis in order to elucidate the effects of MP size and the presence of adsorbed contaminants on the organism. Mussels were provided daily, mixed with algae, at 1000 particles/ml/day, during 7 and 26 days. Effects were determined on early cellular biomarkers (catalase activity [CAT], neutral red uptake [NR] and DNA damage in hemocytes; histopathology in digestive gland) and on biometric responses (scope for growth [SGF] and condition index). Chemical analysis showed that BaP concentrations in mussels increased with time (up to 150 times greater than background levels) and that smaller MPs posed 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 in NR and DNA damage in hemocytes, histopathology in digestive gland and on biocharacteristics (SGF and condition index). Higher effects were observed in samples treated with NPs, confirming that the presence of pollutants within a relevant scenario. The presence of NPs for further toxicity assessment 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 size and concentrations in NR as well as DNA damage in hemocytes. The exposure of mussels to NPs can act as a stressor, inducing oxidative stress and DNA damage. Further work is required to understand the effects of a variety of plastic type, size, shape combinations together with a wide variety of pollutants. *Funded by Spanish MINECO (NACE project CTM2016-81310-R), Basque Government (consolidated group ITI8-10-13) and UPV/EHU (UFI 1137, VRI grant PLASTOX). Work carried out within EU project PLASTOX (IPI Oceans 05/2015).

**TH026**

**Characterization of the adsorption/desorption of benzo(a)pyrene to/from polystyrene micro- and nanoparticles for further toxicity assessment**

J. Martinez, University of Basque Country; K. Le Menach, UMR CNRS EPOC Université Bordeaux / EPOC UMR 5905; M. Dèvèr, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; M.P. Cajaraville, University of the Basque Country UPV/EHU / Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; A. Orbea, 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; J. Hatfield, N. González-Soto, University of the Basque country UPVEHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; H. Budzinski, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; M.P. Cajaraville, University of the Basque country UPVEHU; 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

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 available to biota and enter into the food web. Microplastics have a higher proportion to surface volume ratio and hydrophobicity, plastics can adsorb/biosorb other pollutants present in the water column acting as Trojan Horses. In order to further investigate the ecotoxicological aspects of this phenomenon, the characterization of the adsorption of benzo(a)pyrene (BaP), as a model polyaromatic hydrocarbon, to polystyrene MPs and NPs (4,5, 0.5 and 0.05 µm), was undertaken. 50 mg.1 of plastics of the three sizes were incubated for 24 h in an orbital shaker at 300 rpm (21°C) in three BaP solutions (100, 10 and 1 µg.l containing 0.01% DMSO) in MilliQ water. After the adsorption period, centrifugation was performed in order to settle the plastic and allow the removal of non adsorbed BaP (NA-BaP). NA-BaP was quantified in the
The POPs on plastic particles were extracted in selected solvents. Known amounts of POPs were artificially charged on the plastic debris, and analysed in e.g. gas chromatography/mass spectrometry (GC/MS). The loss of plastic weight was measured for the evaluation of the stability of plastic particles under given extraction conditions. Further, we investigated the influence of polymers dissolved in solvent on quantitative analysis for POPs. TU Darmstadt and CARAT are participants of an EU project “PLASTOX”, a consortium of a JPI Oceans’ Joint Action. TU Darmstadt is funded by BMBF.

**TH028**

Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord.

A. van Oven, ECOLAB UMR254 CNRS UPS IRT; C.G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biochemistry.

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 polystyrene were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishing activities are the main source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polystyrene, 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.

**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 (PAHs) on microplastics (MPs).


Determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aqueous environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3 ), phenanthrene (log Kow = 4.6 ) 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 (Bocholt, Germany). 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, 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**

Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment.


Accumulation of persistent organic pollutants (POPs)-loaded microplastics (MPs) in the aquatic milieu is an emerging issue of international concern. Qualitative/quantitative determination of POPs on MPs is essential for the estimation of the impact of POPs-loaded MPs on a range of marine organisms. In general, hydrophobic pollutants like POPs are first extracted from the matrix, in this case plastic debris, using non-polar solvents. Then, the extract will be cleaned-up and analysed in e.g. gas chromatography/mass spectrometry (GC/MS). Some non-polar solvents applied for POP extraction, however, may dissolve plastic debris partially or completely, which disturb subsequent analyses. A number of methods have been reported for the extraction of POPs from MPs. Yet, the validity of these methods have not been fully discussed and the influence of polymers in extraction solvents in subsequent POP analysis has not been thoroughly investigated. The goal of the current study is the development of an optimal analytical protocol to extract POPs from different MPs. Known amounts of POPs were artificially charged on the surface of selected polymer particles, including preproduction resin pellets from different polymer type (polyethylene, PE; polystyrene, PS; polyethylene terephthalate PET, polypropylene, PP; poly vinyl chloride, PVC) in the laboratory. The POPs on plastic particles were extracted in selected solvents using soaking and sonication methods under different conditions. Solvents used in this study include n-hexane (nHex), isopropanol (iProH) and dichloromethane (DCM). Extraction methods and conditions were evaluated for a high extraction recovery, a high reproducibility, as well as for a minimal damage of polymer particles, i.e. carriers of POPs. The recovery rate and analytical reproducibility of POP was determined using gas chromatography-mass spectrometry (GC/MS). The loss of plastic weight was measured for the evaluation of the stability of plastic particles under given extraction conditions. Further, we investigated the influence of polymers dissolved in solvent on quantitative analysis for POPs. TU Darmstadt and CARAT are participants of an EU project “PLASTOX”, a consortium of a JPI Oceans’ Joint Action. TU Darmstadt is funded by BMBF.
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 recognized planktonic gyres, 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 with multiple settlement plates associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microlayer (IP25), pelagic microlgae (C25:3) and sewage (copropstanol) enabled correlations to be made on potential sources, pathways and fate of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a system already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

Microplastics – an ecosystematic issue? How to balance facts and perception without marginalizing an environmental problem

C. Völksen, ISOE - Institute for Social-Ecological Research / Water infrastructure and risk analyses; J. Kramm, ISOE - Institute for Social-Ecological Research While plastic has been known for a factor of 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 has led to an upswing of the debate. In the 2000s, small plastic particles that had already been detected in seawater in the 1970s were labeled “microplastics” for the first time. Since then, the number of studies on the occurrence and effects of microplastics has risen exponentially. 13 years after the publication of the article by Thompson et al. the question of whether microplastics actually pose a risk to the environment could not yet be answered conclusively. In 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 the great ecological impact of plastics. In recent years, however, the adverse effects of plastic waste are increasingly being attributed to the release of chemicals, such as endocrine disruptors, into the environment.”

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

TH031

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, RFID / Environmental Science; K.M. Johannig, KJ Scientific LLC / d/b/a 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 in the living organism is one of the major mechanisms by which xenobiotic compounds are eliminated from the body and therefore the source of uncertainty in bioaccumulation assessment. Currently, in vitro methodologies utilizing the rainbow trout metabolic assay not only are gaining interest, but are being used increasingly by several sectors as a key component in model-based estimates of BCFs as well as for the identification of key metabolites. The test guideline for BCF measurement utilizing rainbow trout liver S9 fractions and cryopreserved hepatocytes to test chemical biotransformation has gone through a Ring Trial for an OECD validation process (OECD Project 3.13 coordinated by ILSI HESI) and the Test Guidelines and Guidance are being reviewed by the OECD assigned panel. In the present study four fragrance materials (Cyclamate, Melatfluor, Trimofix and Verdox) with known measured BCF values obtained using OECD 305 method were tested for biotransformation utilization both rainbow trout liver S9 fractions and cryopreserved hepatocytes. The results indicate that all four fragrance materials were metabolized in both biological systems at different rates, but in all cases the BCFs determined were comparable to the measured in vivo BCF values. The in vitro metabolic assay is a powerful tool that can be used to determine BCF of test chemicals and provide data to build the database information on fragrance materials for fish metabolism and modeling.

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 mined available species transcriptome databases and examined full-transcript, isoform 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.

Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies

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Organophosphate flame retardants (PFRs), as widely used alternatives of brominated flame retardants, are present in a wide array of consumer products and aquatic matrices. Considering 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. D-alkyl 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 FRs and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs was relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low limited affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of PFRs and DAPs than the other tissues of fish. It suggested the excretion of parent compounds in wild animal studies. In the consequent laboratory control study, we screened the metabolites of alkyll-PFRs by in vivo exposure of *Gobiocypris rarus*. Metabolites of alkyll-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 glucuronidation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BBOEHEP, 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 alkyll-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 its high lipophilicity, it can pose a risk for non-target aquatic invertebrates. Biotransformation can reduce the internal concentration of parent compounds hence, influencing their bioaccumulation. The aim of this study was to assess the toxicokinetics of prochloraz and its biotransformation products (BTPs) in *Hyalella azteca*. Adults of *Hyalella azteca* were exposed to prochloraz at the concentration of 100 µg L\(^{-1}\) 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 Kg\(^{-1}\). Finally, the data will be modeled using a toxicokinetic model and thus uptake, elimination 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***

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Marine ecosystems have been historically sinks for many pollutants and chemicals that have been recognized as a model organism to test toxicity of organic chemicals due to its rapid reproduction and sensitivity to xenobiotics. Biotransformation can reduce the internal concentration of parent compounds hence, influencing their bioaccumulation. The aim of this study was to assess the toxicokinetics and metabolism of alkyll-PFRs and their 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 Kg\(^{-1}\). Finally, the data will be modeled using a toxicokinetic model and thus uptake, elimination 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***

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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 OECD and ISO test guidelines for bioassays that are not by themselves capable of a metabolic transformation. The most prominent example is the Ames mutagenicity test. A reverse mutation assay according to the ISO 11350 or the OECD 471. However, the application for S9 is much more diverse and spans from various not guideline-based bioassays towards the ad-hoc production of metabolites for chemical analysis. It is also applied for stability testing of pharmaceuticals and the observation of the potential in bioaccumulation of chemicals and their metabolites. In this study, we look at the proteomics of multiple rat S9 products and compare them with an animal component free biotechnological alternative.
mammals and fish

J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; A. Loczy, ARC Arnot Research and Consulting Inc.; K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); J.M. Armitage, University of Toronto - Environmental Toxicology; S. Scarsbrook / Physical and Environmental Sciences; M. Halden, European Commission Joint Research Centre / DG Joint Research Centre IHC EURC ECVAM; A. Lostia, European Commission Joint Research Centre: A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-IHR EURC ECVAM

Toxicokinetics (TK) plays an important role in ecological and human health assessments. When TK data are not available for a chemical of concern, methods must be applied in order to ascertain the TK of chemicals subject to regulatory assessment requirements. It is not feasible to measure TK data in all organisms (e.g., humans, rodents, fish) and there is a recognized need to reduce animal testing. Reliable (evaluated), high-quality existing in vitro and in vivo TK data could help evaluate in vitro-in vivo extrapolation models (IVIVE), parameterize TK and bioaccumulation models, and develop and validate quantitative structure-activity-relationships (QSARs) for predicting TK parameters from chemical structure. Biotransformation and elimination rate data can be used in diverse contexts for chemical assessment. For example, biotransformation rate constants (ka) are key determinants and sources of uncertainty in bioaccumulation assessment. ka can be determined in vivo with whole animal models or from in vitro assays using intact cells or subcellular fractions from the liver or other tissues (e.g., gastrointestinal tract, kidney). We have developed a new database (funded by the JRC CCRF.C931336.X0) containing TK data (i.e., biotransformation rates) for fish and mammal species (i.e., rat, mice) derived from in vivo and in vitro (59 fraction, hepatocytes, microsomes) methods. The database entries are scored based on a data quality evaluation. The data quality assessment methods and criteria have been developed from standardized testing guidelines when such guidance exists and from professional judgement in the absence of standardized guidance. In total the new database includes approximately 9000 entries for organic chemicals. There are approximately 4000 and 400 chemicals from in vitro and in vivo studies respectively from rodent species. There are approximately 120 and 700 chemicals from in vitro and in vivo studies respectively from fish species. The database can be used as a source of information for chemical assessments and can help identify future research needs (i.e., chemicals that require chemical evaluation and for which reliable quality data are not available). We believe the database will also be a valuable source information for model developers (e.g., for in vitro-in vivo extrapolation models, kinetic models, models to predict exposure and internal concentration in an organism) and chemical evaluators. The database will be publicly available at the Joint Research Centre website.

TH041

A tiered testing strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate constants for fish and mammal models

K. Schirmer, Eawag / Environmental Toxicology; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; N. Bramaz, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; M. Halden, ILST Environment & Health; J. Stadnicka, EPFL - Chemical Safety and Alternative Methods Unit

Our research seeks to improve alternative methods to estimate bioaccumulation of organic chemicals in fish. We follow a tiered strategy that integrates toxicokinetic (TK) models, quantitative structure-activity-relationships (QSARs), in vitro extrapolaion methods, and in vivo extrapolation methods. In the first step, we derived at a list of candidate chemicals for in vitro testing based on model dependencies, availability of reliable in vivo BCF and BMF data, and availability of in vitro biotransformation rates. The resulting chemicals were divided into three ka categories based on predominant exposure route(s) to guide in vitro testing: 1) log ka < 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log ka = 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log ka > 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support membranes are used to determine the combined biotransformation/permeation route through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound). Permeant cell lines of gills, liver and intestine, exposed in monolayer, complement the in vitro methods applied, yielding parent compound loss rates as well. In vivo models are each applied under their respective optimal conditions, taking e.g., temperature and media composition into account. Chemical starting concentrations are set uniformly for all models based on non-toxic concentrations and analytical method sensitivity. Thus far, permeation/biotransformation was observed for all chemicals applied. The resulting rate constants are subject to comparison between the different in vitro models and are input into the TK and QSAR models for model development and hypothesis testing. This poster will describe the overall in vitro testing strategy, the different in vitro models and the results of the chemical testing with regard to in vitro-derived rate constants.

TH042

Update on development of OECD Test Guidelines and Guidance Document on determination of fish in vitro hepatic clearance


Chemical biotransformation represents the largest source of uncertainty in chemical bioaccumulation assessments, and model-based estimates of chemical bioconcentration in fish may be greatly improved by including biotransformation rates, as measured in vitro. Substrate depletion assays, using rainbow trout hepatocytes (RT-HEP) or liver subcellular fractions (RT-S9), have been successfully developed and are being used to determine rates of fish biotransformation. In addition, a multi-laboratory ring trial, coordinated by the ILSI Health and Environmental Sciences Institute (HESI), was recently completed which demonstrates assay reliability within and across laboratories and similar performance of substrate depression assays using the two biological systems. Based on the successful results of this ring trial, two OECD test guidelines (TG) (“Determination of in vitro intrinsic clearance using cryopreserved rainbow trout hepatocytes” and “Determination of in vitro intrinsic clearance using rainbow trout liver S9 sub-cellular fractions”) have been drafted and are accompanied by a Guidance Document (GD). The OECD GD provides detailed information on how to conduct the tests as well as how to apply the measured in vitro biotransformation rates to predict bioconcentration factors. In addition, guidance on selection of the assay system (e.g., primary hepatocytes vs. liver S9 fractions), specific considerations for testing chemicals, use of negative and positive controls, BCF extrapolation models, and application of the two test methods beyond BCF prediction are also covered. Draft TGs, the GD, and the ring trial report underwent two OECD public commenting rounds during 2017 and submission to OECD WNT final approval is planned for 2018.

TH043

The Bioaccumulation Assessment Tool (BAT): A quantitative weight of evidence approach for bioaccumulation assessment

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Chemicals are being assessed for bioaccumulation (B) potential in regulatory programs using various methods, metrics and criteria. B data can be obtained from various data streams including laboratory studies, field studies and model predictions using mass balance models and quantitative structure-activity-relationships (QSARs). Examples of bioaccumulation metrics include: the bioconcentration factor (BCF), bioaccumulation factor (BAF), biomagnification factor (BMF) and intrinsic clearance. The Bioaccumulation Assessment Tool (BAT) was designed to collect, evaluate and integrate various lines of evidence (LOE) associated with these B-metrics and related B classification criteria to aid decision-making. The BAT provides a transparent and consistent framework for evaluating neutral and ionizable organic chemicals in aquatic and terrestrial organisms. It uses a quantitative a weight of evidence (QWOE) approach which includes evaluations for the relevance, reliability (confidence) and outcome of each B-metric. Each substantive LOE (e.g., BCF, BMF, biotransformation rate) is subject to data quality evaluation resulting in a data confidence score. The Data Evaluation Templates (DETs) have been derived from standard test protocols and expert judgment when standard protocols are not yet developed. Physical-chemical properties can be used or the user is allowed to enter biologically relevant partition coefficients in place of default assumptions that assume octanol as surrogate for biological components (i.e., lipid). Estimates for biotransformation rates can be included from in vitro assays (i.e., S9, hepatocyte, microsomal) and from in silico (QSAR) predictions. Empirical data such as lab BCFs and BMFs and field data as
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 (e.g., 7 lab BCFS, various BCF-QSARs, biotransformation rate QSARs, in vitro transformation rates). Future work for improving the BAT is discussed.

TH044
Towards the use of elimination rates in bioaccumulation assessment – Current challenges and future trends
M. 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 (kₘ) experimentally while the uptake rate (kₑ) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to kₑ 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 (kₘ) 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 kₑ based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro kₘ of different tissues, e.g. gills, liver and gastro intestinal tract, could be serve as alternative screening criterion under REACH. This approach is expected to 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 kₑ based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH045
SETAC Bioaccumulation Science Interest Group
L.P. Burkhard, U.S. EPA / ORD/NHEERL/Mid-Continental Ecology Division

Advances in evaluating and regulating endocrine disruptors

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 developed upon achievements on development of framework, development and disrupting effects of chemical substances “EXTEND2016” in June 2016. It is Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of 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 kₑ based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH047
Effects of endocrine disruptors on reproductive health: A new approach to integrating ecotoxicological and human health data
I. Parent, Télé-université / UER Science et Technologie; P. Grigorova, Université TELUQ / Département Science et Technologie; M. Nikolaros, Université TELUQ / Science et Technologie

Exposure to synthetic and natural chemicals is almost inevitable in our daily lives. Some of them raise concerns with their endocrine disruptive potential and possible interference with endocrine system leading to the variety of adverse health effects. It was initially through clusters of presumptions that the potential effects of endocrine disruptors (EDs) on human health and the environment were highlighted. EDs, as a growing source of concern, now need to better document the complexity of the relationship between exposure and effects, hence the development of new evidence-based approaches to better document decision-making in health policy. Among these approaches, we retained the systematic reviews, based on objective methods, to integrate multiple sources of evidence (epidemiology, wild animals, laboratory animals, in vitro and in silico data) relevant to the evaluation. Our project aims to systematically review the data published the last 10 years linking the existence to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, perfluorinated compounds) with the effects on the development and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development. 16 701 articles were screened and 744 met the inclusion criteria for the review. The data was extracted from 155 EU legal documents, 424 in in silico studies, 377 in ecotoxicological studies and the ROB (risk of bias) analysis was performed for the relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss 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. Kienzle, JRC-EC / F3-Chemical Safety and Alternative Methods

Unit-EURL ECVM/ Z. DANG, RIVM / LieEC 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 administrations to address the endocrine and reproductive safety of chemicals (PBDEs, endocrine disruptors, comparison of these tests in response to EDs has not yet been made in the literature. In this paper, these fish test guidelines are compared on the basis of the existing information case by case. Due to a difference in sensitivity of species and life stages, many EU discussions have focused on which test should be suitable. However, due to practical considerations, (e.g. regional preference, practical use, and specifically sensitivity,) it is unlikely to meet all of the requirements within one test. In order to avoid further additional testing, species selection should always consider prospective 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 stage, 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. Prosser, ExxonMobil Biomedical Sciences, Inc.; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI)

Compared to other areas of human and environmental hazard assessment, evaluating the potential for endogenous compounds to interact with endocrine pathways is relatively nascent. However, recognizing the possibility of a public and environmental hazard, many national governments, international organizations, industry bodies, public interest groups and academic institutions established research programs to address the impacts of endogenous substances on the endocrine system. This has resulted in attempts to develop and validate a battery of
tests to screen for endocrine active compounds with multiple publications by both regulatory agencies and academics 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 when planning interlaboratory validation trials. This presents 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 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**

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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.) are 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 ED options, is used for getting 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 biological plausibility of a causative link and to support or reject the scientific relevance of the data. For example a low water solubility, lead to the necessity to conduct a long term toxicity test. 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. The investigation of the endocrine disruptive potential of substances to environmental organisms is not explicitly part of the standard information requirements under the REACH Regulation. However, the legal text of REACH Regulation does not refer to a specific mode of action and unexpected effects oberved in a substance evaluation. In our opinion it is possible to avoid a specific mode of action or mechanism of action (MoA). Under certain legislations, understanding the potential MoA is particularly important because regulatory decisions might categorize a substance as an endocrine disruptor (ED) through a hazard characterization process rather than taking into consideration exposure and risk. The WHO/IPCS definition of an endocrine disruptor requires that a substance alter the function of the endocrine system and can affect the biological plausibility of a causative link between the MoA and endocrine active chemicals. The challenge remains in distinguishing between effects that are specifically man-made and not naturally occurring in an intact organism. Pathway models are being established that provide plausible links between molecular initiating events, key events and ultimately adverse effects. However, when several potential pathways or MoA converge on the same adverse effect in an intact organism it becomes challenging to identify the scientifically relevant link between the MoA and the environmental or health effect of regulatory concern. The first part of the WHO/IPCS definition, that of the chemical acting through an endocrine MoA to alter the function of the endocrine system, focuses on the need for the substance to have sufficient affinity for and activity with components of the endocrine system, compared to endogenous hormones, in order to compete with the normal hormonal signaling and feedback mechanisms that maintain homeostasis. Additionally, some substance properties, such as high or low water solubility, may predict endocrine-related bioactivity and the potential for a chemical to interact with the endocrine system, affinity and activity, also known as mechanistic potency, can be used in comparison to that of the endogenous ligands to support or reject the biological plausibility of a causal link between an endocrine MoA and an adverse effect. A hypothesis testing, weight of evidence framework and case study examples will be used to illustrate the use of bioactivity and mechanistic potency data, along with other lines of evidence, in the assessment of endocrine activity.

**TH051**

**Assessing endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs**


Before pesticides and biocides are allowed to enter the European market, a number of relevant regulatory requirements, availability and needs were considered in order to build a heat-map summarising all the toxicological information collected by endpoint. The heat-map can be used to group chemicals based on the similarity of their toxicological behaviour as a mean to prioritise chemicals for further analysis or to build read-across strategy to fill data-gaps.
TH054
Structural Alerts for Potential Endocrine Disruptors
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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 secondly binding of a co-activating ligand to a part of the LBD (AF-2) triggers gene expression. Chemicals binding to LBD may again yield agonistic or antagonistic effects, for binding to AF-2 only antagonism is known. However, adverse effects to thyroid hormones can also result from other mechanisms as enzyme/protein interaction e.g. with the transporter protein and aryl-hydrocarbon-receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For estrogen/androgen systems such alerts 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 hormone effects a screening level model detects 95% of the known active compounds, but there is suspect of missing compound classes due to the lack of respective experimental data. Particular remark was given to characterize the applicability domain and reliability of the predictions. All models are implemented as automated tools in the software system ChemProp (UFZ Department of Ecological Chemistry 2017. ChemProp 6.6. http://www.ufz.de/ecochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412 (0).

TH055
Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae
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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 reproductive and physiological processes. 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 Horizon 2020 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 behavior caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be used as a sensitive endpoint for sub-letal 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 diol 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 histological characteristics (VTG, glucose). Both urban and agricultural exposures resulted in growth alterations between treatments most likely due to density-dependent growth. Urban exposure indicated higher fecundity (both first and second generation) at low and environmentally relevant concentrations as compared to control and high treatments, potentially as a therapeutic hazard associated with the estrogenic nature of the mixture. Agricultural exposure indicated lower biocompatibility and estrogenic effects on growth for first generation only, whereas the second generation demonstrated decreases in environmentally relevant concentrations as compared to low and control treated fish, highlighting the differences between adult only exposed fish (first generation) and lifetime exposure (second generation). Urban exposure demonstrated no changes to male plasma VTG (egg-yolk precursor protein), but agricultural exposure demonstrated increases in high exposed male fish (first and second generation) and environmentally relevant exposed male fish (second generation) due to the estrogenic nature of the mixture and exposure during different developmental stages between generations. Results indicate that mixtures, environmentally relevant in composition and concentrations, have the potential to mimic growth and lead to reductions in fecundity, and elevated egg-yolk precursor proteins in male fish. Potential, yet unknown, consequences to the population level of exposed aquatic organisms may exist and warrant further study.

TH057
Assessing species sensitivity using environmental mixtures
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Contaminants of emerging concern (CECs) have been detected ubiquitously in aquatic environments, and their endocrine disrupting effects concern us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol in exposure mixtures. In addition to estrogenicities of CECs, Minnesota Pollution Control Agency reported that an exposure to CECs in the river water activated a peroxisome proliferator-activated receptor (PPAR)/retinoid X receptor (RXR) pathway in the transcriptome analysis of fathead minnow. Our laboratory found that an exposure to CECs induced a higher incidence of hepatic vacuolization in fathead minnow, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway. Two isoforms of estrogen receptor (ESR) of fathead minnow, bluegill sunfish, American alligator or human was examined in the human embryonic kidney 293T cells by quantifying their transcriptional activities using estrogen-response elements and luciferase reporter gene in an exposure to agricultural or urban CECs. Utilizing the same method in vitro, alligator PPAR-gamma and RXR-alpha examined for both AG and UB mixtures were estrogenic, however, their estrogenicities varied depending on isoforms of ESRe and 4 species. Human ESR1 was the most sensitive to AG based on their estrogenicities, while minnow ESR1 was the least sensitive to AG. Bluegill ESR1 was the most sensitive to UB based on their estrogenicities, whereas BG ESR2 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate neither alligator PPAR-gamma nor RXR-alpha. Although in vitro investigations of PPAR/RXR signal are required in fathead minnow, PRAR/GXRXA signals might not be involved in a CECs-exposure inducing a hepatic vacuolization in fathead minnow. These results indicate that efficacious receptors and species differ between CECs mixture, and further endocrine studies of CECs are required for a better understanding and prediction of CEC effects by utilizing a variety of receptors cloned from diverse threatened and endangered species.

TH058

Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures

U. Hasbey, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented endocrine perturbations and growth 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 emerging treatment technologies of wastewater and also indicated observation 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

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Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/dechlorination). The receiving aquatic 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 observation 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 Towards a multiparallel detection of biological effects caused by anthropogenic micro-pollutants

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Organic micro-pollutants (MPs) can enter the aquatic environment via diverse pathways and sources e.g. waste water treatment effluents, agricultural activities or the disposal of various consumer goods. Tracking the occurrence, distribution and fate of MPs in the subsurface environment and their potential adverse biological effects. The project “TREESE” [1] (TRack Tracking of Environmental organic micro-pollutants in the Subsurface) aims to develop an innovative technological platform for monitoring MPbs based on the assessment of their biological effects. The proposed setup will be composed of the following steps: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) bioreactors. A main goal of our study is to develop tools and methods for a multiparallel effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescent reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC to solid phase extraction (SPE) with different biological endpoints (angidroidic, thyroigendic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of additional sensor-strains and (iii) the development of a series of interlaboratory comparisons (eco)toxicological effects and (ii) method development for the detection of compounds by chemical analysis after separation by HPTLC. <br>clear="all"> [1] A German-Israeli research and development project in the field of water technology within the framework of the BMBF-MOST cooperation, FKZ: 02WIL1387.

TH061 Endocrine disruptors used in polymers in the offshore oil and gas industry

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Chemos 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 by leach endocrine disrupting effects, (ii) the potential to release endocrine disruptors in environmental conditions that directly links chemical analysis of contaminants to their potential adverse biological effects. The project “TREESE” [1] (TRack Tracking of Environmental organic micro-pollutants in the Subsurface) aims to develop an innovative technological platform for monitoring MPbs based on the assessment of their biological effects. The proposed setup will be composed of the following steps: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) bioreactors. A main goal of our study is to develop tools and methods for a multiparallel effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescent reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC to solid phase extraction (SPE) with different biological endpoints (angidroidic, thyroigendic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of additional sensor-strains and (iii) the development of a series of interlaboratory comparisons (eco)toxicological effects and (ii) method development for the detection of compounds by chemical analysis after separation by HPTLC. <br>clear="all"> [1] A German-Israeli research and development project in the field of water technology within the framework of the BMBF-MOST cooperation, FKZ: 02WIL1387.
TH063
Thyroid disorder screening using zebrafish as vertebrate model
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Endocrine disrupting compounds are frequently found in the environment and have a profound impact on the development and physiology of vertebrate organisms. Thyroid Disrupting Compounds (TDC) specifically affects the function of thyroid hormones, interfering with their synthesis, transport and/or binding; altering important physiological processes. Several environmental contaminants such as polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and hexabromobiphenyls cause thyroidal activity. Acknowledgements: This work was supported by the Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación, project CTQ2010-18272-C02-02.

TH064
Development of stably transfected cell lines with zebra fish thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples
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Endocrine-disrupted chemicals (EDCs) are ubiquitous in the environment and can be found in many products including food/feed, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents... Accordingly, they suppose a threat to animal and human health through different exposure routes. In vitro bioassays are valuable tools for detecting and studying EDCs action and provide a sensitive and rapid system to evaluate their potential effects. In addition, the stemness properties of primary cells in line with the 3R principles in relation to TG gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

TH065
Screening endocrine disrupting potentials of alternative plasticizers using the zebrafish line TH065
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Phthalates have been used as plasticizer in polyvinyl chloride (PVC), food containers, medical devices, building materials, and personal care products. Because of reproductive toxicity of several phthalates including bis(2-ethylhexyl) phthalate (DEHP) and diethyl phthalate (DEP), use of major phthalates are regulated in many products in several countries. Accordingly, many alternative plasticizers have been developed and increasingly used worldwide, but their possible adverse endocrine disruption effects are not well-known. The aim of this study is to screen endocrine disrupting potentials of several widely used alternative plasticizer, cyclohexane dicarboxylic acids (DINCH), acetyl tributyrl citrate (ATBC), dioctyl terephthalate (DOTP), trioctyl trimellitate (TOTM), bis(2-ethylhexyl) adipate, and diethylhexyl adipate (DEHA). A series of in vitro assays employing human a breast (MVLN), a human adrenal (H295R), and a rat pituitary (GH3) cells, were employed. The test doses for each plasticizers applied were determined based on preliminary cytotoxicity assays for each cell line. While none of the alternative plasticizers showed significant cytotoxicity, thallium exhibited significant increase in estradiol (E2) to testosterone (T) ratio in H295R cells. This result suggests that these plasticizers DINCH and DEHA cause increased estrogenicity through altering the estradiol receptor expression, as shown in a previous study.

TH066
Development of reporter gene system for assessing cherry shrimp ecdysone receptor agonists using mammalian cells
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Ecdysteroid is a key steroid hormone that regulates growth, development and molting in animals under the phylum of Arthropod, which includes the insects and crustaceans. The hormone targets the receptor complex which comprises the ecdysone receptor (EcR) and retinoid X receptor (RXr). The activated complex anchoring on the ecdysone responsive element (EcRE) stimulates the promoter subsequently initiates transcription of the responsive gene(s). Chemicals act as receptor agonists do not necessarily adopt the structure of the native hormone, as in the case of estrogenic endocrine disruptors. Recently, for insect pest control, synthetic ecdysone receptor agonists using mammalian cells were developed to disrupt ecdysone/receptor signalling. They work as the ecdysone receptor agonists, which cause premature launching of the molting process and subsequently death. Crustaceans, as a subphylum closely related to insects phylogenetically, also adopt this ecdysone signalling system, as they share the hormone, hormone synthetics enzymes and the receptors. Thus, these endocrine disrupting insecticides, together with other untested potential endocrine disruptors, may post a threat on the crustaceans. Here we report the development of an in vitro reporter assay for the screening of ecdysone receptor agonist in cherry shrimp. The assay is done by transiently transfecting mammalian cells with plasmid vectors expressing cherry shrimp EcR and RXr, together with a vector carrying a luciferase reporter gene fused to a minimal promoter linked to five copies of EcRE. The results show that the system responds well to the native ecdysone hormones in a dosage-dependent manner. The adaptation of mammalian cells in in vitro assay for heterogenous receptor is satisfactory. Three DAH/BAH insecticides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecticides aimed for insect pest control can be potential hazards to crustaceans. More studies on different mammalian cells and competition study with mixtures of chemicals are being carried out to validate this reporter gene system.

TH067
Micro-injection as an alternative for aquatic exposure? A case study in zebrafish embryos with 17a-ethinylstradiol.
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Pharmaceutical companies have to perform an environmental risk assessment for every drug that is launched to the market. The mandatory tests for potential endocrine disrupting (ED) properties are mainly animal-based aquatic toxicity 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 commonly used exposure route via water. As a first in a series of test, 17a-ethinylstradiol (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 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 counterbalanced atrazine effects. 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 pulex and consequences of endocrine disruptor exposures
E. Gismondi, University of Liege
Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent crucial models for the research of these processes, which are key to understand the functioning of the invertebrate endocrine systems. The purpose of this study was to identify the endocrine system of Procambarus pulex. Two sequences, corresponding to molt-inhibiting hormone (MIH) and ecdysteroid receptor (EcR), were identified in Procambarus pulex transcriptome data. The MIH sequence was validated by in vitro assay, and the EcR sequence was validated by in silico assay. The MIH sequence was found to be homologous to the MIH sequences of other crustaceans, while the EcR sequence was found to be homologous to the EcR sequences of other crustaceans. These sequences were used to design primers for qRT-PCR experiments. The expression of these sequences was analyzed in response to different treatments, including EE2 exposure, and the results were compared to the expression of these sequences in unexposed animals. The results showed that EE2 exposure significantly increased the expression of MIH and EcR sequences, suggesting that these sequences are involved in the regulation of the endocrine system of Procambarus pulex.

TH070
Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius
S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; V. Esser, RWTH Aachen University / Physical Geography and Geology; A. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shulikievich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; H. Hollett, RWTH Aachen University / Institute for Environmental Research.
Sediments act as a sink and source of chemicals in the environment and, therefore, it is of great importance to know how sediment-bound chemicals affect aquatic organisms. The synthetic hormone 17α-Ethynylestradiol (EE2), a component of oral contraceptives, is ubiquitous in the environment and is a known potent endocrine disrupting compound (EDC) that adversely affects aquatic vertebrates (e.g. reproduction) and development of fish. The potential of sediment-bound EE2 on benthic organisms is important for understanding the potential effects on vertebrate predators and subsequent upper trophic levels as a secondary source of contamination.

TH071
Assessing acute toxicity of Bisphenol A on Daphnia magna by passive dosing approach
H. Kwon, Y. Jeong, H. Jeon, S. Kim, KIST Europe / Environmental Safety Group
Bisphenol A (BPA) is a raw material for widely used polycarbonate plastics, but it is known to have negative effects on human health and the environment. It was classified as an endocrine disrupting chemical (EDC), which requires an accurate and reliable toxicity data for robust risk assessment. However, currently available toxicology data of BPA is still lacking. In the present study, the effects of EE2 were analyzed through a yeast estrogen receptor (YES) assay, a common in vitro assay used to estimate estrogenic potential. Additionally, EE2 tissue extracts were quantified through LC/MS-MS with deuterated internal standards which were used to account for any losses during the extraction process. The bioavailability of EE2, inferred through the YES assay and LC/MS-MS analysis, provides insight into the bioaccumulation of EE2 in D. riparius larvae. Knowledge about the bioavailability, bioaccumulation, and estrogenicity of BPA in water and sediment is crucial for the development of risk assessment for BPA and its compounds.

TH072
Concentration of BPA in sediments and effects on Chironomus riparius
G.R. Silveyra, University of Buenos Aires / Dept. of Biodiversity and Experimental Biology.
Our results showed that passive dosing does not require a co-solvent for exposure and can be used to test the toxicity of BPA and other EDCs in aquatic systems. The method is easy to use and does not require a complex setup, making it suitable for use in multiple laboratories. The results also showed that the concentration of BPA in sediments can have a significant impact on the toxicity of BPA to Chironomus riparius. The concentration of BPA in sediments can be used as a predictor of the toxicity of BPA to Chironomus riparius, making it a valuable tool for risk assessment.

TH073
Sediment contamination analysis using a yeast estradiol receptor (YES) assay
G. de la Lande, University of Liege / Institute of Biodiversity and Experimental Biology.
The use of the YES assay for the determination of estrogenic activity in sediment samples has been widely reported in the literature. However, the effect of the concentration of estrogenic activity on the YES assay has not been thoroughly investigated. The primary objective of this study was to investigate the effect of the concentration of estrogenic activity on the YES assay for the determination of estrogenic activity in sediment samples. The results showed that the concentration of estrogenic activity had a significant effect on the YES assay for the determination of estrogenic activity in sediment samples. The results also showed that the YES assay is a reliable and sensitive method for the determination of estrogenic activity in sediment samples.

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Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi) X. HU, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences; K. Chu, The Chinese University of Hong Kong / School of Life Sciences

Crustaceans are a large group of arthropod, and they are the major constituents to the aquatic ecosystem and the major components of the marine food chain. Therefore, the increasing quantities of insecticides leaching into water bodies severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disruptors known to interfere with the normal hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesoate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JHA insecticides would cause adverse effects on the development and reproduction in crustaceans as in insects. The aim of our study is to examine the toxic effects of JHA insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully cultured and maintained in our laboratory as a new crustacean model. These insecticides are being used 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 μmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 μmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And the total number of molts of 20 shrimp over this period reduced by 29.2% and 17.7%. Differential expressions of JH signaling pathway genes were investigated in this study. The genes h3 (hormone receptor 3) and e75 in N. davidi were up-regulated, while Chd64 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

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 models (multimedia fate model for Hu/man Risk Assessment in Multimedia Environment) has been developed considering topographic features and environmental and been meteorological data of watershed region of Asan Lake in Korea. Human risk assessment system using this multimedia fate model was established and integrated to assess spatial exposure and risk about human living in this area. For this purpose, first, GIS database system containing various environmental the meteorological data and mensuration data of these two chemicals have adverse effects on the development of juvenile N. davidi. After six weeks chronic exposure to 100 μg/L (0.33 μmol/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 genes were investigated in this study. The genes h3 (hormone receptor 3) and e75 in N. davidi were up-regulated, while Chd64 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural atmospheric extracts on crustaceans G–3 human stage embryos: B.L. van Drooge, IDAEA-CSIC / Department of Environmental Chemistry; A. Marqueno Bassols, Institute of Environmental Assessment and Water Research IDAEA-CSIC; B. Pina, C. Porte, IDAEA-CSIC / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry

Outdoor ambient air particulate matter and pollution are related to adverse effects on human health. The present study assesses the cytoxicity 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 cytoxicity 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 cytoxicity 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 growth inhibition in high mortalities over 96h. The results show that the exposure of these samples to the crustaceans 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 μmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 μmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And the total number of molts of 20 shrimp over this period reduced by 29.2% and 17.7%. Differential expressions of JH signaling pathway genes were investigated in this study. The genes h3 (hormone receptor 3) and e75 in N. davidi were up-regulated, while Chd64 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH075 Dietary and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study. M. Mar, INDEED, RODRÍGUEZ, J. Rovira, Universitat Rovira i Virgili; R.P. Sharma, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Nadal, Universitat Rovira i Virgili / School of Medicine, 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 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 closely 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 indicate that for both, BPA and DEHP, diet is the main contributor to the total exposure. However, indoor 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. Diaram, 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 toxicity 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 70 0000 pg/mL for T4 was developed and validated using LC-MS/MS (liquid chromatography coupled to tandem mass spectrometry detector). The method validated utilizes a 50 μL sample volume of serum to determine both T3 and T4 from the same sample aliquot. Across several studies from various Toxicology facilities, this method was observed to be different particularly in fetus and Day 4 of age pups. Considering that samples are collected from animals of fetus and Day 4 of age pups, which may be triggered for analysis subsequent to Day 13 and adult male samples being analyzed, the emphasis of the integrity of the sample is paramount to...
ensure meaningful data can be collected. An experiment was performed to evaluate if tubes containing clot activator could produce ‘cleaner’ serum samples to avoid loss of data points from analytical instrument signal suppression, yet provide true and accurate data without significant loss of T3 and T4 arising from potential absorption or non-specific binding to the clot activator tube. The CV (precision) and RE (accuracy) for both T3 and T4, across quality control samples (generated from collection tubes (a) and (b)) were within acceptance criteria of ≤20% (25% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling.

TH077
Steroid estrogens and estrogenicity activity in absorption in dairy farm watersheds regardless of effluent management practices
L. A. Tremblay, Cahtron Institute; J. B. Gadd, NIAWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited

Steroid estrogens contamination has been linked to adverse effects on aquatic biota. Steroid estrogens are excreted by all mammals and are therefore found in most agricultural wastes including dairy manure and dairy shed effluent (DSE). Some previous studies have demonstrated elevated levels of free and conjugated estrogenic steroids in DSE and this source has increased as New Zealand has experienced rapid expansion and intensification of dairy farming. This research used an approach incorporating analytical chemistry and bioassays to evaluate the levels of estrogenic activity in environmental samples from representative dairy watersheds with differing DSE management practices: either managed or unmanaged. The toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrogen was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow estrogen, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalent effect) (EEq) was found at low levels in 83% of the stream samples (highest 1.44 ng L\(^{-1}\)) and groundwater (≤0.15 ng L\(^{-1}\)). While estrogenic activity was generally -1, one of (10) stream with measurable estroene, 17α- and 17β-estradiol 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?
L. Mišić, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šojić, ALHem - Safer Chemicals

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 packages 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 ice cream packaging. This chemical is proved to be toxic for fertility, disruptive for endocrine systems, 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 technological 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.

TH080
Evaluate the ecological risk during product development: safe by design case study - Met@link project
R. K. VITO / ARCHE; S. geerts, VITO NV / Health; s. verstraelen, 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). Estimation and use of an early stage ERA allows assessment of the potential effects on the one hand (concentration effect relations for the target organisms) and evaluates the potential exposure of target organisms on the other hand (i.e. to define the environmental compartments and organisms of concern). Risk management either reduces the potential effects (f.i. redesigning the product) or prevents the predicted exposure (f.i. redesign the production process) to minimize the potential risk. Case study: ERA Ag-NP metal based ink. Potential effects considered: 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 technological properties were formulated. Both were tested for their leaching potential and for their ecotoxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the ecotoxic effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH081
REACH Substance Evaluation of silver - justification of read-across from ionic silver to nanosilver
K. Ariis, ARCHE; J. Mertens, Precious Metals and Rheinum Consortium c/o 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 nanoparticles. 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. An 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 media used in the ecotoxicity tests. The nanosilver dissolution behaviour qualitatively explained the observed toxicity. Since the ecotoxicity testing demonstrated that nanosilver was equally or less toxic than ionic silver, further fate testing in soil was not required. The data collection on the uses of the silver nanoforms covered by the REACH registration dossier showed limited tonnage and use of nanosilver. Furthermore, since nanosilver is transformed to ‘bulk’ silver during its use, there is limited release to the environment. The generated data show that the read-across of toxicity values from ionic silver to nanosilver as a ‘worst case’ approach is justified and scientifically defensible.

TH082
Revising REACH technical guidance on information requirements and chemical safety assessment for engineered nanomaterials for aquatic ecotoxicity endpoints - recommendations from the EnvNano project
S.F. Hansen, Technical University of Denmark / DTU Environment; S.N. Sørensen, DTU Environment / DTU Environment; L. Skjølding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Bang, Technical University of Denmark (DTU) / DTU Environment; J. Mertens, Precious Metals and Rheinum Consortium c/o EPMF; S. geerts, VITO NV / Health; S. verstraelen, VITO / ABS

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

Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science (P)
in suspension is fundamentally different from that of chemicals in solution. The aim of this paper is to present the findings of the EnvNano project and through these provide the scientific background for specific recommendations on how ECHA guidance could be further improved. Key EnvNano findings such as the need to characterize dispersion and dissolution rates in stock and test media have partially been addressed in the updated guidance. However, it has to be made clear that multiple characterization methods have to be applied to describe state of dispersion and dissolution over time and for various test concentration. More detailed information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, if data from dispersed media are used to suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that data from dispersed media is not acceptable to predict transfer of data for each commercialized functionalization of the nanomaterials is required. Finally, as an outcome of the project a method for assessing the regulatory adequacy of ecotoxicological studies of nanomaterials is proposed.

TH083 Identifying criteria for environmental risk assessment models at different stage-gates of nano-material/product innovation considering requirements of various stakeholders

S. N. Sørensen, DTU Environment / DTU Environment; S.F. Hansen, A. Baun, Technical University of Denmark / DTU Environment; D. Spargue, Centre for Ecology & Hydrology; M. Matzke, NERC Centre for Ecology and Hydrology; K. Schuwald, Chemical Defence R&D, Eawag; J. Helmholz Centre for Water Science / Southern Ocean Persistent Organic Pollution Program; M. Dal Maso, M. Poikikkimaki, Tampere University of Technology / Aerosol Physics; A. Verschoor, RIVM / Centre for Safety of Substances and Products; J.T. Quik, RIVM / DMG; W. Peijnenburg, RIVM / Center for Safety of Substances and Products; H. Wigger, Eawag Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, Empa Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab

The EU H2020 project calibrate aims to establish a state-of-the-art versatile risk governance framework for assessment and management of human and environmental risks of manufactured nanoparticles (MN) and MN-enabled products. The ultimate goal is to develop an innovation process platform and a toolbox for these materials and products. Initial efforts have focused on identifying criteria for environmental risk assessment (ERA) models and tools for such governance framework. It was recognized that some criteria are applicable to both environmental and human risk assessment (HRA), and these so-called “overall” criteria were identified through joint efforts of the ERA and HRA working group experts in calIBRATE. The identified “overall” criteria relate to RA model features and resources needed to use the tools, whereas the criteria specific to ERA models relate to model output on hazard, exposure and risks. The identified criteria were listed against the Cooper stage-gates®, thus forming a table in which the importance or relevance of each criterion could be assessed for each of the stage-gates. This was formed into questionnaires with defined response options for each environmental and human stage of the innovation process. In this way, a prioritization of the criteria and the importance of the criterion. These questionnaires were sent to stakeholders representing regulators, consultants, researchers and industries, who provided their feedback, either by filling the questionnaires or by listing general input on their current RA approaches or needs. Efforts to obtain input from NGOs and insurers remain ongoing. The feedback clearly illustrated different requirements between stakeholder groups. For example, not all use the (same) stage-gate approach or have the same level of expertise for RA. Other criteria were similar or similarly important to most stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria suggested useful for users in calIBRATE partners included the use of modeling/estimation and safety-by-design considerations as low cost options to identify “red flags” for hazard and/or exposure at early stage-gates of MN innovation. The criteria and stakeholder feedback generated will be applied to evaluate existing models/tools against, but also to enable the creation of a “System of systems” for RA along stage-gates when developing MN and MN-enabled products, incorporating the needs of different specific user groups.

TH085 Matrix to predict possible environmental risk of nanomaterials during use

M. Herchen, Fraunhofer IME; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; C. Nickel, Institute of Energy and Environmental Technology e. V. - IUTA / Air Quality & Sustainable Nanotechnology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schuwald, German Federal Environmental Agency UBA; T. Kuhlbusch, BBAuA

Grouping of engineered nanomaterials (ENMs) is a strategy in environmental risk assessment that should allow an adequate hazard assessment while reducing the testing effort needed for a material-by-material fate and effects testing. We present a practicable matrix that allows to group of ENMs regarding their potential risk to the aquatic and terrestrial environment. This matrix is based on the combination of assumptions regarding release and fate as well as ecotoxicological effect. The assumption the fate information is based on the fate bond concept with three toxicological (hazard properties (ecotox bond); present at an additional post) of an ENM. In this position, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: transformation, transport, fate grouping Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03XP0002

TH086 Concepts for nanomaterial categories regarding environmental hazard and for prediction of their environmental risk as well as proof of principle

K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; C. Nickel, Institute of Energy and Environmental Technology e. V. - IUTA / Air Quality & Sustainable Nanotechnology; K. Schuwald, German Federal Environmental Agency UBA; D. Volker, German Environment Agency; E. van der Zalm, German Federal
Environment Agency UK.

The grouping of engineered nanomaterials (ENMs) is being intensively discussed in order to develop approaches that allow an adequate hazard assessment of ENMs while reducing the testing effort or to rank them regarding their environmental hazard. Two approaches differing in their focus have been developed and evaluated with a set of 25 ENMs. Based on systematic testing using aquatic test designs used in regulatory testing, the physical-chemical (PC) properties, ion exchange and aggregation/micro-aggregation/micellar properties as well as ecotoxicological properties were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the parameters ecotoxicity of the bulk chemical, solubility and reactivity we decided upon a pragmatic approach with questions which have to be answered “yes” or “no”. Approach I (ecotox flow-chart) is characterized by maximum 24 groups, where the property morphology is defined by three categories i.e. fibers, small spherical ENMs, others. The ecotoxicity of the ENMs of a specific group is attributed to similar PC-properties thus support discussion on grouping with the final objective of read across. Approach II (ecotox-bond) was developed for risk assessment by using an approach similar to control banding. For risk assessment the hazard information has to be combined with properties influencing environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-bond every “yes” for an answer gives one point. The points are added together resulting in five groups in a range or band of 1 to 5 which is used for further assessment. The same number of points can be achieved by different properties resulting in groups of ENMs which can differ significantly in their PC-properties. This procedure is considered suitable for the initial prediction of dissolution and importance of the ENMs that have been subjected to environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

TH087
Forms of released engineered nanomaterials: A systematic assessment in material flow analysis
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The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO$_2$ flowing in different forms (e.g. dissolution, mechanical 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. This model is based on 10 different compartments. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of these distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-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 so far is the oxidation of TiO$_2$-based ENMs to TiO$_2$-oxide, which ENMs are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

TH088
Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials
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In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox® modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox model was recently extended for use with nanomaterials (SimpleBox4.0-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution.

In this study we show the sensitivity of SimpleBox4.0-nano to the newly added process parameters. This shows that in addition to the dissolution rate constant and attachment efficiency, also the concentration of natural particles and their size play a role. In order to use SimpleBox4.0-nano we provide guidance on measuring or calculating the relevant input parameters. Furthermore, we indicate the relevance of the different fractions of PECs as calculated by SimpleBox4nano for estimating the risk quotient. 1: www.rivm.nl/simplebox2: Meesters, J.A.J., et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4-nano: Model Definition and Evaluation. Environmental Science & Technology, 2014. 48(10): p. 5726-5736.

TH089
Directions of in silico method development to complement the predictive models used in risk assessment of nanomaterials
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There is an increasing need for predictive risk assessment of nanomaterials (NMs) due to the rapid introduction of NMs that are to be subjected to environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

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 nanoscale technologies-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 coating of a second layer of organic coating is aimed at favoring the nanomaterial dispersion in the sunscreen formulation. The fabrication and end of life steps are mainly considered and studied. Water leaching and photo degradation of these coated nanomaterials are of importance but few studies have been conducted to assess the fate of coated nanoparticles in terms of chemical (PC) properties, ion release, and transformation (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.

TH091
Engineered Nanoparticles with SimpleBox4nano: Model Definition and Evaluation
OECD Test Guidelines and Guidance Documents for Environmental Safety Assessment of Nanomaterials

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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 GDs applicable and adequate? The need for an obligatory testing of nanomaterials? 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 test results with the data on test chemicals. 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 TG on exposure stability in simulated environmental media, which was published in 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 / 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 and Guidance Documents for Environmental Safety Assessment of Manufactured Nanomaterials (MNMs) are difficult to carry out due to the lack of suitable test systems that allow a permanent and constant exposure of the compounds. MNMs tend to sediment in water and are supposed to be primarily taken up by benthic species in aquatic ecosystems. Different studies have shown that mussels are able to ingest and incorporate MNMs suspended in water. However, existing standardised test methods to investigate the bioaccumulation of substances in mussels have been developed and optimized for soluble, non-particulate substances. Therefore, an alternative test concept was developed allowing to investigate the bioaccumulation of MNMs both in mussels under flow-through conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. By using silver MNMs (NM300K) and silver nitrate we were able to compare the accumulation and elimination of ionic and nanoparticulate silver. Mussels were exposed for a period of 4 - 6 days. In both cases steady state concentrations of total silver in the mussel tissue were reached within 24 hours. The quantification of the silver content in mussel was carried out by ICP-MS or ICP-OES. The concentration of silver and water concentrations were used to determine bioaccumulation factors for both test items. In a further study the bioaccumulation of a titanium dioxide nanomaterial (NM 105) was tested. The studies have shown that the new test system is suitable to investigate the bioaccumulation of MNMs.

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

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TH095
Assessment of persulfate oxidation liquid chromatography tandem mass spectrometry for the analysis of perfluoroalkyl and polyfluoroalkyl substances in water

G. Munoz, Université de Montréal / Chemistry; S. Mejia, McGill University / Civil Engineering. A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel Corbicula fluminea. S. Kühr, 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 Environmental Analysis; B. J. Navas, A. Bermejo, INIA National Institute for Agricultural and Food Research and Technology / Environment; F. Torrent, Un...
Environmental risk assessment of perfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible impact on human health and the ecosystems. The soil mixture assayed, as well as a careful assessment of the matrix effect that may occur at the instrumental analysis stage. The method was applied to a limited survey of surface water and groundwater samples. It was observed that even though fluorotelomer sulfonates (ZFTSAs) were the target pre-PFAs predominantly reported before oxidation in most instances, they could only partially account for the observed APFAs (molar concentration increases upon oxidation). The unexplained APFAs portion likely results from the oxidation of untargeted pre-PFAs for which oxidation yields are yet to be determined.

**TH096**

Biochar for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils

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The contamination of soil with a mixture of compounds represents a worldwide environmental issue. Contaminants in soil can leach to groundwater or be transferred to the food chain by crop uptake and affect safety and quality of food resources. Of particular concern are industrial contaminated soils, where high concentrations of both organic and inorganic pollutants can be found. In the present study four soils with different types of pollution (poly- and perfluorinated alkyl substances (PFASs) and heavy metals) and two different total organic carbon contents (high and low), were used. PFASs are a class of compound characterised by hydrophobic, alkylated, fluorine-saturated carbon chain with a hydrophilic head attached at a terminal position. The high adsorption of heavy metals and organic and inorganic pollutants can be found. In the present study four soils with different types of pollution (poly- and perfluorinated alkyl substances (PFASs) and heavy metals) and two different total organic carbon contents (high and low), were used. PFASs are a class of compound characterised by hydrophobic, alkylated, fluorine-saturated carbon chain with a hydrophilic head attached at a terminal position. The high adsorption of heavy metals and organic and inorganic pollutants can be found.

Biochar (BC) has a high adsorption potential for organic and inorganic contaminants and can be made at a low cost. Biochar is thus a promising and economic alternative to other carbonaceous materials, such as activated carbon, for this environmental application. In this study, three BCs were used as sorbents: a wood BC (wBC) made from wood chip waste (used for all the treated soils), an iron enriched BC (Fe-BC) (used for the metal contaminated soils) and an activated biochar (aBC) (used for the PFAS contaminated soils). Isotherm batch tests have been carried out using a water and soil mixture (L/S=10) to which BC was added at increasing doses (from 0% to 20%). The aim of this work is to investigate i) whether biochar can be used as a sorbent material for the treatment of industrial contaminated soil, ii) whether BC can 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**

Thirteen sorption of PFASs to organic soil constituents - the effect of H+, Na+, Ca2+ and Al3+ ions

H.F. de Campos Pereira, Swedish University of Agricultural Science / Department of Soil and Environment; M. Ullberg, Swedish University of Agricultural Sciences / Department of Soil and Environment; D. Berggren Kleja, Swedish University of Agricultural Sciences; I. Gustadsson, 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 perfluoralkyl 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 (PFSAs) and perfluorooctanesulfonamide (FOSA), to an organic soil horizon and the effect of solution pH and simulated soil organic matter (SOM) net charge as a function of pH and added concentrations of Al3+, Ca2+ and Na+. Generally, the organic C-normalized partitioning coefficients (Koc) were negatively correlated with MOD and showed 0.32 ± 0.11 log units per unit pH increase. The SOM bulk net negative charge (−1.41 ± 0.40 log units per g C/g g−1). The sorption increased with increasing perfluorocarbon chain length (hydrophobicity) for both PFCAs and PFSAs with 0.60 and 0.83 log units per CF2 moiety, respectively. Comparing the effect of the PFAS functional head group on sorption, sorption affinity followed the order PFCAs < PFSAs < FOSA. Effects from cation incorporation on sorption were significant for the C11, C17 or C19 PFOAs and perfluorohexane sulfonate (PFHxS), and for these substances, the SOM bulk net charge was the better sorption predictor as compared to the pH value alone. However, for sorption of the most long-chained substances (i.e. the C8-C11, C13, C14 PFCAs, PFSAs and FOSA), cation effects were small and instead sorption was more strongly related to the pH value. This suggests that the most long-chained PFASs have a binding preference towards the highly condensed parts of the humin fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

**TH098**

Environmental degradation rates for new PFAS via decarboxylation potential in water, in a MS collision cell and in soil

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Straight-chain perfluorolipophilic carboxylic acids, like PFOA, are extremely stable chemical compounds. In contrast, several other perfluorinated carboxylic acids are less stable and undergo decarboxylation – spontaneous degradation with loss of carbon dioxide. For instance, perfluorobenzoic acid decomposes slowly in aqueous solution, while perfluoropivalic acid is too CO2 fast at room temperature that its spontaneous decomposition is a synthetic method for nonafluorosubstane. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PFCAs is based on the same decarboxylation process: SRM transition from [M-1] to [M-45]. A collision energy, required for such transition is a measure of intrinsic stability of a compound. The spontanous degradation of PFASs can be measured by monitoring the parent ion and the degradation products and their formation in the MS. If the parent ion is still visible, the degradation process might not be complete. For this transformation can be satisfactorily predicted by DFT calculations at standard RB3LYP/6-31G(d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carboxylic acids also correlate well with MS and DFT-derived energies. Thus mass-spectral information and results of simple quantum-chemical modeling can be used as a measure of abiotic degradation potential for per- or perfluorinated acids in aquatic environment.

**TH099**

Perfluoroalkylated acids (PFAAs) in soil and invertebrates (Isopoda) near a fluorochimical plant in Flanders, Belgium

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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 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 fluorochimical plant has been characterized as a source of PFOA for environmental contamination. In the present study we measured the concentration of 12 PFAAs (8 perfluoralkyl carboxylic acids (PFCAs) and 4 perfluoralkyl sulfonic acids (PFSAs) in soil and isopods collected at a fluorochimical 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. organic carbon content) and PFAA concentrations in soil, as well as correlations between PFAA 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 PFDoA and PFBS, were < LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOS and 8 ng/g ww for PFOA were detected in soil at the plant site, which are high compared to what has been reported in previous studies conducted in the area. Furthermore, these concentrations decreased significantly with distance from the plant. However, concentrations did not differ between the three locations that were situated farthest away from the plant. No significant differences in TOC were
Perfluoroalkyl sulfonamidoacetic acids (FASAAs) are to the best of our knowledge trifluoromethane sulfonic acid (TFMSA), which was tested in water samples from China, Japan, India, the United States of America, and Canada. PFAS is still scarce and, if available, is markedly more persistent than other long chain PFASs, their voluntary phase out has been taking place, moving away from long chain PFASs toward alternative substances, such as per- and polyfluoroether carboxylic and sulfonic acids (PFECAEs and PFESAs). Due to structural similarities, the question arises whether the alternatives represent a substantial improvement on their predecessors. The majority of the water data on 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 PFESAs 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 WAX, 6cc, 500 mg, 60 μm). After a washing step, the target compounds were eluted using methanol and 0.1 % ammonium hydroxide in methanol. The eluates were reduced to 150 μL under nitrogen and 13C8-PFOSA was added as injection standard (10 μL, 100 pg/μL). Instrumental analysis was performed by HPLC-MS/MS, using an Agilent HP 1100 LC system coupled to an AB Sciex API 4000 triple quadrupole mass spectrometer. First results show that the fluorinated alternative GenX can not only be detected in all water samples along the German North coast, but is 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 (PFECAEs and PFESAs). Perfluorooctane sulfonate (PFOS) are the two most frequently used and most well studied legacy PFASs. Presence of PFOS in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Samples were collected in two semi-confined coastal areas, one of them an area with high industrial and port activities (Ría de Vigo) and the other one with high touristic and recreational activity (Mar Menor). PFAS, PFOS, PFDA, n-MeFOSA, n-Fluorosiliconoxane, n-EFOSA were extracted from sediments by sonication, cleaned up by dispersive solid phase extraction and the analyzed by LC-MS/MS in full scan mode. This is the first time that these compounds were measured in these areas. N-MeFOSA and N-EFOSA 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 levels higher than quantitation limit for field blanks. The outcomes of the present study will be used in further monitoring studies on the effects of soil type on PFAAs bioavailability to invertebrates, as well as effects of PFAAs on marine plants, whic...
Oceanography

Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial mineralization processes. They can degrade into various fluorinated carboxylic acids (PFicas) 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/m³), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log Kₚₑ, were obtained using a Waste Water Treatment Plant (WWTP) and a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log Kₚₑ, during the 3-week uptake experiments. Derived log Kₚₑ values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOS and EFOS, derived log Kₚₑ 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, MeFOS and EFOS.

TH105 Occurrence and Removal of perfluorooctyl and polyfluorinated substances (PFASs) in full scale water and wastewater treatment plants

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Perfluoroalkyl and polyfluorinated 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, bioaccumulation and possible adverse effects to aquatic and non-aquatic 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 one-year monthly sampling for the removal of 31 PFASs, including 20 perfluorooctyl acids (PFAAs) and 11 PFAB precursors. The treatment processes include conventional activated sludge system (CAS) and membrane bioreactor (MBR) system in plant 1, and membrane bioreactor (MBR) system in plant 2. The third plant (Plant 3) had two MBR systems (MBR-1 and MBR-2). The lowest PFOS concentrations were found in Plant 1, 2 and 3, respectively. Results showed that RO is the most effective process for removal of PFASs (>98%) for both short-chain and long-chain PFASs. The RO process in plant 1 had a limited removal efficiency (< 50%) for PFABs. In some cases, the effluent concentrations of PFASs were even higher than the influent, suggesting potential degradation of PFAB precursors. The biodegradation of PFAB precursors also leads to the higher removal of some PFAB precursors. Considering the low removal of PFASs in most of the treatment processes, further research is needed to improve the efficiency and efficiency of their removal.

TH106 Perfluoroctanoic acid (PFOA) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers

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Objective of the Study The study compares PFOA and PFOA concentrations detected in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected perfluoroalkyl compounds in biota was carried out in several selected rivers in the Czech Republic. Monitoring comprises two profile sets containing 21 and 22 monitoring sites. Sampling at those two site sets alternates in the three-year cycles. Sites are located at important parts of main Czech rivers (country borders, before confluences, downstream industrial sites or large cities, etc.). An assessment was made for following matrices: juvenile fish, benthos (Hydropsyche sp., Euphyllophila sp., Rhyac PRIA sp.), molluscs (bivalve and gastropods) and fish (Coregonus / cusk eels (Coregonus / cusk eels). The analyses of fish were conducted for following tissues: muscle, blood and liver. In total, following number of samples of various matrices were analysed using LC-MS/MS and LC-HRMS: fish blood 105, fish liver 15, fish muscle 78, juvenile fish 149, benthic organisms 126, mussels 73. Results PFOA highest values were detected in fish blood (10 - 3030 μg/L), weight wet concentrations in fish liver and muscle 0.5 - 317 μg/kg wet weight). Small concentrations were detected in mussel and fish muscle (0.05 to 61 μg/kg); significantly exceeded levels of PFOA found in fish muscle (0.4 to 38 μg/kg). The lowest PFOS concentrations were found in mussels (0.01 - 2 μg/kg). PFOA concentrations to PFOA reached significantly lower levels in all monitored matrices. Range of values was between 0.01 - 3.1 μg/kg, where minimum represents the smallest concentration found in mussels and the maximum represents concentrations in juvenile fish. PFOA highest values were detected in juvenile fish (0.01 - 3.1 μg/kg), followed by benthic organisms (0.02 - 2.5 μg/kg) and fish blood (0.06 - 1.8 μg/L). Small concentrations were found in mussels (0.01 - 1 μg/kg), fish muscle (0.05 - 0.5 μg/kg) and fish liver (0.02 - 0.7 μg/kg). Concentration in general the PFOA concentrations were lower than expected, except fish muscle as expected. PFOA concentrations in fish blood, kidney and liver were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQs for PFOA (9.1 μg/kg).
precursors to the apparent biomagnification of PFCAAs, via their biotransformation. In addition, the Total Oxidizable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFAs in sediments/biofilm/leaf litter samples (64-80% of total PFAS molar concentration); this proportion was lower in invertebrates (28-54%) and in fish (15-26%). These results suggest either the biotransformation of precursors in benthic invertebrates and fish or the limited bioaccessibility of unidentified sediment-bound pre-PFAs.

TH109
PFAS and their precursors in the Environment. First indications from a large-scale environmental monitoring study


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 PFPeAs), and also precursors (e.g. PAPs, dPAFs, FTPs, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring 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)

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Perfluorinated substances, PFOS and perfluorohexane sulfonate (PFHxS). Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2009. Two dietary exposure experiments were performed on adult rainbow trouts (O. mykiss) at two water temperatures (7°C and 11°C). Fish were fed in the field or contaminated via food spiked with a mixture of PFOS and PFHxS during several weeks. Then, fish were allowed to deplate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFASs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in blood were obtained by a simultaneous adjustment to experimental data. Half-lives were estimated for both compounds, in blood, at both conditions. Globally, fish acclimated to the warmer temperature showed faster absorption and elimination rates of PFOS and PFHxS, and their distribution differed between organs, suggesting that temperature represents an important factor in the toxicokinetic profile of PFASs.

TH112
Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo

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Perfluorinated alkyl acids (PFAAs) are widely distributed and have been detected e.g. in humans, wildlife and numerous other environmental matrices. These surfactants are highly bioaccumulative as well as persistent and have been associated with several health effects including hepatotoxicity, immunotoxicity and developmental toxicity. The chemical structure of PFAAs mainly differ in two ways: the length of the hydrophobic alkyl chain and the hydrophilic end groups. Little or nothing is known how the structure affects the toxicokinetics (TK) (uptake, distribution, biotransformation, elimination) and, consequently, the toxic effects in different organisms. We therefore studied the TK of four PFAAs; perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS) and perfluorobutanoic acid (PFBa) in the greatzysthm fish (Danio rerio; ZFEs, ZFET), the most used alternative test model for toxicity testing. We exposed ZFEs at three concentrations of each PFAA up to 120 hours post fertilization (hpf). The test concentrations were selected from pilot studies at which the highest would cause developmental effects in less than 20% of the embryos. Exposure medium and ZFEs were sampled separately at nine time points. Water samples from chemical controls without ZFEs present were taken in parallel. Mass-labelled internal standards specific for each PFAA were added prior to further sample treatment and analysis by LC-MS/MS. The exposure concentrations in the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA< PFBa). Chemical control concentrations remained constant until 120 hpf for all PFAAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFE included the biphasic uptake kinetics with slow uptake before hatching to a faster uptake after hatching. Apparent steady-state concentrations were reached at 96 hpf for PFOS, PFHxS and PFBO where PFBa did not reach steady-state within 120 hpf. Moreover, PFOA and PFHxS (sulfonic acid end group) showed a higher bioconcentration than PFOA and PFBA (carboxylic acid end group). In conclusion, these data indicate that the functional group of PFAAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

TH113
Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFPO-DA

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Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluorooctanoic acid (PFOA) and hexafluoropropylene oxide dimer acrylate (HFPO-DA); also referred to as GenX, FRO-902 or PFOSworn. These ERLs serve as advisory values according to the guidance under the Water Framework Directive to set environmental quality standards (EQS) in Dutch policy. For these two PFAS substances, the assessment of the bioaccumulation potential is a key issue in the derivation of the ERLs. The most critical receptors are humans and wildlife, which are not only exposed directly via drinking water, but also obtain a significant part of the total exposure indirectly through their diets. For this purpose, bioaccumulation through the (aquatic and terrestrial) food chains has to be evaluated. This information is amply available for PFOA, but is very scarce for HFPO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.
Fluoropolymers, therefore, are distinctly different from the other polymeric and non-polymeric classes of PFAS and should be separated from all other classes of PFAS for hazard assessment or regulatory actions. Grouping all classes of polymeric and non-polymeric PFAS together for restriction or regulation is not scientifically appropriate. Fluoropolymers, as polymers of low concern, are uniquely benign PFAS.

TH116 Fluoropolymers Are Unique, Low Hazard PFAS Needing Different Analytical and Regulatory Approaches Than Monomer Fluorinated Substances of High Health and Environmental Hazard B. Henry, T. Kennedy, W.L. Gore & Associates, Inc.; H. Fiedler, Oerebro University, Oerebro, Sweden

Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoralkyl substance (PFAS) classes, such as perfluoroalkyl acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of PBT (Persistent/ Bioaccumulative/Toxic) or vPvB (very Persistent/ very Bioaccumulative) chemical substances, nor do they meet the Persistent, Mobile and Toxic (PM or PMT) substances criteria proposed by the German Environmental Agency, Umwelt Bundesamt (UBA, 2017). As high molecular weight fluoropolymers (e.g., PTFE) are benignly persistent (i.e., not mobile, bioaccumulative or toxic), all “highly fluorinated” substances do not pose equivalent health or environmental hazards and thus should not be regulated as a single class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous monomeric per- and poly-fluoralkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.

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

TH117 Challenges and Open Questions in Earthworm field testing J. Volmer, Eurofins Agroscience Services EcoChern GmbH / Field Ecotoxicology; O. Klein, Eurofins Agroscience Services EcoChern GmbH / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotox Field

In the risk assessment of plant protection products for in-soil organisms, the earthworm field test following ISO 11268-3 (ISO 2014) is used as the highest tier option. The test protocol is currently under revision and transition to an OECD document under the auspices of UBA (Germany), mainly focusing on improving/testing statistical analysis 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 position 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 herbidal action (impact on vegetation coverage in test-item treated plots vs. plots of positive and negative control). Plot size and distance between neighbouring plots, plot allocation patterns, and plot separation, especially with a view on potential migration of earthworms between plots and on external re-colonization. Testing of persistent substances (e.g. how to establish a plateau concentration in soil)? Toxic reference (positive control): reduced replication for the toxic reference? Alternatives to the standard reference item Carbendazim? Examples and suggestions will be given and discussed in this contribution and areas for further research will be identified. EFSA [European Food Safety Authority], 2017: Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms. EFSA Panel on Plant Protection Products and their Residues (PPR). EFSA-Q-2011-00978, Parma, Italy. ISO, 2014: ISO Guideline 11268-3: Soil quality – effects of pollutants on earthworms. Guidance on the determination of effects in field situations.
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 widely distributed in the environment, usually by spraying, but also in various other ways such as a coating on seed material. (3) Since their effects are supposed to act only against the pests, when being applied regularly the amount of pesticides ending up in the environment is high. Due to the long experience with this very detailed approach the results of the EU ERA for pesticides are often taken over by other countries (e.g. in Africa). But is this practice really 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. Proposed will be made how to improve the ERA process but keep it at the same time practical (e.g. by using a tiered approach). These ideas will include the selection of representative reference soils and test conditions for Mediterranean regions. In addition, we will discuss whether the range of standard test species used so far is sufficient. In this context comparisons such used for regulation. This data on soil as statistically evaluate helpful. Based on the answers to these questions it will be discussed whether (and if yes, how) the ERA of pesticides has to be modified for Mediterranean regions (both inside and outside of the European Union).

TH119
Adaptation of the earthworm field test method: conceptual overview and first results
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In 2016, the German Federal Environment Agency (UBA) launched a project entitled “Necessary adaptations of the standard Earthworm Field Test” to improve the scientific basis when transferring the ISO 11268-3 (1999) guideline to a new OECD standard. As a first step, a literature search was performed to compile available data from earthworm field tests, both from the open literature and from anonymous test data. This data on soil as statistically evaluate a develop a design for a pilot study for the earthworm field test. In February 2017, a workshop was held to discuss the outcome of this statistical evaluation and in particular the proposal for a pilot field study design together with members of the “OECD-GSIE-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, predictability and flexibility. In this discussions various options were chosen, all of them with the intention to improve the quality of the output but without increasing the efforts in routine application of the new design. In simulation studies, the number of plot replicates dedicated to either NOEC- or ECx-derivation were varied as well as the number of samples per plot. Additionally, the number of treatments of the chemical to be tested (carbendazim, because it is the reference substance for earthworm field tests for more than 20 years) was also modified in order to cover a broad range. This study can be considered as the biggest earthworm field studies ever conducted. In April 2017, the pilot study was started in a design with 30 plot replicates. After this pre-sampling two further samplings have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

TH120
Soil ecotoxicology and ecological risk assessment in southern African mining landscapes
M. Mabururwa, North-West University / Unit for Environmental Sciences and Management; H. Eijssackers, WUR/NWU

Although there has been a remarkable development in the field of soil ecotoxicology and risk assessment (RA) models, it is debatable if these RA models are representative enough in order to utilise them on larger spatial scales, attuned to specific landscapes and ecosystems worldwide. An example of this is southern Africa where some soil ecotoxicological research has been done. To address this we will present the results of: An inventory of research on the ecotoxicity of metals in the geographical surroundings of gold and platinum mine waste deposits in South Africa. The field study of open coal mining in and near a national park in Swaziland. It is concluded that there is a limited body of information on southern African soil life, and most of these were laboratory based studies done by a small group of researchers. Future research with regards to incorporating the information available into a soil ecosystem assessment procedure is needed and recommended. It is recommended that a starting point to address this might be the development of site-specific guidelines for Ecological Risk Assessment (ERAs) taking into account landscapes, vegetation and faunal characteristics. From our studies in the surroundings of platinum and gold mine waste, we conclude that these wastes still contain considerable amounts of other chemical elements. The extraction methods, moreover, result in very alkaline or acidic conditions. Further the mine waste is very heterogeneous and therefore the environmental and ecological conditions vary significantly. The extent of prediction is due to the prevailing wind conditions in these areas, will be dispersed over a wide area causing risks for organisms in natural and built areas surrounding these deposit areas. The coal mine study illustrates that mining in or around natural protected area cause risks due to the irradiating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess the impacts on the natural ecosystems present in the area, and compare these with the outcomes of a Potentially Affected Fraction of species FAF analysis. Key words: soil ecotoxicology, ecological risk assessment, mining, southern Africa

TH121
Establishment of tiered risk assessment approach of pesticides for soil ecosystems in China
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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, meaning that these risk assessments are based on Risk Quotients (RQ), calculated by dividing the Predicted Environmental Concentration (PEC) by the Predicted no Effect Concentration (PNEC). This calculation takes into account, that beside the toxicity of a pesticide, the amount of this pesticide in the environment plays a major role when assessing a risk. If RQ > 1, the risk is unacceptable and higher tier risk assessment should be conducted. Exposure and employ tiered approach. Tier 1 exposure analysis employs simple model (PECsoil_SFO_China from NIES) to predict exposure to soil organisms. A higher tier exposure analysis can be applied by refining environmental exposure parameters or using semi-field trial test. Currently, the models PRAESS and China-PEARL, which developed by NIES and ICAMA in China, are applicable to predict the exposure concentration at specific depth of soil layer and at specific scenarios in China. Proposed test systems for effect assessment include acute toxicity test or reproduction of earthworm, reproduction test, nitrogen transformation test, litterbag test and earthworm field test. The PNEC can be calculated using the endpoint obtained from ecotoxicological studies and corresponding uncertainty factors (UF). Tier 1 risk assessment mainly focuses on the earthworm acute or earthworm and soil microorganisms which are involved assessment and N - transformation assessment. High tier risk assessment mainly focuses on the litterbag test assessment and earthworm field assessment. We have used these 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
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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 of pesticides, which is intrinsic or due to biological interactions, as individuals are embedded in complex food and interaction networks. However, the recovery of a network depends on the fact that all ecological and functional roles within such a complex entity are still realised by a certain number of species (and their individuals). Usually, only abundance criteria are applied in ecological recovery investigations. For example, if numbers of individuals trapped are similar to a control group on two subsequent occasions, recovery is concluded upon. But if the proportion of one functional role (e.g. predators, parasitoids, pollinators or herbivores) in the focal group is far below the proportion of the same functional group in the control group, recovery is not reported in the abstract.
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

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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 metazoen organisms and thus highly representative components of communities suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH124

To what extent do soil micro-arthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products

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Soil functional test systems provide valuable and ecologically relevant information for the risk assessment of plant protection products (PPP). Functional tests directly measure ecosystem functions and services which are provided by soils and soil organisms (e.g. organic matter (OM) degradation and mineralization). Focusing on structural endpoints in the risk assessment for PPP lacks a clear link to the protection goals derived from ecosystem services. Directly measuring soil functional tests and services is essential to provide a better understanding of the fertility of soils. Furthermore, functional test systems can help to evaluate the ecological relevance of a density change of a soil organism population affected by a certain stressor. To quantify the soil mesofauna and microorganism contribution to the process of OM breakdown, a project on soil functional test systems was initiated by the European Crop Protection Association (ECPA). A field study was set up in 2013 in which mean effect of two insecticides (Methamidophos, Lindane) on organic matter degradation in a minicontainer test. Soil micro-arthropods abundances were monitored in parallel to determine the link between effects on the structure of soil micro-arthropods and their soil functional implications (i.e. OM breakdown). The results indicate that the process of OM degradation is dominated by soil microbes. Soil mesofauna contributed only a minor amount to OM degradation. The minicontainer test did not show a clear effect of insecticides on the mesofauna driven organic matter degradation, although total abundances of Collembola and Acari were heavily reduced by the insecticide applications. In the recently published Soil Scientific Opinion (2017), EFSA proposed Specific Protection Goals for soil micro-arthropods in field-areas. This foresee that even short-term effects on single species in a magnitude of >65% are considered unacceptable to ensure the provision of Ecosystem Services in agricultural soils. The present study shows that a reduction of the total soil micro-arthropod community by 80% over a period of 6 months has no unacceptable effect on the mesofauna driven OM degradation in a minicontainer test on an arable field. Thus, the relevance of the structural endpoints on soil micro-arthropods (i.e. single species populations) within an in-field soil risk assessment for PPP, which focus on maintenance of soil fertility (protection of soil functions), is questionable.

TH125

The role of source sink dynamics in the assessment of risk to non-target arthropods from the use of plant protection products

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The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980’s culminating in the paper by Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependent. However, this issue does raise important questions pertaining to how well these models can be applied to risk assessment of non-target arthropod communities. Good examples of this currently include the lack of information 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 ECPCA non-target arthropod group

TH126

Classification of uncertainty in ecological risk assessment of pesticides

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Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and experimental results often increase the perception of uncertainty, making it, making this an issue of significant concern. The lack of straightforward presentation of all sources of uncertainty puts an extra burden on risk managers. This issue has been recognized by EFSA recently, but still there is very little research into classifying, visualizing and addressing uncertainty in ERA of pesticides. Currently EFSA recognizes and 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 identify the most important uncertainties and sources of uncertainty, classify different uncertainties and link them to recognizing 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 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.

TH127 Derivation of soil threshold concentrations for arsenic: consideration of bioavailability through combination of ecotoxicological and analytical data


The German Federal Soil Protection Act (1988) defines precautionary values for seven metals which, if exceeded, indicate that concern for a harmful soil change exists. All precautionary values given in the German Soil Protection Ordinance (1999) are based on total concentrations (“aquarégia”). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc.) and various metal extractions (1M NH₄NO₃, 0.01M CaCl₂, Ca(NO₃)₂ with ionic strength corresponding to soil solution, DTPA/CuCl₂, 0.43M HNO₃, plus aqu 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 microorganisms, plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC₀ and, preferably, EC₁₅₀ values), based on the six extraction methods, have been determined. The variance in EC₀ values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH₄NO₃ < CaCl₂ < Ca(NO₃)₂ < DTPA < CuCl₂ < HNO₃. For most soils, plants were the organisms reacting most sensitively, partly together with the Bacteria. Both invertebrate species were always less sensitive (i.e. EC50 values (nominal concentration) > 250 mg As/kg soil) than microbes and plants except in one sandy soil (RefSoil-01A). Currently, chemical and biological results are combined in order to explain the observed variation in toxicity expressed as nominal or total As concentrations in soil. This information will be used to include As bioavailability into the derivation of precautionary values. The representativeness of the different extraction methods regarding bioavailable fractions as well as the properties of the different soils are checked as part of a more realistic risk assessment of metals in soils.

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 directly involves the collection of soil arthropods followed by heat extraction such as Berlese-Tullgren or McFayden methods. Activity-based sampling implies installing hypogean traps and collecting the catch at pre-determined intervals. Soil core sampling provides an instantaneous assessment of the fauna at the exact moment and at the very location of sampling, whereas hypogean traps provide an assessment of the activity in a wider area and over a longer time span. Clearly, higher tier assessment of activity-based activity is therefore necessary. 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 field 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. Jansch, ECT Oekotoxikologie GmbH; P. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; M. Ross-Nickoll, B. Scholz-Starke, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research Field studies to determine effects of pollutants on earthworm community are generally conducted according to standardized ISO-guidelines (ISO 11268-3). However, statistical test procedures suggested in the guidelines are frequently criticized, mainly for two reasons: test data characteristics do not fulfil test requirements (normal distribution and variance-homogeneity) and the resulting toxicity metrics of multiple testing procedures (NOEC / LOEC) fail to adequately detect the actual level of effects. Lehmann et al. (2016) presented a new approach to overcome these shortcomings by introducing the CPCAT procedure. We applied this statistical method to detect effects in a set of 16 earthworm field studies and provide a comparative analysis with regard to results of well-established multiple testing approaches. This will be the performance of CPCAT 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 to then for the determination of microbial biomass activity. Microbial biomass 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

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The determination of microbial biomass activity is a pre-requisite for OECD laboratory studies that are designed to investigate the environmental fate of chemicals in soils. By determining soil microbial biomass prior to, during and after a study, the viability and suitability of the experimental soil can be demonstrated. Choosing the appropriate methodology for soil microbial biomass is critical for conducting successful environmental fate studies. One common method, referenced in the OECD guidelines, for determining soil microbial biomass is the fumigation extraction method. This method determines the carbon content of the soil biomass, via fumigation, using ethanol-free chloroform. During fumigation, cells are lysed by the chloroform, which results in a flush of organic carbon into the soil environment. This organic carbon is then extracted and quantified. Another suitable way of estimating soil microbial biomass is by substrate induced respiration. This method uses a suitable labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response is then used to determine the microbial biomass size. The microbial biomass size can then be determined by relating respiration and fumigation extraction data. In spite of there being multiple recognised ways of determining soil microbial biomass, it is important to recognise that they reflect different aspects of the soil microbial community. One fundamental difference between these methods is that they can potentially distinguish between active and non-active components of the biomass. As noted in OECD 1579, substrate induced respiration can be used to estimate the active aerobic biomass, whereas in OECD 14240:2:1997, fumigation can extract carbon from both active and non-active biomass components. With such differences between methods, it is important to consider which method is more appropriate for determining soil suitability for environmental fate laboratory studies. Work is currently being undertaken by Smithers Viscent to investigate the relationship between the soil microbial methodologies commonly used for laboratory soil studies. The aim of this work is to better understand how the choice of soil biological methods relates to soil suitability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies.
The population dynamics experiment is a one-year study assessing the dynamics of Folsomia candida in artificial OECD soil at constant 20°C. The study started with 25 individuals of different age classes in 100 g OECD soil. Since then the population increase was measured on at least a monthly basis with five replicates per testing day. The food regime is adapted to the increasing population density to make sure that the maximum population level is achieved during the study. We will show a fast growth at the beginning of the experiment and expect to reach an oscillating trend in the middle of the study. In a second experiment the vertical dispersal of F. candida relating to food location is investigated. Transparent PVC columns were filled with soil having 350 g of OECD soil up to a level of 20 cm soil column height and 86 F. candida of different age classes. Each column was closed with Parafilm on top and a gauze on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity set to 50% of the maximum water holding capacity of the soil. The columns were separated into six compartments at different heights: 1, 2.5, 5, 10, 15 and 20 cm. Septa in the middle (4th) and bottom (6th) compartment allowed for watering and feeding. We varied the location of feeding by four different regimes while all other parameters were kept constant. The columns were provided either with food on the top and bottom, or the middle, or in 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
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The responses of organisms in soil ecotoxicity tests are often determined by the bioavailable concentrations of contaminants they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, Oppia nitens exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of enchytraeid and collembola survival and reproduction with the plant biomass in each of the soils. From the 47 soils, 18 soils were divided into three habitat quality groups based on high, medium and low habitat quality. The 18 soils were dosed with low to high concentrations of zinc and mites exposed to the soils for 28 days. Mite survival, reproduction, and biomass were measured, and bioavailable zinc were determined at day 28. 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.

TH136
Effects of endocrine disruptor chemicals (EDCs) to soil algae
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There were many data for endocrine disruptor 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 used in the soil. Soil algae, Chlorococcum infusionum, were exposed with 2.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algae culture medium after 6-d exposure, and the chlorophyll intensity was measured by fluorescence microplate reader. We observed that the BPA was most toxic following NP and DEHP. The effect of DEHP is insignificant to Chlorococcum infusionum and Chlororococcus infusionum. The results can be used for risk assessment of BPA, DEHP and NP in soils. This study was funded by the Korea Environment Ministry (MOE) as the Environmental Health Action Program (14850144858). Key word: bisphenol A, bis[2-ethylhexyl]phthalate, nonylphenol, soil algae

TH137
Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in nature and after pH adjustment
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The use of sugarcane vinasse as fertilizer in crops has been widely used in order to promote an adequate destination for this residue however, it has properties that can be prejudicial to the animals present in the soil, as already verified in numerous studies. Therefore, the objective of this work was to treat vinasse with lime (CaO) to adjust pH to 7.0 (neutral), in an attempt to reduce its toxicity for later use in the soil. In this context, the development of ecotoxicological tests presents itself as a tool of great assistance in the analysis of residues released to the soil. Thus, reproduction tests were conducted using animal soil biondicators to evaluate the effects of vinasse may have on reproductive behavior of these animals. Earthworms of the species Eisenia andrei (Annelida) and enchytraeids of the species Enchytraeus crypticus (Annelida); both tests were developed according to the protocols for earthworm reproduction tests in accordance 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 biosavas vinasse compared to exposed to vinasse in nature. The results allow to infer that the pH adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in animals exposed, since the environment favored the reproduction of the animals tested.

TH138
Ecotoxicological Characterization of Nitrogen-Based Energetic Soil Contaminants
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We provide an overview of ecotoxicological effects of copper-based metal contaminated plant species on the soil ecosystem in the presence of heavy metals. These results further confirm the Cu tolerance potential of these bacteria strains tested. It is important to note that although these studies were conducted on a single bacterial species, the use of copper oxychloride soils could be beneficial for the development of new strategies for soil remediation and bioremediation.

TH141 Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam

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The presence of mine tailings may promote the development of both heavy metal and antibiotics resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phenotypes such as heavy metals and antibiotics resistance due to gene transfer. This study describes the characteristics of plasmids isolated from various bacteria that displayed an ability to withstand high metal concentrations. Isolated plasmids were individually transformed into E. coli JM109. The presence of mine tailings may promote the development of new plasmid capabilities using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/μl after extraction. Incompatibility groups were determined by subjecting plasmids to PCR amplification using IncN, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were carried out to determine the ability of transformed E. coli JM109 to tolerate metals at varying concentrations. Results indicated that transformed E. coli JM109 developed ability to grow in the presence of several heavy metals. Some strains were resistant to high concentrations (+10 mM) of Ni(II), Pb(II), and Ba(II) with metal resistance order of Ni(II)>Pb(II)>Ba(II). 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 not observed in the AlNi alloy containing media. Two-dimensional electrophoresis PAGE analysis revealed 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 this new metal-tolerant bacterial strain. The results of this study have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnological potential.

TH144 Sensitivity of the waterside species, Yuukianura szeptyckii (Collembola: Neanuridae), to cadmium and copper

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Collembola is the most abundant organism in the soil ecosystem and some species are used as ecotoxicological evaluation species for toxic substances in soil. However, Neanuridae species, which is one of the family of Collembola, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukianura szeptycki was linked to the fraction of biotic ligand sites occupied by free metals (i.e. Cd²⁺ and Zn²⁺). The results showed that the fraction of the biotic ligand and occupied by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors affecting bioaccumulation and toxicity of metals.
explained by their overwintering or ageing. In contrast to insecticides, tebuconazole respectively. However, the toxicity of both insecticides was almost identical respectively, and for Sherpa − 0.556 (CI 0.453 − 0.658) 0.048 10 times more toxic than Sherpa: the 96 spring (after overwintering) or autumn (population dominated by newly emerged Bembidion lampros pyrethroid cypermethrin (CYP), and Spekfree 430 SC, containing the fungicide Intensification of agriculture and the widespread use of pesticides during the la Stress Ecology Group Jagi Ecotoxicology and Stress Ecology; G. Sowa, Institute of Environmental Sciences Do we use plant protection products cor respectively? Impact of agrochemicals on arthropods in agricultural areas. Due to the growing demand for food, it is not possible arthropods (NTA), including the ground beetles (Carabidae), which are natural pest enemies in agricultural areas. In this study, we calculated the toxicity of each factor for the full fauna of naturally occurring non-target arthropods, on the full fauna of naturally occurring non-target arthropods... (collembola) and their Prediction Modes in 18 Soils of China TH144 Toxic Effects of Cadmium on Chinese Cabbage, Folsomia candida (collembola) and their Prediction Modes in 18 Soils of China L. Zheng, Y. Feng, Y. Zhou, Nanjing Institute of Environmental Sciences In this paper, we adopted 18 Kinds of typical soils in China,Chinese cabbage,... model, we obtained key soil parameters in soil solutions to assess the relationship with pCu^2+ and pZn^2+. Copper and Zn phytotoxicity can be considered as a tool to measure the uptake flux of Cu and Zn in plants and the related availability of Cu and Zn in the rhizosphere that is physically separated from roots. The results already achieved showed no clear relationship between pCu^2+ and pH or dissolved organic carbon among the four field trials altogether. When studying each trial separately, we observed a pH gradient as a function of the type of fertilizer (mineral or OW) applied. A similar trend was obtained in the analyses of the concentrations of Cu and Zn in the rhizosphere. Thus, our measurements will enable to test whether Cu and Zn availability in unplanted soils determined Cu and Zn phytotoxicity or whether root-induced chemical changes in the rhizosphere additionally determined it. TH145 Do we use plant protection products correctly? Impact of agrochemicals on non-target beetle, Bembidion lamaspros (Coleoptera: Carabidae) J. MOKRAPAT, Institute of Environmental Sciences, Jagiellonian University / Ecology; G. Solary, Scientific Department, Jagiellonian University; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group Intensiﬁcation of agriculture and the widespread use of pesticides during the last few decades have led to signiﬁcant reduction of the abundance of non-target arthropods (NTA), including the ground beetles (Carabidae), which are natural pest enemies in agricultural areas. Due to the growing demand for food, it is not possible at the moment to stop using pesticides. We need, therefore, to make every effort to ensure that they are used in a way that do not jeopardize NTA. In the present study, three commonly used pesticide formulations: Durban® 480 EC, containing the organophosphate parathion-methyl, tebuconazole, tebuconazole + cypermethrin (CYP), and Spekfree 430 SC, containing the fungicide tebuconazole (TEB), were tested for their effects on survival of the ground beetle Bembidion lampros. The beetles were collected from agricultural ﬁelds either in spring (after overwintering) or autumn (population dominated by newly emerged individuals) and exposed individually to a single pesticide spray applied with the Porvair®. In terms of recommended ﬁeld dose (RFD), Durban appeared almost 10 times more toxic than Sherpa: the 96-h LD50 for Durban was 0.057 (CI 0.048-0.071) and 0.054 (CI 0.046-0.066) RFD for spring and autumn beetles respectively, and for Sherpa ~ 0.556 (CI 0.453-0.704) and 1.003 (CI 0.863-1.214) RFD respectively. However, the toxicity of both insecticides was almost identical in terms of their active ingredients (g a.i. ha−1): the LD50 for CPF was 16.4 for spring and 15.6 for autumn beetles, and for CYP 16.7 and 30.1, respectively. The beetles survival rate decreased signiﬁcantly with increasing dose of both insecticides, but the spring-collected beetles appeared more sensitive, plausibly explained by their overwintering or ageing. In contrast to insecticides, tebuconazol caused significant increase in survival at higher doses, possibly due to its interference with immune competence of insects or elimination of pathogenic fungi. The results show that at least some insecticide formulations may cause unacceptable effects on NTA when applied according to recommendations, indicating the urgent need for revising current pesticide usage recommendations. The differences in sensitivity between the spring and autumn-collected beetles call for further studies on whether such seasonal differences can be important for ERA. This study was supported by National Science Centre, Poland (2015/19/B/NZ6/01939) TH146 The fate and bioavailability of currently used and emerging pesticides in agriculturally used ﬂuvial soils – effects of soil and pestiside agronomy M. Šudoma, N. Neuwirthová, Masaryk University; M. Svobodová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielski, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Hvezdova, Z. Simék, L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstädt-Scherr, University / 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, flussilazole and prochloraz are currently used pesticides and members of the triazole group, used as broad-spectrum fungicides that inhibit ergosterol biosynthesis and are typically applied as foliar sprays for cereals, sugar beet or oilseed rape. Conazole fungicides are widely used in EU countries and their residues are frequently found in European arable soils which corresponds to their environmental properties. CFs are strongly sorbed to soil (logKOC of 3–4) and have low to moderate water solubility (50 μg/L). They are very persistent in soils and tend to form long-term residues. Typical DT50 values range from 120 days to 1 year. These attributes predetermine 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 exchange system, in which 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 ﬂuvial soils under the addition of selected model compounds (CPF, CYP, KT, Metalaxyl, MCPA) at background levels (0.5 mg/kg), seedling plants (Lactuca sativa), earthworms (Eisenia fetida), SPME passive sampling ﬁbers, Silicon rubber sheets and Chemcatcher® passive samplers. A subset of 10 ﬂuvial soils was selected based on the DRIFT mid infrared portion using the Kenard-Stone algorithm. These 10 soils are representative of a large ﬂuvial range in terms of their qualitative and quantitative SOM properties (TOC, DOC, HA, FA, WHC, pH, texture, etc.). 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 Limited; F. Bakker, EurofinsMixtox; P. Thorbek, Syngenta / Environmental Safety; M. Finnegan, Syngenta The aim of this study is to assess the potential effects of thiamethoxam, applied as a seed coating to sugar beet, on the full fauna of naturally occurring non-target arthropods (NTAs) in a commercial arable ﬁeld in The Netherlands when compared to a non-insecticidal control treatment. This is a three year study which began in March 2017 with the drilling of the sugar beet seed at two different seed treatment rates equivalent to a typical sugar beet seed loading and oil seed rape seed loading using plots of 2 ha each organized in 4 blocks of 8 ha each (32 ha total study area). NTA ﬁeld studies are important for investigating impacts of pesticides on populations, communities and different life stages of NTAs under realistic exposure conditions. However, over such a long duration, it is challenging to assess the regulatory acceptable risk of a pesticide to NTAs in-ﬁeld a study should be designed in a way that enables an adverse effect to be detected if present. A toxic reference is used to show the test design is adequate to demonstrate persistent adverse treatment-related effects. Many of the chemicals historically used as toxic reference items with large historical datasets are now not available due to changing regulations, making it difficult to select a suitable toxic reference. Conducting such a study requires multiple sampling methods such as pitfall traps, mine traps, soil cores and sweep nets to account for different life histories of NTA species and a team of qualiﬁed taxonomists to identify all organisms. In this study NTA populations will be monitored for a three year period that covers at least two generations to enable the detection of any trans-generational effects that might occur. The current EU risk assessment scheme considers that effects on population dynamics are acceptable for the in-ﬁeld area above the threshold value of 50% if recovery or potential for recovery is demonstrated within 1 year. This study has been designed to enable the assessment of: (1) the magnitude of treatment effects on non-target
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 two arable soils differing in the organic carbon (1.02 and 1.93% respectively) and clay content (10.7 and 20.7% respectively). Concentrations of the pesticides in soils and earthworms were determined by LC-MS/MS after QuEChERS extraction which has shown to be rapid, simple and effective approach to determine broad spectrum of pesticides in soil and earthworm samples. According to our results, a steady state was reached after 3 to 5 days for both pesticides and soils. The values of bioaccumulation factors calculated at the steady state ranged from 4.5–6.3 for chlorpyrifos and 2.2–13.1 for tebuconazole. Bioaccumulation factors were also calculated as the ratio of uptake and elimination rates with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also profoundly contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydropobicity 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 lethal effects of diuron and imidacloprid (insecticide) on ubiquitous organisms at the basis of food webs, we performed multispecies toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. Diuron and imidacloprid belong to the top 15 of the most frequently used pesticides worldwide and to the top 10% of the most frequently used pesticides in Europe. The assessment was done via adsorption isotherm modeling and soil column leaching with the model earthworm species 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 BSAF and log CEC was confirmed by laboratory studies and is also consistent with the significant decrease in diuron and imidacloprid toxicity observed for Eisenia fetida reproduction with increasing CEC of the soil. It was concluded to implement the effect of soil properties on BSAF by using the overall regression between log CEC and log BSAF in the risk assessment of Pb in soil. This yields a generic BSAF of 0.30 on dry weight basis, corresponding to 0.048 on a fresh weight basis, for the median CEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.28 for soils with highly, moderately or immobile CEC of 16 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of CEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

TH150
Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida
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The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (BDE47) on the springtail Folsomia candida were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or BDE47 for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method, which shows that BDE47 affects egg hatching through the reproductive capacity of adults. The affected endpoints of springtails can be inferred by the two methods. PCP and BDE47 do not influence completely the same endpoints.

TH151
Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioavailability soil accumulation factor (BSAF) for risk assessment
K. Oorts, ARCHE; J. Chowdhury, International Lead Association / Senior Scientist

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 critical 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 of earthworms in Europe. The cation exchange capacity (CEC) is significantly correlated with BSAF values. No significant correlation with Pb content, pH, organic carbon content or clay content is observed. The significant negative regression between log BSAF and log CEC was confirmed by laboratory studies and is also consistent with the significant decrease in Pb toxicity observed for Eisenia fetida reproduction with increasing CEC of the soil. It was concluded to implement the effect of soil properties on BSAF by using the overall regression between log CEC and log BSAF in the risk assessment of Pb in soil. This yields a generic BSAF of 0.30 on dry weight basis, corresponding to 0.048 on a fresh weight basis, for the median CEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.28 for soils with highly, moderately or immobile CEC of 16 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of CEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.
of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10<sub>−</sub>L<sub>C</sub><sub>50</sub> = 100 mg L<sup>−1</sup> (liquid-only exposure) and 100 <sub>H</sub><sub>C</sub><sub>50</sub> ≤ 1000 mg kg<sup>−1</sup> dw soil (calculated soil pore-water based) of the quinaldines assigning these chemicals to category “harmful” to soil organisms. Predicted no-effect concentrations showed 1–3 orders of magnitude higher the effective concentrations than the former suggesting potential risks of the chemicals toward the soil environment and proper monitoring is needed in the application of the LOHCs. Key words: adsorption, bioavailability, hazard assessment

TH153
Combining field measurements and biotest to assess lead and zinc phytoavailability in contaminated urban soils
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Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. Due to the lack of adequate plant biotest at the time the guideline was published (i.e. in 2005), the guideline suggests to measure trace element phytoavailability in the aerial parts of plants collected in situ in contaminated and uncontaminated soils. The present study aimed at applying the guideline methodology with the combination of a recently developed plant biotest (i.e. the RHIZOtest) and field measurements to lead (Pb) and zinc (Zn) contaminated urban soils on which irrigation with treated wastewater was foreseen. Ten contaminated and uncontaminated soil samples (hereafter referred to as soil) were collected in representative sites expected to be irrigated with treated wastewater. The phytoavailability of Pb and Zn was estimated on each soil by measuring Pb and Zn concentration in the aerial parts of field-collected plants and by deploying the RHIZOtest and measuring the uptake flux of Pb and Zn in the whole plants exposed to the contaminated soils. As expected, field-collected plants exhibited a large range of Pb and Zn concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be refused 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 characterizing the effects on soil microflora provide an added value in the scope of regulation?

Although 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 more comprehensive risk assessment is required. We investigated whether a combination of several test approaches addressing various microbial aspects results in a better understanding of the fluctuation of the soil microflora after a threat and a more comprehensive risk assessment taking the new requirements into consideration ecosystem services and the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the protection of the biodiversity into account.
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives V. Kisielius, Metropolitan University College; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Rodamer, Agilent Technologies; D. Lindqvist, L.H. Rasmussen, Metropolitan University College

Significant variety of toxic secondary metabolites produced by plants appear in chemical structures of glycosidic molecules. These compounds are highly water soluble and mobile in soils and sediments. In cases when toxic glycosides are persistent and released in high loads from vegetation, evaluation of the risk to afe conditions adjacent to drinking water supplies is needed. Nevertheless, the environmental fate and fate of these compounds are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aquatic ecosystems. Bracken ferns (Pteridium aquilinum) are known to produce up to 6 kg/ha of carcinogen ptaquiloside. Previous studies demonstrated leaching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – ptesculentoside and caudatoside – have recently been studied in Australian Brackens. Except from a few positive samples included in the Australian study, there have been no reports of these compounds in Europe. We hereby report a novel method for quantification of ptaquiloside, caudatoside and ptesculentoside and their respective pterosin-derivatives (6 compounds in total) to be used for the abovementioned study. The novel LC/MS method (Agilent 1260 Infinity HPLC – C18 semi-UPLC column (3.0x50 mm, 2.7 μm)) enables simultaneous identification of all 6 compounds within about 5 minutes (1 ng/ml) using logoan as an internal standard. The total analysis time is 16 minutes and the system is operated under semi-UPLC conditions with a max. pressure of 400bar. Mobile phase was selected to be of highest anaerobic fraction (10% v/v). These features are favourable for high-throughput analysis and could be practically utilised in e.g. water supply facilities. The method will be applied for studies of the spatial and temporal variation of the 6 compounds in in plants, soils and surface waters. The project is part of the European Treatment Network NaToAq, investigating the natural toxins in waters from the perspectives of their physio-chemical properties, spatial and temporal variation, health risks and concepts of water treatment operations for their removal (Horizion 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

A novel method for ptaquiloside and pterosin B preservation in groundwater samples M. Skłodowska-Curie, University of Copenhagen / Plant and Environmental Sciences; S.C. Christensen, A. Pedersen, HOFOR A/S, Copenhagen; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; L.H. Rasmussen, Metropolitan University College

Analyzing natural toxins in groundwater is challenging due to their labile and susceptible nature. Ensuring sample integrity for analysis is a critical step to facilitate trustful findings, and appropriate preservation methods need to be developed. This research focuses on the development of a preservation technique for ptaquiloside (PTA) and its degradation product pterosin B (PTB) in groundwater. Ptaquiloside is a carcinogenic compound produced by one of the five most common plants on the planet, Bracken fern (Pteridium aquilinum). It is highly water-soluble with almost no detectable residue in soil and sediment, and hence leaches to the aqueous environment. In turn, PTA can potentially contaminate groundwater, which presents a concern for human health if used as a drinking water source. Ptaquiloside is chemically unstable under acidic and alkaline conditions, making it difficult to collect and preserve for analysis. Thus, a controlled and well-designed preservation procedure that can ensure its stability for the subsequent analyses is necessary. In order to develop a technique for preservation of PTA and PTB in groundwater samples, a Plackett-Burman experimental design is applied. This approach allows assessing the influence of a number of independent factors such as sample bottle type, test time, water type, pH, temperature and transportation conditions by a reduced number of experiments. In each of the experiments, a water sample with known concentration of a given compound was treated under a set of incubation and extraction conditions and a recovery percentage of the compounds were evaluated by LC-MS system. This led to an optimal combination of factors for the preservation of the compounds of interest. We also performed robustness and range tests to quantify the precision, accuracy and linearity of the method. The optimized technique was further validated by applying it at field sites covering different groundwater types and different spiked toxin concentrations. By utilizing this method we can facilitate reliable investigation and monitoring of PTA and PTB in groundwater. In that way, we contribute both to the scientific discourse on the topic as well as offer a practical tool for water supply companies. This research project is part of European Training Network – NaToAq, which is funded by the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 722493.


Northern Kentucky University and the U.S. EPA Office of Research Development in Cincinnati Agency are collaborating to develop a harmful algae 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 validate the HAB APP. The project is ongoing. The HAB APP is developed for the rapid screening of these two MCs 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 (1 μg/L). 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/GC/MS method for determining multi-class HAB odor compounds in water C. Avagianos, M. Pitsianis, T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL

HABs 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 unavailable 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 fast and effective methods for early warning and control of off-odor events. The objective of this study was to develop and optimize an efficient method for monitoring of multi-class HAB odors in freshwaters using automated 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 selected as indicative of the wide range of odorous compounds, ranging from volatile, early-eluting (e.g. alky1 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 was based on the selected factors and 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
efficiently computed for classes of compounds. The most significant factor was the extraction temperature, especially for volatile early-evoluting 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.

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THI63

Suspected screening of cyanotoxins in freshwater by high performance liquid chromatography coupled to high-resolution mass spectrometry

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Cyanobacteria are one of the components of the freshwater microecosystem in permanent formation. The community distribution is affected by water quality, flow regime, climate, and geography. During the past decades, there has been a noticeable increase of cyanobacterial blooms, dominating in many freshwater bodies worldwide. Some cyanobacteria species are known to produce toxic secondary metabolites called cyanotoxins, which vary in structure and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water and recreational water use. The best known 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 based on analysis of cyanotoxins by 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 interface used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the potential presence of transformation products and other non-targeted toxicins in the samples. This multi-toxin method has been developed and validated for freshwater cyanobacteria such as microcystins, nodularin, cylindrospermopsin, and anatoxins-a. The developed method was applied for the study and characterization of cyanotoxin concentrations in Catalonia freshwater reservoirs. Keywords: cyanotoxins, microcystins, high-resolution mass spectrometry.

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THI64

Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters

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Natural toxins constitute a potential risk to water supplies in Europe. Only a few cyanotoxins are officially assessed as contaminants (e.g., MCs) and estimates of their degradation rate constants in the aquatic environment that have been determined by experimental methods or estimated using quantitative structure-activity relationship (QSAR) and quantitative structure-property relationship (QSPR) models. QSAR predictions should be considered carefully when applied to a set of chemicals that are structurally distinguishable from those that were used to develop the model. The establishment of an applicability domain of the models provides a range of chemicals where the predictions are expected to be reliable and based on extrapolation rather than extrapolation, regarding the structure of the chemicals in the training set (Gramatica 2007). We present here an analysis of the applicability domain of selected EPI Suite™ QSAR models, and interpret the results with reference to natural toxins within these limits that could be included in a dossier to provide a quantitative assessment of the potential risk of aquatic cyanobacterial biological activity. References Bucheli, Thomas D. 2014. “Phytoxins: Environmental Micropolutants of Concern?” Environmental Science & Technology 48 (22):13027–33. Gramatica, Paola. 2007. “Principles of QSPAR Models Validation: Internal and External.” “QSPAR & Combinatorial Science 26 (5):694–701. US EPA. 2017. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.

THI66

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 knowledge. Cyanobacterial oligopeptides are natural toxins from various kingdoms, those produced by aquatic organisms have a direct entry into our water resources. More frequent and intense surface water blooms of cyanobacteria have triggered particular scientific interest in their secondary metabolites as potential aquatic toxins. The variety of cyanopeptides is well documented since the 1990s and the growing publication record reflects an increasing scientific awareness of this group of small molecular weight compounds with potential ecological and economic importance. Cyanotoxins can be gathered into six structural classes characterized by indicative monomeric building blocks. Microcystins are by far the most intensively studied class of cyanopeptides. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides beyond microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides under different culturing condition of common cyanobacterial strains. Our targeted LC-HRMS analysis of biomass samples of single strain cultures show that besides microcystins, cyclamides and various cyanopeptolins are co-produced. Our data shows the evolution of the
peptide abundance throughout the growth phase of single strains (e.g., Microcystis aeruginosa and Anabaena flos-aquae) and under different culturing conditions (e.g., N/P ratios and light intensities) by 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 carcinogen ptaquiloside under alkaline conditions  
D. Lindeqvist, L. Rasmussen, Metropolitan University College  
The carcinogen ptaquiloside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus Pteridium (Bracken fern) E. coli and P. aeruginosa are not able to degrade PTA. In regards to mycotoxins and isoflavonoids as reference compounds in addition to determination of As HPLC based methods, both approaches show the capability to be largely accepted in microflora. A crucial challenge is to systematically identify among the plethora of phytotoxins those that actually present a serious risk for the aquatic environment. For this purpose, we ranked 1586 phytotoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytotoxins. Toxicity was included as descriptor of the effect and 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 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 pterosins are formed from caudatoside and ptesiculoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH 5.7 - 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 occurrence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC %: 0.1-7.4, pH 3.3-7.7). 0.25g of dry soil were equilibrated with 9ml 0.01M CaCl2 overnight. 1ml of pterosin B solution in 0.01M CaCl2 was added resulting in a Ceq 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). Ceq were calculated as Ceq = C0 - (C0/1+Kd * C0). Irreversible sorption and microbial degradation were measured in batch based bioassays. Pterosin B sorp strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g⁻¹ for the soils tested corresponding to a Koc values of 300-2,500 mL g⁻¹. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic matter. As Koc values can vary substantially, depending on soil type and properties, the soil pH and temperature and their variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.

TH171  
Modelling the fate of natural toxins in the soil using DAISY - a case study of ptaquiloside  
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University of Copenhagen

Natural toxins are gaining more interest in the scientific community as emerging pollutants. The reason behind is that they are released continuously to the environment and often in high amounts. The related risks to humans depend strongly on the physicochemical characteristics, load and fate of the natural toxins in the environment. The aim of this work is to develop a modelling approach to predict these fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work, a model code DAISY, a soil-plant-atmosphere model has been used. Modelling of natural toxin fate presents several challenges compared with xenobiotics: many and partly continuous sources, variable and poorly studied physicochemical properties of the toxins, highly variable temporal and spatial rates of transfer of the toxins from the source plant to soils, - often linked to spatiotemporal events. This work focused on ptaquaiolide (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The carogenicin toxin is produced by bracken fern (Pteridium aquinum) 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 parameters to characterize hydrolysis. Hydrolysis is pH and soil horizon dependent, while microbial degradation rates follow the guidelines by FOCUS:in Maximum PTA concentration in the leachate at a depth of 2 m were 2.5 and 1.9 μg g⁻¹ in a sandy loam and sandy soil, respectively. These could become relevant when piled up in concentrations. Clayey soils presented higher leaching due to macropore transport, as toxins might bypass the biologically active soil layers. Leaching accounts for less than 1% of the total PTA load, being highest in autumn when bracken wilts and the amount of water percolating is highest. In this study, the model predicts several uncertainties such as the toxin production in the biomass, seasonal variation in toxin concentrations and in particular, the transfer rates from plant to soil. Spraying is not an ideal “dosing” function and might overestimate the leaching, hence the results must be taken with caution.

TH172

Genomic insight into biosynthetic pathway of retinoids by cyanobacteria

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Extensive occurrence of cyanobacterial water blooms associated with the production of wide range of toxic compounds into environment represents one of the most challenging problems in aquatic ecosystems. One group of the recently described cyanobacterial toxic compounds are endocrine disruptors, retinoids. It has been documented that cyanobacteria are potent producers of retinoids and they are able to produce these compounds into their surrounding environment. However, our understanding how are retinoids synthesized by cyanobacteria on genomic level remains poor and description of the biosynthetic machinery of these small “dietary” hormones is essential to the elucidation of the role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDHs). Mayor apparatus for retinoids synthesis has already been described. Mayor role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochrome (CYP). Our study has been inspired by biosynthetic apparatus of retinoids in animals and provides an evolutionary comparison of all ALDHs and CYPs. We sequenced publicly available genomes of cyanobacteria to well-characterized ALDH and CYP from human and mouse, which are involved in the biosynthesis of retinoids. This comprehensive phylogenetic study describes evolutionary similarity of cyanobacterial ALDH to human and mouse ALDH from family 1. This fact points out to a similar function of these enzymes in the biosynthetic machinery of retinoids. Based on these results, the most related cyanobacterial ALDHs (to human) were selected from different cyanobacterial genomes and heterologously expressed in direct cloning proficient E. coli strain GB05-dir. Effectivity of expression reflected as the amount of produced retinoids was assessed by in vitro bioassay on cell line P19A15 with endogenous expression of retinoid receptors stably transfected with reporter luciferase gene under the control of retinoid response elements. In both approaches, the expression of all-trans retinoic acid was measured by LC-MS/MS. The project is supported by the Czech Science Foundation and National Sustainability Program of the Czech Ministry of Education, Youth and Sports (LO1214 and LM2015051).
B1 (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 demonstrate that AFs were detected from Turkish and Israeli origin, where ELISA is a sensitive screening method to monitoring residue levels. The aflatoxins levels in pistachios exceeded even more than five times the maximum permitted limits set by European Commission in Reg 165/2010 and referred to the edible part of the tree nuts. The higher incidence of AFs in imported shellfish pistachios is probably due mostly to an easier aflatoxin contamination following the fact that pistachios’ shells are less 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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Mytilus galloprovincialis under current environmental conditions and at conditions simulating scenarios of climate change, namely warming, acidification and the combination of these two factors were exposed to paralytic shellfish poisoning (PSP) toxin-producing Gonyaulax catenatum. Shellfish toxicity derived from accumulation of algae toxins was assessed in mussels at the four treatments as well as the damage at DNA level via the comet assay. Mussels were acclimated for 21 days and then exposed to G. catenatum, 5 days (uptake), followed by 10 days with non-toxic diet (elimination). The analyses of PSP toxins in the mussels were carried out by Liquid Chromatography with Fluorescence detection. The highest PSP content was observed at day 5 in mussels in the actual conditions (1493.8 ± 202.4 µg STX eq. kg⁻¹), which exceeded the international seafood safety limits (800 µg STX eq. kg⁻¹). Significantly lower PSP content was observed in mussels under climate change scenarios. The lowest levels (661.9 ± 22.8 µg STX eq. kg⁻¹) were found in warm-acclimated mussels, followed by acidification (761.2 ± 62.3 µg STX eq. kg⁻¹). However, interaction of both parameters did not reveal an additive effect. Lower toxin elimination was observed in warm-acclimated mussels. Genotoxicity was assessed in gills and hepatopancreas of mussels sampled at the end of each period. In mussels not exposed to toxic algae, the comet assay revealed highest damage levels in mussels under combined effects of warming and acidification at the end of the experiment (i.e after 36 days). When mussels were exposed to G. catenatum, DNA damage in both gills and hepatopancreas significantly increased at an earlier stage, i.e just after the uptake period. The treatments representing the acidification scenario and the interaction of warming with acidification revealed higher DNA damage than the actual conditions, highlighting a synergistic impact. DNA damage decreased in all conditions of humin exposure. The analyses of PS and SETAC Europe 28th Annual Meeting Abstract Book

TH177
Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems

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The eutrophication of aquatic ecosystems, associated to climate change, enhance the frequency and the severity of cyanobacterial proliferations. Cyanobacteria are photosynthetic organisms producing endotoxins such as neurotoxins, hepatotoxins, dermatotoxins, and cytotoxins, threatening target organisms and humans. The best validation models of cyanobacterial impacts on organisms is overall quite well documented. However, the neurotoxin β-methylamino-L-alanine (BMAA), suspected to be a causative agent in the human neurodegenerative disease amyotrophic lateral sclerosis (SLA), is less studied. The bioaccumulation of BMAA has recently been demonstrated with highly selective analytical methods in various marine organisms (zooplankton, mussel, oyster, fish), but rarely in freshwater organisms. Bivalves are known to consume phytoplanktonic species such as cyanobacteria or diatoms, both known to produce BMAA, and can be used as sentinel organisms to reveal the environmental contamination. A dual approach, in the laboratory and in situ, is used to evaluate the pertinence of the bivalves Anodonta anodonta, Dresissa polymorpha and Mytilus edulis as bioindicators of the contamination of fresh and estuarine waters by MCs and BMAA. The laboratory approach consist in the evaluation of the kinetics of BMAA and MCs accumulation and detoxification in bivalves at various times and concentrations of exposure. The in situ approach consist in the evaluation of the MCs and BMAA accumulation in caged bivalves along a river continuum from with varying freshwater and coastal conditions used for mussel aquacultures. First results show MC and BMAA bioaccumulation in laboratory-exposed D. polymorpha and A. anodonta, with varying kinetics. Freshwater and marine bivalves also accumulated MCs in situ and a MC transfer from fresh to estuarine waters occurred, highlighted by an accumulation in the marine bivalve M. edulis. The results of this project will facilitate the long-term tracking of the contamination of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecophysiology of cyanotoxins and the main conditions of human exposure.

TH178
Tetrodotoxin an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels

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Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (Tetraodontidae) [1]. Successively, TTX was isolated from other marine and terrestrial animals, as xanthid crab, trumpet shellfish, blue-ringed octopus, gastropods, starfish, and frogs. The wide distribution of TTX in genetically unrelated organisms has made TTX origin for long time controversial, with different kind of bacteria being identified as TTX-producing organisms [2]. Even Alexandrium tamarense – one of the paralytic shellfish poisoning toxins (PST) producing organisms – was proposed as potential biogenic source of TTX [3]. Although fatal human poisonings following consumption of TTX-contaminated seafood have been reported for over 50 years, the accumulation of TTX in fish, oysters and mussels collected in Europe (Spain, Portugal, UK, Greece) has been recently reported. So, in the frame of a collaborative study on evaluation of PST-related risk in the Mediterranean area, mussels collected in the Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophilic interaction liquid chromatography coupled with both high resolution and tandem mass spectrometry detection (HILIC-HRMS and HILIC-MS/MS). Both techniques highlighted the presence of high PST contamination levels, with samples collected in 2016 containing up to 10851 µg STX eq/kg. Unexpectedly, together with PST, tetrodotoxin was detected in Sicilian mussels. Although this was the first report of TTX in Italy, contamination levels found in mussels (0.8-6.4 µg/kg) were well below the regulatory limit of 2 mg TTX eq/kg established for TTX in Japan. Interestingly, much higher contamination levels of TTX (413 µg/kg) have been detected in mussels collected in 2017 in the NE Adriatic coasts of Italy (Lagoon of Marano), in the frame of the monitoring programme for marine biotoxins regulated in the EU [4]. Wu Z, Xie L, Xia G, Zhang J, Nie Y, Hu J, Wang S, Zhang R. 2005. First Detection in Italian Mussels

TH179
The first report on neurotoxic anatoxin-a occurrence in cyanobacterial blooms in the Czech Republic

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Prototype cyanotoxins such as microcystins have been extensively studied all around the world but there is still a lack of research on the occurrence levels and risks of other toxic metabolites produced in harmful blooms of cyanobacteria. In this paper we present the results of the first survey focusing on less explored cyanotoxins, namely anatoxin-a, in the samples from the Czech Republic. Levels of cyanotoxins were analyzed in freeze-dried biomass collected during 2012-2015 in various reservoirs in the country. The focus was on blooms (total 34 samples) dominated by potential producers of anatoxin-a such as Dolichospermum sp. (syn. Anabaena sp.), Aphanizomenon sp. as well as blooms formed by less common cyanobacteria. The multi-target UPLC-MS/MS methodology was applied that allowed to analyze in parallel all major cyanobacterial toxins (microcystin-LR,
and they can degrade drinking water quality, making it unacceptable by consumers. By influencing the aquatic biodiversity and promoting the growth of invasive species, they can result in pollution and affect water quality. The development of appropriate monitoring and management strategies is essential to minimize the adverse effects of cyanobacteria blooms on human health and environmental quality.

Cyanobacteria as well as eukaryotic algae produce a wide range of volatile organic compounds (VOCs) which include terpenoids, oxetanes, and dimethyl-disulfide (DMS) that are detected during cyanobacterial blooms. The detection of these compounds is important due to their potential role in odor emissions and their potential impact on human health.

In recent years, there has been increasing interest in the analysis of cyanotoxins in aquatic organisms, particularly in fish, due to the potential health risks associated with exposure to these compounds. The analysis of cyanotoxins in aquatic organisms, particularly in fish, has recently received increasing interest, due to the potential health risks associated with exposure to these compounds. The analysis of cyanotoxins in aquatic organisms, particularly in fish, has recently received increasing interest, due to the potential health risks associated with exposure to these compounds.

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especially FAs have great structural diversity and high biological specificity, essential for every living cell, as sources of energy, as membrane constituents, or as metabolic and signaling mediators. FAs have long been used as food-web tracers, and, more recently, changes in FA profile have also been exploited to better understand how contaminants affect organisms in aquatic food-webs (Silva et al. 2017). In this study, the potential impact of A. armata exudates in the FA profile of two marine invertebrates was assessed. For this, after calculating the lethal concentrations of the alga exude, 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 differences of macroalgae toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

TH184
Impacts of Asparagrposis 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 macroalgae. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20°C±1. After the exposure, macroalgae was collected and filtered for further testing. After assessing the lethal concentrations of the alga exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed by biochemical biomarkers responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for G. umbilicalis and the avoidance behavior for P. serratus. The biomarker responses 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 exudes released to the environment and can serve as warning indicators of prospective effects of this macroalgae on the invaded ecosystems under a global change scenario.

TH185
Assessing consumption risks through cadmium-contaminated shellfish intensified by ocean acidification
Wenhui, Kao et al. National Taiwan University / Dept Biomedical Science and Environmental Biology; H. Lin, National Taiwan University; S. Chen, Chung Shan Medical University / Public Health
The purpose of this study is to assess the human health risk of Taiwan population through consumption of cadmium-contaminated hard clam and oyster amplified by ocean acidification. This study employed forecasted ocean surface pH from the coupled model into the project planned projected emission scenarios representative concentration pathways 8.5, and C dodistribution 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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Cyanobacterial toxins, generally referred to as microcystins (CYN), are a group of structurally related hepatotoxic cyanobacterial metabolites with known human and animal health effects. Cyanobacteria are unicellular or colonial microorganisms common in freshwater habitats and produce diverse secondary metabolites including microcystins. Microcystins are present in water-based habitats and are produced by cyanobacteria in stressed conditions such as increased nutrient loading. Microcystins are widespread in freshwater habitats and can be produced by various cyanobacterial species, including Microcystis, Anabaena, and Aphanizomenon. Microcystins are known to be harmful to human health through shellfish consumption. They are produced by cyanobacteria and can accumulate in shellfish, such as mussels and oysters, from contaminated water. The consumption of shellfish containing microcystins can lead to acute and chronic health effects, including gastrointestinal symptoms, liver damage, and in severe cases, even death. Microcystins are potent inhibitors of protein phosphatases, including protein phosphatases 1 and 2A, which are responsible for the dephosphorylation of signaling molecules. This inhibition can lead to the activation of cell signaling pathways, resulting in various health effects. Microcystins can also affect the central nervous system, causing symptoms such as headache, dizziness, and nausea. In addition, microcystins can cause liver damage, leading to hepatic fibrosis and cirrhosis. Microcystins are also known to affect the renal system, causing nephrotoxicity and kidney damage. The toxicity of microcystins is dependent on the specific microcystin variant and the dose consumed. There is a need for continued monitoring and research to better understand the health risks associated with microcystin exposure and to develop effective strategies to minimize exposure.
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercommunication in bronchial cell lines. Regardless MCLR cell uptake, the toxin was relatively less cytotoxic to human bronchial epithelial cells when compared to the effects of other cyanotoxins (e.g. cylindrospermopsin), or in comparison with other cell types (e.g. hepatic or neural cells). Further experiments should focus on more detailed characterization of MCLR uptake and on longer term effects of MCLR and LPS on inflammation-related endpoints. Inhalation toxicity of other hazardous cyanobacterial bloom 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. GJ17-25279Y and H2020-MSCA-ITN-2016 Project No.722493 NToxAg.

TIH88
Estrogenic and retinoid-like activity in stagnant waters
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TH189
Excitatory effects of 2,4- diaminobutyric acid on leech Retzius nerve cell membrane potential
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Neurotoxicity of 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 in aquatic and terrestrial ecosystems. In the light of scarcity of electrophysiological studies and ubiquitous presence of DABA-producing Cyanobacteria, we conducted in vitro experiments to evaluate potential of DABA on leech neurons. Experiments were conducted on Retzius nerve cells of isolated segmental ganglia of the leech H. sanguisuga. Classical intracellular recording technique was performed. Cell membrane potentials were recorded using glass single-barrel microelectrodes and amplified with a high input impedance amplifier. DABA was administered in concentrations of 1, 3, 5 and 10 mM over a period of three minutes each. Input membrane resistance was first measured using current clamp technique by injecting hyperpolarizing current pulses through the recording electrode via a Wheatstone bridge unit. Application of 1mM DABA solution depolarized membrane potential by 5.0±0.43 mV (n=6, p<0.01), while 3 mM DABA produced depolarization of 9.84±1.38 mV (n=7, p<0.01). Rapid and substantial depolarization of membrane potential by 39.6±2.22 mV (n=9, p<0.01) was induced by 5 mM DABA, and administration of 10 mM DABA caused membrane depolarization of 47.05±4.33 mV (n=6, p<0.01). DABA had several times higher efficacy than Glutamate and J-L-Methylamino-L- alanine (BMAA) on our model. After washout, cells exposed to 1 or 3 mM DABA fully recovered, but on the cells treated with 5 mM DABA, depolarization was only 10% of 10 mM DABA there was no recovery at all. Application in concentration of 5mM DABA induced a decrease of the input membrane resistance by 8.09±1.51 MΩ (n=7, p<0.01). DABA elicits substantial dose-dependent membrane depolarization. Decrease of input membrane resistance indicates that this effect is a consequence of increased membrane permeability. At higher concentrations DABA induces irreversible functional changes of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH190
Generating ectotoxicity information on microcystins and prymnesins: A different approach
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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 human. Recent investigations indicate that cyanotoxins, metabolites which 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. The high risk of mutagenesis, development, reproduction or apoptosis. This study focused on freshwater ponds and reservoirs affected by water blooms and determined the estrogenic and retinoid-like activity of water by in vitro bioassay as well as concentrations of main estrogenic and retinoid compounds by LC-MS/MS analyses. Water samples from freshwater reservoirs and ponds with water blooms elicited estrogenic activity up to 2 ngEQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic hormones, alkylphenols or phytosterogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng EQ/L. We analysed the presence of nine retinoic substances, where 4-keto all trans retinoic acid and retinal were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and relative contribution of individual for each retinoid. However, authors 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.

TH191
Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure
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Irrigation with cyanobacteria-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 in cell growth and growth-related gene expressions remains unclear. 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 differently expressed proteins of them in 1.0 μg/L MC-LR treatment group, and 289 differently 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, and the different biological pathways involved in the mechanism of MC-LR-induced toxicity to rice were revealed using GO Term and KEGG analysis. Exposure to 1.0 μg/L and 50 μg/L of MC-LR could disturb the photosynthetic and ribosome pathways in rice leaves, causing the adverse effects on the normal growth and photosynthesis of rice. The significant alterations of the biological processes induced by the exposure to 50 μg/L of MC-LR were the inhibition of ribosome, porphyrin and chlorophyll metabolism, photosynthesis, and tetracyclic backbone biosynthesis-related pathways, and the induction of thiamine, inositol phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provided evidence of the molecular mechanisms underlying adverse effects in terrestrial plants exposed to water containing microcystins (MCs). Keywords: rice, microcystin-LR, photosynthesis, proteomics

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TH192 Probabilistic human health risk assessment for dietary exposure to aflatoxin in Taiwan
M. L. H. Wang, National Taiwan Ocean University; K. Lien, National Taiwan University

Aflatoxins (AFs) are secondary metabolites naturally occurring in many different kinds of food, including peanuts, spices, rice, tree nuts and maize. As both genotoxic and carcinogenic substance, aflatoxins could cause severe adverse health effect. AFs have been classified as group 1 carcinogen by International Agency for Research On Cancer (IARC), because of sufficient evidence provided by cancer studies in humans and experimental animals. The purpose of this study is to evaluate the probabilistic risk of people in Taiwan who accidentally consuming aflatoxin contaminated peanut and peanut products. Concentration data (1.84 ± 4.03 ppb) are gathered from Taiwan Food and Drug Administration (TFDA) between 2005 and 2015, along with consumption rate data (from Nutrition and Health Survey in Taiwan, NHSTP, 2001-2012) for groups 1-2 baby, 3-9 toddler, 10-17 teenager, 18-65 adult and above 65 elder) in two sub-populations (whole group and consumer only) are essential parameters for exposure analysis. Based on benchmark dose lower confidence limit 10% (BMDL10) (170 ng/kg bw/day) suggested by European Food Safety Authority (EFSA), calculated Margin of Exposure (MOE) value is below 10,000. As the result, it isn’t fit the recommended standard by EFSA. According to cancer potency from Joint FAO/WHO Expert Committee on Food Additives (JECFA), estimated population risk ranged from 0.0007 to 0.2713 cancers per 100,000 population per year. This study has calculated the risk of total aflatoxins contaminated peanut and peanut products by MOE approach and population risk method. From the result of population risk for primary liver cancer (Hepatocellular Carcinoma, HCC), it is obvious that aflatoxin isn’t the major cause of HCC. Despite the low cancer risk, MOE calculation indicates a possible health problem for Taiwan population. Further studies could focus on the prevention and reduction of AFs in order to reduce AFs occurrence in foodstuff, especially reducing risk for high exposure and vulnerable groups.

TH193 Organ distribution of the environmental neurotoxin β-N-Methylenalino-L-alanine in the freshwater mussel Dreissena polymorpha A. Lepoutre, UMR101 INERIS-URCA-ULH SEBIO; E. Faassen, RIKILT; A. Geffard, Université de Reims Champagne Ardenne; E. Lance, University Reims Champagne Ardennes / Biology and Biochemistry Among toxic substances, perfluorooctanoic acid (PFOA) (β-N-Methylenalino-L-alanine), a hydrophobic non-proteinogenic neurotoxic amino acid, has the ability to accumulate in marine and freshwater food webs, as well as in that vertebrates' brain. This toxin could promote long-term human neurodegenerative pathologies such as amyotrophic lateral sclerosis (ALS). Human exposure could occur during the ingestion of BMAA-containing food, as this neurotoxin has been detected in animals destined to human consumptions like fish, mussel and oysters. However, BMAA is an emerging toxin from which little data of toxicity or occurrence in the environment are available. In a context in which human activities are promoting the development of phytoplankton, it is important to gather information about this toxin. The zebra mussel Dreissena polymorpha is a freshwater bivalve, known for its ability to bioaccumulate substances in the freshwater environment. In this study, the distribution of β-N-methylalnine-L-alanine (BMAA) was investigated. The species was sampled in sediment cores from different lakes in the Netherlands, and the concentrations of BMAA was determined. The results showed that BMAA was present in the sediments, with concentrations ranging from 25 to 250 µg/g of dry weight. BMAA was not detected in the mussels collected from these lakes. The study highlights the need for further research to understand the mechanisms of BMAA bioaccumulation in mussels and its impact on human health.

TH194 Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida)
P. Irao, L. Guidolin, University of Padua, Department of Biology; F. Mazea, Regional Agency for the Environment, ARPA Veneto, Verona; L. Operative Service - Verona; G. Santovito, N. Tormen, University of Padua, Department of Biology; S. Trabucco, University of Padova / Department of Biology; A. Vantini, Regional Agency for the Environment, ARPA Veneto, Verona / Operative Service - Verona; L. Tallandini, University of Padova / Department of Biology The aim of this work was to evaluate the effects of perfluoroalkyl substances (PFOA and PFBS) on the macrofauna Dendrobaena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (mitochondrial 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/air. For the 72 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% of 1x or 10x MAC-EQS fw values (Maximum Acceptable Concentration-EQS calculated by the Italian Working Group for the derivation of Environmental Quality Standard (EQS)) while for the long time the PFOA, or PFBS, nominal concentrations were 30% of 5x MAC-EQS fw values. Different accumulation patterns were observed for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significantly higher coelomocyte mortalities than in the controls, with both compounds, were detected after the 14 and 28 days exposures. As for the lysosomal membrane stability significant decreases were detected both after the short and the long-time exposures. In the soft tissues primary data don't show the 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 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.
risk management framework for addressing potential environmental management issues of PFAS.

TH196 Interception 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 acid taxonomized about 100 years. On site, one identified at fumarole and leachate a tiered approach. The 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 predator 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, liliosipida, chlorophyceae, secerentea, clitellata and collombola) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliosipida, chlorophyceae and collombola) were investigated. Finally, acute and chronic hazardous concentrations for HCF, HC10, HC50 and HC90 were suggested for protection of soil ecosystem. These values can be applied to environmental risk assessments for nonylphenols. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (148501458).

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro
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The toxicological properties of organophosphate (OP) triesters that are used as flame retardant and plasticizer additives are currently not well understood. Willmore, Carleton University / Department of Biology; J. Kamstra, NMBU / BaSam; W. Willmore, Carleton University / Department of Biology; I. Sylte, The Arctic University of Norway / Department of Medical Biology; B.M. Jenssen, Norwegian University of Science and Technology / Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division

Tetradeacarbrom-1,4-diphenyloxenylene (TcDB-DiPhOBz) is a highly brominated additive flame retardant (FR), Debrominated photodegradates of TcDB-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’,4”-tetrabromo-DiPhOBz. Chemically related methoxylated tetra- to hexabromo-DiPhOBz are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBz-based compounds. The present study investigated the potential thyroid chemotoxicity of 2,2’,4’,4”-tetrabromo-DiPhOBz. Three strains of S. oregae – and hydroxy-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 thyroid (T4) for the binding site on human TTR and ALB. The para-MeO-tetabromo-DiPhOBz and the tetra-bromo-DiPhOBz were much less competitive to in silico homology model for gull TTR, to predict whether these tetrabromo-DiPhOBz-based compounds may also act as ligands for an avian TH transport protein despite evolutionary differences compared with human TTR. This analysis found all three tetrabromo-DiPhOBz analogues to be potential ligands for gull TTR, and with similar binding efficiencies to THs. Overall, the results indicated both species- and structure-related differences in binding affinities of these ligands, and suggest there is potential for these exogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

TH200 Phosphine changes cytochrome c oxidase in Sitophilus oryzae
K. Kim, H. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee, Kyungpook National University

Phosphine resistance in 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 mechanism for referring phosphine resistance. Three strains of S. oryzae were prepared as control groups (C), medium-resistant group (MR), and strong resistant groups (R) for this study. One of target sites of phosphine is cytochrome c oxidase (COX) and we analyzed the enzyme activities within the three strains. The highest COX activities were found in C groups with about 1.5-fold increase when compared to the controls. IC50 values on the COX activity by ethyl formate, one of COX inhibitors, was 2.92, 3.71 and 6.95μM per C, MR, and R strains. Lineweaver-Burk plot for COX using ethyl formate exhibited different modes from R strains to C strains. And six genes cat, hip, voltage, casp, wnt7, wnt11 were analyzed using RT-PCR for comparing gene expression and cat gene was dramatically down-regulated in the R strain. hip gene expressing juvenile hormone inducible protein was differently expressed in the two phosphine-resistant strains was up-regulated in the R strain, but it was not so big different. Three biomarker enzymes such as acetylenecholinesterase, glutathione S-transferase, and carboxylesterase activities were also determined within the three strains. Only glutathione S-transferase activity decreased in the R strain. Taken together, phosphine resistance in S. oryzae may be related to the changes in COX enzyme and up-regulation of hip gene expressing juvenile hormone inducible protein.

TH201 Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS
S. Bäck, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kato, KIST Europe / Environmental Safety Group

Glutathione is an important non-protein compound and existed in both internal and external organs. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) of glutathione is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, using high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very useful. In this study, we have developed high throughput and sensitive analytical methods. GSH and GSSG are usually analyzed in positive ionization in electrospray, and formic acid can be a general additive in mobile phases for a better protonation in positive ionization mode in MS. In this work, we investigated the effects of additives other than formic acid for a better understanding to enhance the ionization of GSH and GSSG in the gas field of MS source. With the presence of formic acid only, as a result, protonation of GSH was very limited. However, using formic acid and ammonium acetate together in mobile phases delivered the enhancement of protonation for both GSH and GSSG. Furthermore, as increasing the concentration of ammonium acetate from 5mM to...
50mM, sensitivities of GSH and GSSG were increased from 0.0034 to 0.0072 and 0.028 to 0.046, respectively. Detection limits of both GSH and GSSG were also significantly lowered as using higher concentration of ammonium acetate. This indicates that producing ammonium adducts followed by dissociating ammonium ions from adducts to protonate GSH and GSSG is important mechanism for protonation of these compounds with using ammonium acetate as a mobile phase additive. This enhanced sensitivity strategy was applied to ZFL (zebrafish liver cells) to investigate the occurrence of both GSH and GSSG and achieved more than 100% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZFL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZFL exposed to different concentrations of a target chemical as well as 6 mg/l of H_{2}O_{2}, a negative control. The lowest concentration of GSSG in this work was 5.0 ng/ml, higher than its detection limit, 2.0 ng/ml. This is meaningful because it could not be achieved by other conventional methods and assays with higher detection limit than its original concentration. Therefore, we can conclude that our method could avoid underestimation to quantify biomarkers such as GSH and GSSG.

TH202 Rapid analysis of bivalves’ xenometabolome using High Resolution Mass Spectrometry
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A total of 500 bivalves were extracted with recoveries ranging from 40.54 to 65.26%. The extraction of lipids and the subsequent purification and concentration were performed with a modified QuEChERS protocol. Recoveries of the most intense peaks of identified xenometabolites were between 40.54 and 80.44%. The xenometabolome of bivalves is complex and consists of xenobiotics and endobiotics 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 local and potential sources of xenobiotics, 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 chemical adducts. The purified adducts were injected in Orbitrap-Q-Exactive for identification and quantification of the priority contaminants. Twenty compounds including endocrine disrupting compounds, pesticides, and pharmaceuticals were extracted with recoveries ranging from 40.54 to 105.51%. Quality parameters such as method detection and quantification limits, accuracy, and precision were studied. Besides, non-target analysis of other relevant contaminants that may be present in bivalves’ xenometabolome is ongoing.

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TH203 River ecosystem: an ecosystem approach to evaluate the ecological risk linked to the human health protection
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The anthropogenic pressure on river ecosystems can induce changes on their structural and functional characters as well as an increasing risk for human health. Over the last years an ecosystem approach mainly based on multilevel bioindicator methods has been 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 μAQUA PVII. At the same time, tests were carried out using raw water samples. The approach of this study is based on the following parameters: biological community (diatoms, macro invertebrates, macrophytes and fishes fauna); chemical–physical parameters, a set of ecotoxicological bioassays (Vibrio Fischeri, Daphnia magna and Vicia Faba), microbiological analysis (Salmonella spp., Staphylococcus spp., Clostridium spp., and Campylobacter upgmd virological analysis of invertebrates; HEV and HAV, Norovirus NoGI and NoGiII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41). The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The ecotoxicological analysis is an important aspect in the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and organic vision of the qualitative state of the ecosystem. In conclusion these results highlighted the different levels of alteration and the potential need for the primary prevention and restoration, confirming that an ecosystem approach plays a key role in the ecological and human health risk assessments.

TH204 INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT
Use of available exposure and effect data are key to performing hazard and risk assessment of pollutants, and compiling different sources of data are often done in a case-by-case manner. Processing data is thus cumbersome and time consuming, whereas the availability of data is a large source of uncertainty in resulting assessments. The NIVA Risk Assessment database (NIVA RAdB) has been developed as a module-based tool to facilitate the assembly, organisation, integration, visualisation and quality assurance of available exposure and effect data. The databases and tools developed are integrated into the NIVA RAdB database, which is in a test phase with a focus on the exposure assessment (in vitro) of antibiotics, endocrine disrupting chemicals and pharmaceuticals and the risk assessment of their possible human health effects in the Danube estuary. The NIVA RAdB database has been developed as a module-based tool to facilitate the assembly, organisation, integration, visualisation and quality assurance of available exposure and effect data. The databases and tools developed are integrated into the NIVA RAdB database, which is in a test phase with a focus on the exposure assessment (in vitro) of antibiotics, endocrine disrupting chemicals and pharmaceuticals and the risk assessment of their possible human health effects in the Danube estuary.

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TH205 Assessing exposure risk for marine bivalve Mytilus posed by microplastic polystyrene particles
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BACKGROUND: Microplastics (MPs) are one of the most widespread emerging contaminants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs on marine ecosystems. OBJECTIVES: The aim of this study was to evaluate the risk posed by microplastic polystyrene particles (MPs) and MP-based microorganisms on marine bivalve Mytilus posed by environmentally relevant concentrations of microplastic polystyrene (MPs) and MP-based microorganisms on marine bivalves. 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 functions were also estimated. Results revealed that a 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 gyres.
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 (un)known (mixtures of) compounds. Alternatively, water quality can be assessed by observing adverse effects of surface water on test organisms. Therefore, the present study aimed to innovate surface water quality assessment by applying an innovative design in a nationwide monitoring campaign in The Netherlands. To this purpose bioassays with two aquatic invertebrate species, Daphnia magna and Chironomus riparius, were employed and the performance of passive sampling techniques to include time integrated compound concentrations was explored. D. magna neonates and C. riparius larvae were exposed to surface water samples from 34 locations. Daphnids were additionally exposed to POCIS passive sampler extracts from 7 of the same 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 noteworthy that the use of bioassays with multiple test species provides better insight into surface water quality, and is therefore a valuable addition to regular water quality monitoring.

TH208

Smart Monitoring: Application of innovative tools in nationwide water quality assessment
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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 chemicals that have serious impacts on water quality, and is therefore a valuable addition to regular water quality monitoring. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy, applied in a nationwide water quality assessment campaign in The Netherlands. The monitoring strategy combines passive and active sampling (PS) with a battery of bioassays to investigate ecotoxicological risk to aquatic biota. At 47 locations silicone rubbers and Polar Organic Chemical Integrative Samplers (POCIS) were exposed to surface water for 6 weeks. Alongside the PS a 7 day in-situ daphnids test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in vitro bioassays, a 7 day in-situ daphnids test and an in vitro LLuciferase 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 - exhalatability of effects by destroyed 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 semi-permeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampling device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance reference compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from the catchment of the rivers. The chemicals were detected both in adsorption (ED) and partitioning samplers (SR). The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQαn) of respective model compounds in water. The BEQαn levels were significantly higher in extracts from POCIS and ED samplers showing that the polar chemicals were responsible for most of the detected effects. Chemical analyses detected 103 and 209 chemicals in the Bosna and the Danube samples, respectively. The passive sampling allowed detection of chemicals at pg/L concentrations. The levels of chemicals with known biological potency for the studied endpoints were used for modeling of bioanalytical equivalents (BEQαn). The comparison of bioanalytical to bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQαn. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQαn was comparable with the BEQαn 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 contaminant 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 harpincoatid 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 widespread 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 equilibrium samplers (e.g. AdsorbX™) an extraction is needed before spiking of the 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 reconstituting (environmental) realistic contaminant mixtures in terms of qualitative chemical composition. In the current study we extracted SpeediSM™ passive samplers that were deployed for 8 weeks in two Belgian harbours and one location next to one of the harbours to spike a 7-day larval development test with the harpincoatid copepod Nitocra spinipes following ISO 18220. In order to fractionate the compounds on the SpeediSM™ we followed two different procedures: a sequential and a parallel extraction approach using three solvents: acetoneitrile, ethyl acetate and dichloromethane. We exposed 80 larvae divided into 8 replicates in a fully randomized setup including controls and solvent controls to each of the SpeediSM™ extracts and counted larvae and copepodites after

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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. spinitex.

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, volatility 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. In a competition analysis, 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 application of Oasis HLB as a passive dosing phase was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broad samples mixed with Oasis HLB at natural ambient concentrations in toxicity and other tests.

TH212 Passive dosing strategy for in vitro test systems: static concentration generator and continuous release
F. Begnaud, Firmenich / DRAP; C. Debonville, Firmenich / Research and Development; V. Laubscher, F. Berthaud, Firmenich SA / DRAS; H. Schug, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Toxicology; G. C. Kroplin, University of Bern / Centre for Fish and Wildlife Health; K. Schirmer, Eawag / Environmental Toxicology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs

The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. This is especially the case for valuable and relatively fast when dealing with hydrophobic (logKow> 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro bioconcentration test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartment of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous environmental exposure. Specific handling tools and concentration strategies were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

TH213 Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach
M.A. Hashim, M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Biologically active substances (generally termed as endocrine disrupting chemicals (EDCs)) are present in untreated municipal wastewater, which may cause deterioration of freshwater ecosystem due to their potential to disrupt the endocrine system of aquatic organisms. Untreated municipal wastewater is directly discharged into Danube River, Novi Sad, Serbia and the objective of this study is to identify compounds responsible for the biotransformation of gestagens and steroid hormones 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 bioarrays for agonistic and antagonistic hormonal activity for progestrone and glucocorticoid receptors (PR and GR). The extracted bioactive compounds were subjected to in vitro screening and the effect concentration of the cytotaxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioarrays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using aninopropyl column with gradient elution with methanol:water (30:70) with 0.1% formic acid. One to two minute fractions (total 28 fractions) were collected and biological analysis of these sub-fractions revealed again one active fraction with reduced potency as compared to F18 (parent fraction). For unraveling the compounds responsible for gestagenic and corticoid activity, non-target screening is being performed by using LC-HRMS.

TH214 Mixture Risk - Development of an effect-based chemical risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants
G. Niles, B. Holmes, M. Larsson, Orebro University / M. Technology-Environment research centre (MTM); N. Scherbak, Orebro University / School of Science and Technology, Life Science Centre; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); S. Keiter, Orebro University / MTM research centre

Environmental contamination is usually comprised of a mixture of pollutants, each of them having the potential of causing different toxic responses towards humans and wildlife. Recent risk assessments still generally rely on chemical analyses only; however, such investigations do not provide information regarding the interactions between chemicals including their integrated toxicity. The limited knowledge of the risks associated with mixture toxicity is the starting point for this study, and is part of the EnForce project that aims to investigate the toxic responses of mixtures of pollutants and integrate those results into risk assessment. Particularly, per- and polyfluorinated alkyl substances (PFAS) are of major concern as they are extremely persistent and able to alter the toxicity of other pollutants. However, preliminary results showed that selected PFASs were not able to alter mechanism-specific toxic effects in vitro, while they decreased gene expression of the same mechanism using an in vivo model with zebrafish embryos. Moreover, so far no vertebrate based test system exists to quantify the toxic response of PFASs; thus, one objective of the project is to develop a bioanalytical tool for measurement of PFAS contamination. The toxic effects of environmental samples will be assessed by a combination of biotests and chemical analysis. For the identification of non-target pollutants, effect-directed analysis will be used consisting of fractionation, chemical analysis and biotests. In addition, the project aims to fill crucial gaps in the knowledge regarding molecular and cellular effects of PFAS; respectively. The results of this project 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 Ecotoxicology; A. Bott, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; A. Dayakar, Yamuna River Authority / G. Niles, B. Holmes, M. Larsson, Orebro University / M. Technology-Environment research centre (MTM); M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); S. Keiter, Orebro University / MTM research centre

In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of
multi-resistant bacteria in the Musi River, which might be due to large pharmaceutical production located in Hyderabad. A cooperation between the Department of Ecosystem Analysis RWTH Aachen (ESA), the Helmholtz Centre for Environmental Research Leipzig (UFZ) and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary, 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 ecological effects.

TH216 Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays
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The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluates pesticides in surface water in catchments and 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 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. Wanzenböck, University of Innsbruck / Environmental Research UFZ; H. Hollert, Environmental Research UFZ / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag

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. Wanzenböck, University of Innsbruck / Environmental Research UFZ; H. Hollert, Environmental Research UFZ / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag

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Vermeissen, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; D. Olbrich, Swiss Centre for Applied Ecotoxicology EAWAG - EPFL; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; E. Simon, Centre Ecotoc / Aquatic Ecotoxicology

Many in vitro bioassays are run on 96-well plates and typically, reference compounds, standards and samples are added to the wells of a plate using solvents (e.g. ethanol). These solvents are then evaporated, media with cells are added to the wells, and the assay can then be run. Only a small fraction of the compounds remain sorbed to the wells and never become available to the cells or 2) compounds are partially evaporated along with the ethanol. To gather further evidence for the redissolving behaviour of test substances on 96-well plates in the lyticase protocol) or using ethanol (ethanolic) which was evaporated before medium was added. We tested different redissolving times by shaking the plates, using shaking times between 0 to 120 min. After redissolving, medium was transferred to new wells for further testing (redissolved) and emptied wells were given fresh assay medium and yeast cells and were also tested (rest). We evaluated the recovery of test substances in “redissolved” and “rest” wells. Results revealed that, for all test substances: 1) less activity was observed after ethanolic application compared to aqueous application, while their relative potency towards the reference substance environment in mussel; 2) a contribution of several substances (e.g. E2, E1, EE2 and BPA) of the nominal activity appeared in the “redissolved” wells and ca. 50% of activity remained in the “rest” wells; and 3) shaking times beyond 10 min did not further enhance redissolving. The fact that less activity was observed following ethanolic application compared to aqueous application may be because: 1) a fraction of the compounds remain sorbed to the wells and never become available to the cells or 2) compounds are partially evaporated along with the ethanol. To gather more information on these aspects – and to determine the actual concentrations in the two application methods – LC-MS/MS measurements of E2, E1, EE2 and BPA were performed in parallel to the bioassay. These data are currently being evaluated.

TH220
Mutagenic and ontogenetic responses in freshwater guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (SDS)

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The deposition and persistence of some chemicals in aquatic environments is a constant threat to aquatic organisms. Sodium dodecyl sulfate (SDS) is a surfactant widely used as an emulsifier in household products and is constantly present in the aquatic environment. The overall experimental evidence obtained so far using standard bioassays on 96-well plate invertebrate and vertebrate species showed that SDS was mutagenic and cytotoxic for marine organisms, with the possible exception of mechanical damage. In contrast, many common plasticizers (e.g. phthalates), 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 have long exposure times and plastic-organism interactions not considered in standard toxicity tests. Using ELS of marine organisms, we have adapted standard bioassays with ELS, tested ‘virgin’ microparticles of conventional polymers (PE, PS, PVC) and did not find any relevant short-term toxicity. In contrast, when microparticles obtained from commercial plastic objects are used events of acute toxicity are found, pointing at the additives as the causal agents of the toxicity found. Ongoing experiments explore the kinetics of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some 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 Mizbim body TEV using genetic biomarkers in the mussel (Mytilus galloprovincials) taken from the natural environment

In the present study, we evaluated the ecotoxicological properties of some conventional polymers (PE, PS, PVC) and did not find any acute toxicity effects on animals’ behavior, reproduction and cell division. However, little is known about chronic effects of SDS in aquatic animals. Thus, the present study evaluated the mutagenic (nuclear abnormalities) and ontogenetic (embryo formation) responses in freshwater pregnant female of guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (0.3 and 0.1 mg/L) for two weeks. The guppy females were fixed in Carnoy’s fixative solution and subjected to standard mutagenesis and morphological analyzes. After exposure, females’ blood was analyzed for nuclear abnormalities (micronucleated cells, nucleated buds, binucleated cells and cells with presenting apoptotic fragments), and non-parity females were submitted to cesarean section for embryo classification of development stage (less developed until complete newborn fish). The results demonstrated that there were no external deformities in the newborn fish during the exposure. However, there was a decrease in the number of fry on the females exposed to both concentrations of SDS in relation to the control, as well a delay in the development of the embryos of the exposed females, indicating ontogenetic effects even at low concentrations of SDS (0.3 mg/L). Regarding the nuclear abnormalities, both SDS concentration caused significant increments in the frequency of all abnormalities when compared to the control group (p < 0.01). The major concern about nuclear abnormalities is the permanent damage they can cause and the consequently genotoxic and mutagenic damages. These results indicate that freshwater Poecilia vivipara chronically exposed to SDS does not appear to be protected by European Directive (73/405/EC) that allowing the concentration of 0.5 mg/L of anionic surfactants (such as SDS) in drinking water and 1 mg/L in the freshwater used for other purposes.

TH222
Determination of Izmir bay pollution by using genetic biomarkers in the mussel (Mytilus galloprovincialis) taken from the natural environment

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Izmir Bay, which is surrounded by many agricultural and industrialized cities like Izmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were effectuated very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were being unbearable in 1980, as all the city smell very badly. Micronuclei (MN) tests is a system of micronuclei testing used to detect polynuclear aromatic hydrocarbons (PAHs) and chemical 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 - %5.60 and Binucleated cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, Mytilus galloprovincialis
Effect of thermal stress on endocrine disruption in Daphnia magna
J. Na, Korea University; H. IM, J. Jung, Korea University / Environmental Science and Ecological Engineering
Endocrine disrupting chemicals (EDCs) include various types of natural (17β-estradiol, estrone) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in both humans and animals. Recently, several studies reported that daphnids, which reproduce by parthenogenesis, may generate malformations in response to EDCs. In addition, it was demonstrated that variation of water temperature is able to change reproduction, growth, and survival of aquatic organisms and population number. This study aims to evaluate the effect of thermal stress on endocrine disrupting effect of EDCs using Daphnia magna. Short-term screening (STS) assay was performed to determine the endocrine disruption effects using adult (10–17 days old) daphnids. Animals were exposed to two temperatures of 20 °C and 25 °C, and reproduction, growth, male production and survival rates were evaluated. This study can give a clear 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. Martí, A. Alzuále, BioBide; A. Muriana, BBD BioPhenix S.L. / RD
The development of new chemical compounds is a long and costly process that may span up to 10 years. However, the success rate of new chemical families has decreased exponentially in the last decades mainly due to compounds toxicity detected in later phases of the R&D process. The OECD publishes a series of guidelines to define the toxicity evaluation assays required for regulatory purposes. The 201 guidelines, in particular, describes the alga growth inhibition test for the evaluation of aquatic toxicity. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for 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.

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 SSEEBALANCE®
P. Salinger, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenenwald, P. Koelsch, BASF SE / CDS/S
Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed by the SDGs (Sustainable Development Goals). For this reason, social aspects also have an increasing impact on marketing and management decision-making processes. The SSEEBALANCE® methodology, measures the ecological and economic consequences of alternate products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

TH227
Paving Responsible Research and Innovation in Industry
E. Yaghmaei, I. Van de Poel, Delft University of Technology / Values, Technology & Innovation; A. Porcari, Ari - Italian Association for Industrial Research; E. Mantovani, E. Borsella, Italian Association for Industrial Research
There is now only limited experience with Responsible Research and Innovation (RRI) in industry and there is also limited evidence of the added value of opening up the innovation process in industry for social engagement and gender considerations. In the PRISMA project (http://www.rri-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world industry context. To establish the added value of the RRI approach and the gender dimension in and for industry, we assess the pilot projects on a number of product and process RRI dimensions and compare the pilots on the relevant RRI dimensions with similar projects in the same companies in which the RRI approach has not been followed. We focus on implementing RRI for some of the major technological challenges in the EU including nanotechnology, synthetic biology, Internet of Things (IoT) and self-driving or automated cars.

TH228
Sustainable Guar Initiative - an integrated approach of social and environmental LCA
P. Martz, LÓreal Research & Innovation / LÓREAL; P. Arsac, N. Zaraaoui, LÓREAL; A. Wahelet, Solvay SA / LCA; J. Viot, F. Laurent, Solvay SA; M. Vuijilt, S. Causee, EVEA
Sustainable Guar Initiative (SGI) is a three-year long integrated program aiming at developing sustainable guar production within the Bikaner district in Rajasthan, India. This desert district is one of the largest producers of guar and guar gum in India. SGI was set up by Solvay, L’Oréal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agrodiversity: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (S-LCA) has been undertaken, 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 Dipti Chhagan, “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 as other limits related to these new developments.

TH229
How the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study
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Abstract
Along with environmental and economic assessment, social sustainability of the bioeconomy have become a growing challenge, with important effects for 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 the stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of ‘what to be measured’ is the critical point in S-LCA and, by employing recognised participative techniques, the stakeholders’ involvement can be used to shape the final sustainability criteria and regulatory recommendations. Against this background, our study aims at investigating to the social dimension of the transition towards bio-based products, by identifying and validating the main social impact categories pertaining to the bio-based products realm. In doing so, we employ a robust three-step methodological framework encompassing: impact categories identification, stakeholders mapping, and social impact categories validation. In order to operationalize the methodological framework, empirical data is gathered by means of in-depth literature review, stakeholders’ interviews, and focus groups. By providing empirical evidence on the social dimension, which incorporates different visions of the stakeholders involved in the bio-based value chains, our study paves the way for further developments concerning the integration of social assessments within bioeconomy context. Keywords: bio-based products, social assessment, stakeholders analysis – bio clean society [1] Siebert, A., et al., (2017) [2] Bell, G., et al., (2014). IEA Bioenergy Task42 Biorefining. Wageningen: IEA Bioenergy

TH230
Methodological considerations for applying social LCA to modelled future European energy systems in the REFLEX project
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A methodology has been developed for the social assessment from a life cycle perspective of supply chains for future energy systems for the European Union
(modelled techno-economically as part the Horizon 2020 project REFLEX). It has been developed in light of previously published work aiming at life-cycle based social and/or environmental assessment of single energy technologies and energy systems with a future perspective, and in careful collaboration with the handbook of REFLEX partners responsible for energy systems models. The functional unit for the assessment of the future scenarios is the provision of energy services in the EU in 2050 (the final year of the scenario and modelling). The system boundary for the energy system model proposed should encompass all energy flows and associated supply chains required for the production and delivery of heat (in all sectors), electricity and mobility services. Foreground LCI data for the capital equipment (primarily plant and vehicles) and fuels are taken from output data from energy systems models. Background LCI data about separate future energy technologies (as represented by the identified foreground processes noted earlier) start from existing LCI data for current systems (from Ecoinvent) to which changes are made based on certain assumptions about future developments of the technology in question. Thanks to the availability of price data for material in the latest version of Ecoinvent, LCI data acquired can be converted into monetary values. Finally, the cost data can be inputted into a multi-region IO-table linked worker hours model such as social hotspots database. This yields the country specific sectors required for the material in the energy system. The social impacts are then be evaluated with social theme tables for each country specific sector. It is proposed that IO-tables used should be adapted in order to reflect the development of the energy system in the future. Since the energy models and scenarios used in REFLEX are preserving in nature, it is suggested as a simplification that social impacts for the future system may be interpreted. The methodology will be operationalized in the coming year as part of the REFLEX project.

TH231
Social Life Cycle Assessment of the water system in Mexico City
M. García, Instituto de Ingeniería, UNAM / Ingeniería Ambiental; L. Guerreo, Engineering Institute Universidad Nacional Autónoma de México / Environmental Engineering
One of the main elements of the sustainability of water systems in the cities, is to guarantee a decent job that promotes the welfare of workers in accordance with the objectives of sustainable development in Agenda 2030. Mexico City is one of the most populated cities in the world and is considered as the main political, economic and cultural centre of Mexico. However, it has been several water sustainability problems in the social aspect as risks to the health of workers of the water system. The activities of operation that they perform, are also subject to the changing regulatory requirements and a lack of transparency in evaluation procedures has hampered the process of active substances approval. Such a gap in knowledge caused issues in the assessment of the future scenarios is the provision of energy services in the EU in 2050 (the final year of the scenario and modelling). The system boundary for the energy system model proposed should encompass all energy flows and associated supply chains required for the production and delivery of heat (in all sectors), electricity and mobility services. Foreground LCI data for the capital equipment (primarily plant and vehicles) and fuels are taken from output data from energy systems models. Background LCI data about separate future energy technologies (as represented by the identified foreground processes noted earlier) start from existing LCI data for current systems (from Ecoinvent) to which changes are made based on certain assumptions about future developments of the technology in question. Thanks to the availability of price data for material in the latest version of Ecoinvent, LCI data acquired can be converted into monetary values. Finally, the cost data can be inputted into a multi-region IO-table linked worker hours model such as social hotspots database. This yields the country specific sectors required for the material in the energy system. The social impacts are then be evaluated with social theme tables for each country specific sector. It is proposed that IO-tables used should be adapted in order to reflect the development of the energy system in the future. Since the energy models and scenarios used in REFLEX are preserving in nature, it is suggested as a simplification that social impacts for the future system may be interpreted. The methodology will be operationalized in the coming year as part of the REFLEX project.

TH232
Environmental Risk Assessment for some additives used in hydrocarbon extraction activities into the sea
S. Santoro, National Research Council of Italy (CNR); S. Giardina, Ministry for the Environment, Land and Sea; M. Orrí, National Center for Chemical Substances - National Institute of Health; D. Romoli, Italian National Institute for Environmental Protection and Research.
Concerning the oil 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 obtain a comprehensive picture of the likelihood 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 here for the substance would be acceptable for discharge with a concentration of 580 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 partnerships

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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, market 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 risk, in conjunction with the lack of technical tools available for weed and pest control. Rice farmers recognise the urgent need for active substances to be placed on the market with different modes of action to combat resistance and safeguard the production. The above mentioned topics have been deeply discussed among experts of different disciplines from the rice producing European Countries in an ad hoc workshop facilitated by Dow AgroSciences in July 2017. The outcome of the discussion highlighted the need for a bottom-up multidisciplinary approach, with farmers, local networks, users and research institutes facilitating an environment to coordinate a strategy for implementation, with a Member State authority championing this venture through zonal steering groups. The main conclusions of the workshop will be presented and discussed in the poster.

TH234
The Water Column Monitoring Program in Norway: when regulation and science meet
D. Pampanian, International Research Institute of Stavanger; S.J. Brooks, NIVA
Norwegian Institute for Water Research; B. Grovik, Institute of Marine Research; E. Lyng, International Research Institute of Stavanger; R.C. Sundt, Statoil

Oil and gas companies operating on the Norwegian Continental Shelf (NCS) are required to carry out environmental monitoring to obtain information on the actual and potential environmental impacts of their activities and to give authorities a better basis for regulation. Scientists, operators and regulators have worked jointly for more than a decade in this program, for developing, communicating and implementing knowledge, methods and tools to manage the offshore produced water discharges. A multidisciplinary approach (e.g. chemistry, biology, modelling and risk assessment) has been developed to monitor the discharge and reduce risk. Potential impacts from no-targeted chemicals have also been in the aim of this extensive monitoring program for anticipating negative effects at the ecosystem level. In 2004, a new project was launched as result of a comprehensive assessment performed since 1995. The new requirements have been applied for the first time in the 2017 Water Column Monitoring program. This holistic approach shows a significant improvement in the scientific outcomes of the monitoring, in a cost-efficient way. The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern North Sea and Egersundbanken (reference area) and in additional the near platform effect (Stafljord A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted effects. The impacts on the actual impact of discharges on the ecosystem. Data showed a general decrease in the actual impact in comparison to previous years. This is a great achievement, that demonstrates the importance of collaboration between researchers, operators and regulators. It is worth to notice that while developing the Water Column Monitoring program, scientists in Norway prioritise a RRI (Responsible Research and Innovation) approach.

TH235

DAPHINE: a supporting tool for pesticides risk assessors and stakeholders

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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 in turn were used to refine 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.

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The assessment entity (AE) concept was developed by ECHA together with Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, K. Jenner; M. Torres Sanchez, S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; F. Verdonck, ARCHE; K. De Brouwere, VITO NV / Health; L. Geerts, VITO NV; J. Chowdhury, International Lead Association / Senior Scientist -Environment; L. Allen, S. Binks, International Lead Association

Current chemical safety assessments for metals under REACH typically include a generic, worst-case approach, without regard to regional differences and crop diversity, which may lead to overestimation of risk. In fact, the exposure to metals in food and beverages is often determined based on the worst-case assumption and limited information about the actual environmental fate of the substances in food. This paper presents the development of a new approach for the assessment of the environmental fate of metallic substances under REACH. The approach is based on the identification of a limited number of key substances, which are representative of the group of metallic substances and are expected to be the most important in terms of environmental fate and potential risk. The key substances are then assessed in detail, considering their specific properties and potential sources of exposure. The results of these assessments are then used to support the risk assessment of the rest of the group of metallic substances. The approach is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer risk assessment and recycling operations in the EU. This paper presents the development of a 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 the EUSES-WEV for exposure 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-WEV. Based upon the results of this EUSES-like screening exercise, higher tier approaches are developed for selected exposure pathways and/or scenarios. Ultimately the results of the environmental exposure modeling have been used in a comparison of predicted blood lead levels with biomonitoring data in the process of risk characterization and documentation as needed for REACH authorization purposes.

TH237

Canada’s Approach to Determining Causes of Impact 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--sites identified as contaminated under the Canadian Environmental Contamination Act (CECA). As a result of a comprehensive assessment of ecological risk assessment (ERA) as a site management tool, a Focus Group developed guidance for conducting ERAs under FCSAP. One element of that guidance is a technical guidance module on conducting causality assessment. Causality assessment has the overarching goal of differentiating ecological impairment due to chemical stressors from natural variability and from impairment due to other stressors, such as physical and biological 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 attempt to foster its use at FCSAP sites. The risk to human health is determined by comparing the average chemical exposure with human health reference values (e.g. blood lead concentrations). The reference values are developed using a tiered approach that utilizes the European Union System for the Evaluation of Substances (EUSES), scientific databases, and results of the Environmental Risk Assessment (ERA) conducted at the site.

TH238

Improving “man via the environment” exposure assessment for lead: a case study on children’s exposure due to play habits in near industrialized areas

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

This presentation will critically review the risk assessment and risk management processes in the environmental risk assessment (ERA) for lead exposure to specific uses. Under REACH authorization processes (as part of a socio-economic analysis), it becomes more important to estimate the contribution of a specific use and specific exposure pathways. Consequently, there is a need to better define the contribution of lead exposures resulting from battery manufacturing and recycling operations in the EU. This paper presents the development of a 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 the EUSES-WEV for exposure 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-WEV. Based upon the results of this EUSES-like screening exercise, higher tier approaches are developed for selected exposure pathways and/or scenarios. Ultimately the results of the environmental exposure modeling have been used in a comparison of predicted blood lead levels with biomonitoring data in the process of risk characterization and documentation as needed for REACH authorization purposes.
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. Moreover, the model simulates the chemical fate in industrial STPs (iTreat; Straïns 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 bioelimination rate constant of substances turned out to be the 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 shows to 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 Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; L. Delorme, T. Herza, Hydrosoft Veleslavin Ltd.; L. Brodsky, Mapradix Ltd.; T. Herza, Hydrosoft Veleslavin Ltd.

Objective of the Study In order to calculate an annual pesticide load onto over a certain area, one needs detailed data on pesticides’ application that are hard to find in a real world. One way is to collect desired data from the farmers, but this is feasible just in relatively small areas. Due to missing detailed data, we computed more precise pesticide loads using an approved approach of chemical monitoring in the Czech Republic (in particular in crop production) and maps of crops derived from a remote sensing imagery. Material and Methods Data on annual pesticide usage for 77 districts in the Czech Republic and remote sensing multispectral data (IRS AWIFS and multitemporal images Envisat MERIS, Landsat 7 – LEC, lately Landsat 8 – LDCM and Sentinel-2) together with a custom database of plant protection products were used. Crop cov to 12 classes) grids of 100 m cell size (lately 13 classes, 25 m cell size) were derived from remote sensing images; the crops were linked to leaf protection products (PPP) and active substances. Then redistribution of pesticide usage from districts to grid cells was carried out using established link between a crop, PPPs and respective active substances. Results The grid of pesticide usage on perennial crops is produced before the end of spring every year in order to provide data needed for monitoring of pesticides that starts regularly in April. The grid of pesticide usage on all the other crop classes is produced regularly in November. The results are published on WWW and annually updated in order to provide water managers with information necessary for a meaningful design of pesticide monitoring in the Czech Republic. Conclusion The product provides more detailed information on a spatial load of pesticides than other publicly available data on pesticide usage and it is very welcome by interested water managers. Further enhancements are planned in the future as new remote sensing sensors become available.

TH242

Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater crustacean Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.

A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; L. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water Environment Research Laboratory. E-mail: antoine.ratier@irstea.fr

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. Moreover, the model simulates the chemical fate in industrial STPs (iTreat; Straïns 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 bioelimination rate constant of substances turned out to be the 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 shows to 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.

TH243

Chemical Exposure Disparities by Demographic Traits in the US Population 1999-2014

V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences, University of Michigan

Identifying individuals or populations at high risk for adverse health outcomes due to chemical exposure requires understanding how chemical exposure patterns vary by inherent traits. Currently, we lack of comprehensive screening to study the thousands of chemicals populations are exposed to on a daily basis. The purpose of this study is to develop a systematic approach that quantifies chemical exposure disparities by demographic traits for a broad set of populations. Recently, we have developed a machine learning algorithm that identifies populations at high risk for exposure. We used the National Health and Nutrition Examination Survey (NHANES) datasets to collect information on chemical biomarker measurements and demographic traits for the years 1999-2014 (n = 74,942), focusing on 229 chemical biomarkers from 16 different classes of chemicals. Poverty income ratio (PIR) was used as a surrogate variable for socioeconomic status, while cotinine levels was used as a proxy for smoking habits. We evaluated the association of each individual biomarker and various demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.
Ours 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 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**

Ocasional 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 ultrafine particles in the air the e-waste dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers at the facility to these FRs. Sampling was conducted daily over a total of five days in February 2017. Thirty-three dust samples were collected using vacuum cleaners and air samples were collected using polydimethylsiloxane passive air samplers (PDMS-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 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 now banned BDE-209, accounting for ~70-98% of all target compounds. The median air concentrations of ∑PBDEs ranged 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 phosphates (TPhP) and other replacement FRs were main flame retardants in air and dust samples. The necessary high performance separation for the determination of arsenic species 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 such as arsenite, arsenate, monomethylarsonic acid, and dimethylarsinic acid were preconcentrated from 6,300 fold. The limits of detection achieved with UV absorbance detection were 0.08-0.3 ppb As. For a spring water sample spiked with the four arsenic species, LODs of 2–9 ppb As were obtained, which are lower than the WHO guideline of 10 ppb total As.

**TH245**

Global approaches to environmetal exposure - assessment of e-wastes  
D. Purchase, Middelsex University / Department of Natural Sciences, Faulty of Science and Technology; L. Bisschop, Erasmus University Rotterdam / Department of Criminology; C. Ekberg, Chalmers University of Technology / Division of Energy and Materials, Department of Chemical and Chemical Engineering; P. Fedotov, Russian Academy of Sciences / Vernadski Institute; H. Gangkloch, 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 Specimen Bank and Elemental Analysis; G. Innerebner, A. Schmid, C. Roschatt, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. T. Phi, L.P. Nguyen, University of Toronto / 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. Mieth, J. Ohlemacher, CyPlus GmbH; K. Kreuzer, Evonik Performance Materials GmbH  
Natural background concentrations of cyanide can originate from the degradation of cyanogens, such as cyanohydrins, cyanates and cyanides, cyanohydrins, cyanides, cyanates, and microbes such as algae. Besides, cyanides may also be emitted from industrial processes such as the extraction of metals. Cyanide contamination is a major environmental and public health issue. Cyanide concentrations in environmental samples can range from 10 μg/L to 200 mg/L. The monitoring and regulating of cyanide in environmental samples is crucial for the protection of human health and the environment. Cyanide is a toxic substance that can cause respiratory distress, central nervous system depression, and cardiovascular collapse. Therefore, the determination of cyanide in environmental samples is essential for the protection of human health and the environment.

**TH246**

Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard  
S. Ono, Italian National Research Council; G. Innerbner, A. Schmid, C. Roschatt, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. T. Phi, L.P. Nguyen, University of Toronto / 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. Mieth, J. Ohlemacher, CyPlus GmbH; K. Kreuzer, Evonik Performance Materials GmbH  
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 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.

**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  
A large amount of e-waste is generated annually, particularly in countries such as Canada. Here, we have undertaken the first study to report on concentrations and profiles of selected FRs in indoor air and dust samplers (LV-AAS) deployed with active low-volume 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 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 now banned BDE-209, accounting for ~70-98% of all target compounds. The median air concentrations of ∑PBDEs ranged 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 phosphates (TPhP) and other replacement FRs were main flame retardants in air and dust samples. The necessary high performance separation for the determination of arsenic species 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 such as arsenite, arsenate, monomethylarsonic acid, and dimethylarsinic acid were preconcentrated from 6,300 fold. The limits of detection achieved with UV absorbance detection were 0.08-0.3 ppb As. For a spring water sample spiked with the four arsenic species, LODs of 2–9 ppb As were obtained, which are lower than the WHO guideline of 10 ppb total As.

**TH248**

Determination of background levels of free cyanides in surface waters  
Natural background concentrations of cyanide can originate from the degradation of cyanogens, such as cyanohydrins, cyanates and cyanides, cyanohydrins, cyanides, cyanates, and microbes such as algae. Besides, cyanides may also be emitted from industrial processes such as the extraction of metals. Cyanide contamination is a major environmental and public health issue. Cyanide concentrations in environmental samples can range from 10 μg/L to 200 mg/L. The monitoring and regulating of cyanide in environmental samples is crucial for the protection of human health and the environment. Cyanide is a toxic substance that can cause respiratory distress, central nervous system depression, and cardiovascular collapse. Therefore, the determination of cyanide in environmental samples is essential for the protection of human health and the environment.
µg/L. Here an existing continuous flow analysis (CFA) method was selected using a system with a special cuvette installation allowing a higher sensitivity. The protocol was validated and accredited according to standard ISO/IEC 17025. With this system an LOQ of 0.15 µg/L can be reached under optimal conditions while an LOQ of about 0.3 µg/L is achieved during routine operation. Previous to field testing it was verified that samples can be stabilized for at least 24 h by adjusting the pH of samples and 2-h storage 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, with values including 8 priority substances in the Loire (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 EQU 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 EQU implementation.

TH249
Application of equilibrium and kinetic passive sampling method to quantify integrative chemical profile in a small river and the outflow of WWTP Yvelines, H. KW; with contributions of J.M. Fournier to SAFER groundwater, Meyer, E. Finufroken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Monitoring water quality is challenging as most of organic contaminants present at trace levels and chemical profile is fluctuating. Current legislative requirement of water bodies monitoring, with levels only specified the lower 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 EQU 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 EQU implementation.

TH250
Improvement of relationship between water pesticide contamination and land used at a large scale using the Polar Organic Chemical Integrative Sampler (POCIS) technique, such as the limits of quantification and the lack of spatial and temporal representativeness. Consequently, sampling period highlighted seasonal variations which are characteristic of some sub-watersheds. Similarly, the presence of Norflurazon and Dimetomorph was correlated with vineyards, which is consistent with their use. Additionally, cartographic projections of the contamination levels for the 6 sampling period highlighted seasonal variations which are characteristic of some sub-watersheds. The presence of Norflurazon and Dimetomorph was correlated with vineyards, which is consistent with their use. Additionally, cartographic projections of the contamination levels for the 6 sampling period highlighted seasonal variations which are characteristic of some sub-watersheds.

Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals

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The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations” of the passive sampling of moderately hydrophobic organic contaminants. Polar Organic Chemical Integrative Sampler (POCIS) is one of the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polytetrafluoroethylene) 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 was determined over the time, allowing the calibration of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Then obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to estimate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.


S. Friedlander, Smither's Viscent, LLC / Environmental Fate and Metabolism; S. RAO, Gowan Company / Regulatory; K. Malekani, S. Kang, Smither's Viscent / Environmental Fate and Metabolism

Once applied to a plant, pesticide residues have the potential to move to other plant tissues (via phloem and/or xylem). Translocation of a pesticide to various tomato tissues (flower, leaf, stem, and root) was evaluated by applying a single application at a rate of 0.50 kg a.i./ha. Leaves, stems, and flowers were harvested at 1, 2, 4, 6, and 8 weeks after application (WAP) and root tissue was harvested at 8 WAP. At each sampling interval, the collected tissues were analyzed for total radioactive residue (TRR) by combustion analysis and autoradiography by phosphor-imager analysis. The TRR in all tissue types from the soil drench group was higher than in corresponding tissues from the foliar application group. The autoradiographs of all tissue types from the soil drench group were comparatively darker than in corresponding tissues from the foliar group.
TH253
An Examination of Microbial Biomass in Sediments and the Impact of Seasonal Variation
K. Malekani, Smithers Viscient / Environmental Fate and Metabolism; S.P. MaLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, Smithers Viscient / Environmental Fate
Microbial biomass is an important measure of the health and viability of a sediment just as it is for soils. It is also a parameter used to assess viability of the seetoxicological studies. N. Lemmens, Institute of Industrial Organic Chemistry Branch Pszczyna; M. Frontczak, Institute of Industrial Organic Chemistry Branch Pszczyna; M. Frontczak-Baniewicz, R. Strzalkowski, Mossakowska Medical Research Centre, Polish Academy of Sciences / Electron Microscopy Platform; A. Daniel-Wójcik, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies
The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected with a collecting duct, arranged in the form of long coiled cords lying on the both sides of the head. They played important role in maintaining healthy colonies i.e. through production of "milk" containing proteinous substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 bees per test item (in the highest concentration, which did not cause mortality below 50%), and the negative control. The specimens were fixed in 2.5 % glutaraldehyde and 2% paraformaldehyde in phosphate buffer, then postfixed in 1% OsO₄ and dehydrated with grades series of ethyl alcohol followed by acetone. Next specimens were critical-dried (CPDS, Critical Point Drying System), then coated with gold particles before observation in JEOL JSM-6390LV. The images and linear measurements (small and big axis of symmetry) from ten acini as well as number of acini per 1 mm² were taken from each samples. The analysis of the results showed decreases and increases of acini and their number per 1 mm², depending on the test item, however, these differences were not always statistically significant. It turns-out, that images were very valuable, allowing visual comparison of acini. Data obtained from the studies indicate that SEM can be useful tool for evaluation of hypopharyngeal glands development of Honey bees.

TH256
New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants.
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giesy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre
Research development in the field of advanced 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 isomers and congeners which may either complement or potentially interfere. In the case of a GC/OriOrbStrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high mass resolution spectrometry (GC-UHRRMS). Here we report use of GC-UHRRMS for identification and quantification of PCDD/Fs and PCBs. The methods developed are based on standard US-EPA methods (Methods 1613 and 1680) 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 accuracy of identifications and quantifications and provide validation of the method. Analyses were also conducted to determine the potential for a 'multiplex' analysis of various POPs where the resolving power (>120,000 FWHM) of the MS system was able to eliminate potential interferences from a variety of 'non-target' organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extract preparation and clean-up. In addition, the relatively simple auto-tuning and mass calibration algorithms available for the advanced mass spectrometry systems greatly simplify these otherwise challenging analyses.

TH257
Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment
M. Kostrii, D. Doran, D. Tuohy, M. Tauson, E. Ogburn, J.J. Sheahan, Cefas
It is recognised that Hazardous and Noxious Substances (HNS) transported at sea present a broad range of potential marine spill scenarios due to wide range of fate and effects of the many types transported in bulk through national and international waters. To improve preparedness of response and to provide better advice during marine incidents there is a need to improve our knowledge of the marine hazard/risk associated with the highest priority chemicals. Harbours and ports are typically located in transitional and coastal waters and so ship traffic is much more concentrated around these areas and so potential collisions are more likely. These areas are characterised by a range of salinity from 10 - 20 ppt within estuaries up to 34 ppt in coastal and offshore waters. Similarly, seawater temperatures vary significantly with seasonally. Seawater salinity and temperature, preliminary studies were performed to investigate the toxicity of HNS associated with different salinities (from 20 to 30 ppt) and temperatures (10 - 25°C). Different chemicals were chosen for the tests. Aniline and zinc sulphate were chosen as they are high priority HNS Chemicals due to their relatively frequent transport in bulk quantities. Additionally, benzalkonium chloride is a surfactant and also is a disinfectant, sodium hypochlorite were also investigated as they are transported in moderate quantities, have different chemical properties and modes of toxicity. Toxicity tests were performed with a micro crustacean, Tisbe battagliai, and two seaweeds, Ceramium tenuicorne and Fucus vesiculosus. Our results show that in most cases, chemical toxicity is positively correlated with temperature (higher toxicity with increasing temperature) and negatively correlated with salinity (higher toxicity with increasing salinity). This means that chemical spills are likely to have more impact in the summer in temperate regions and in lower salinity coastal or estuarine areas. These are also the areas that due to the presence of cities and port and harbour facilities have higher...
Using Correlations of Biological Toxicity Equivalent Quotients and Toxicity Equivalent Quotients to Derive Threshold Values for Dioxin-Like Compounds in Sediment

TH258

Using Correlations of Biological Toxicity Equivalent Quotients and Toxicity Equivalent Quotients to Derive Threshold Values for Dioxin-Like Compounds in Sediment

TH259

Measuring bioconcentration of cationic surfactants in fish

TH260

Acetylcholinesterase inhibition: a comparison of available methods for determination of acetylcholinesterase in muscle tissue of Limanda limanda.
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 Fotolotia candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing metal contamination. These community dose response curves allowed estimation of microrhizodrom community EC values, which provide valuable insight on the adequacy of current guideline values and in developing site-specific risk assessments and remedial goals with community endpoints. Produced EC values from this simplified community experiment are currently under validation in a terrestrial model ecosystem experiment, for these same mixtures.

TH264 Alteration of stress-related and thyroid hormone related genes in zebrafish larvae after the administrations of lead acetate, and mixtures of lead acetate and BDE-209

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The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, ccx, cat, gr, gst) and thyroid-related genes (trt, tfdi, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The relative concentrations of lead acetate were measured by ICP-MS and the toxic concentration of lead and nitrate 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 gst were induced upon both individual exposures and co-exposure, suggesting that the combined treatment induced an oxidative stress state. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH265 Assessment of the toxic interaction of lanthanides on aquatic organisms

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The relevance of lanthanides (LNs), in agricultural, industrial and, especially in high-tech applications has increased in the last decades. As consequence, more LNs are expected to enter into the environment and accumulate in the ecosystem. Although no great accumulations have so far been recorded, alterations in the LNs concentration were measured in aquatic organisms. The interactions of LNs toxicity focuses on the effect of single elements, however they are commonly found as a group in nature. LNs are expected to have cumulative toxic effects on organisms, owing to their similar chemical properties, but studies as mixtures, more representative of real scenarios, are required to support this hypothesis. In this research, we evaluated the toxic interactions of binary and ternary mixtures of certain metals namely Lead, Mercury, and Copper. As a terrestrial model ecosystem experiment, for these same mixtures acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH266 ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA FROM SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA

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Incidence of soil contamination by heavy metals is widely increasing with the spread of industrial and agricultural activities. Copper resistance of bacteria isolated from 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 bacteria strains isolated in soil from Mambilla Plateau artisanal mine and to explore their bioremediation capacity. Bacteria were isolated from soil samples obtained from different locations at the Mambilla artisanal mining site. Nine bacterial isolates were characterized for their heavy metal resistance using biochemical tests and they were identified as Staphylococcus aureus, Escherichia coli, Bacillus sp, Enterobacter aerogenes and Pseudomonas aeruginosa. Out of the five (5) bacterial isolates, three (Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli) were selected and grown on nutrient agar plates incorporated with heavy metals namely Lead, Mercury, and Copper. These isolates showed multiple resistance to the three metals. Staphylococcus aureus exhibited maximum tolerance to Lead, Mercury and Copper at concentrations of 0.15, 0.25 and 0.10/00g/100ml respectively. Pseudomonas aeruginosa showed maximum tolerance to Lead, Mercury and Copper at concentrations of 0.20, 0.20 and 0.10/00g/100ml. Escherichia coli exhibited maximum tolerance to Lead, Mercury and Copper at concentrations of 0.25, 0.15 and 0.15/00g/100ml respectively. The isolates also exhibited high level of resistance to these metals with MICs ranging from 0.15-0.30/00g/100ml. Copper was the most toxic metal with MIC of 0.15/00g/100ml while Mercury was the least toxic with MIC of 0.30/00g/100ml. Antibiotic sensitivity test showed that the 3 bacterial isolates were multi-antibiotic resistant. The results of the present study showed that Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli are capable of surviving high metal concentrations and could be a potential agent for bioremediation of heavy metal contaminated environments. However, some species of these bacteria are opportunistic pathogens.

TH268 Predicting the chemical and biological effects of tertiary metal mixture (Ni, Cu, Cd) to aquatic plant, Lemma gibba under different dissolved organic carbon concentrations

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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 Lemna gibba were exposed to Ni, Cd and Zn individually and as ternary mixtures. The influence in the uptake and toxicity of dissolved organic carbon (DOC) as an environmental ligand was studied. Two sets of tests were performed.0.5 mg/L and 10 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 test cases. Fronad number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [Mint] and external dose [Men] were also conducted 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 Mint (IC25Cd: 20.8 μg/L) being 6 times more toxic than Ni and 30 times than Zn. When concentration expressed as Mint/Cd was also the more toxic metal (IC25Cd: 76.67 μg/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 Mint but Cd when expressed as Mint. At the end of analyses, for both DOC concentrations, [Cdint], [Nic] and [Znt] were higher in the single metal exposure compared to the mixtures. For the mixtures exposures, the %RGI responses ranged from 17 to 94 % in the lower DOC concentration test and from 15 to 97 % in the higher. Concentration addition (CA) model for the mixtures' toxicity, those combinations of concentrations were used to calculate the 'sum of toxic units' (ETU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH269 THE EXCEPTIONS TO THE RULE: Metal bioaccumulation in microinvertebrates from a metal polluted site, Synalpheus palmarum, terrestrial model systems

B. Slootmaekers, W.D. Di Marzio, Team, Sysmec 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 (EQS). In combination with other stressors, this situation may lead to an unfavorable shift in the composition of the ecological community due to a variety of direct and indirect effects. The range of concomitant contributing processes that drive the shift is difficult to determine, as the aquatic environment and community will respond to the presence of a stressor(s). To gain insights into the contributing factors, we are investigating eleven sites for which apparently contradictory effects are observed. That is, based on monitoring data (www.vmm.be/geoview) gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQS, yet a good ecological quality is observed, are exposed to elevated levels of dissolved oxygen (DO), nitrogen or phosphorus (MMIF). 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, DO and macronutrients) will identify whether the ecological quality is primarily governed by chemical or biological factors, or a combination of the two. The outcomes of our research will provide mechanistic insights into the determinants of ecological quality and facilitate development of a more differentiated basis for the setting of EQS.

TH269 Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio G. Casadevall, University of Antwerp / Biology; G. De Brecq, University of Antwerp / Technology SPHERE; P. Van Hoegaerden, University of Ghent / 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 cell line organs. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycans are one of the toxic targets of silver nanocolloids (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNC would disrupt glycans function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. In this study, we employed four different SNPs including SNCs to compare their different toxicities using three human cell lines. Of SNPs, one was coated with sulfur and diameter was ca. 30 nm. Another one’s coating material and diameter are unknown. Of SNCs, one SNCs was non-coated and its diameter was ca. 30 nm. The other SNCs was coated with nitrogen and diameter is ca. 20 nm. We used three kinds of human cell lines; lung cancer-derived A549, epidermal-derived HaCaT, and monocye-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, B4GALT2 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 interaction of ENMs with 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 model. 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 1.3702-3.2066 mg/L), respectively. Among the 3 mixtures, mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of all considered, the mixture toxicity was causing mainly ZnO, and the positive bmax points 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

TH272 How relevant is mixture toxicity of herbicides in surface water? R. Sur, Bayer AG / Crop Science Division / Environmental Safety; A. Weyers, Bayer AG / EnSa. Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - TerrestrialVertebrates Expert Team; D. Baets, Bayer AG Crop Science Division / Sustainable Operations

The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixture toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to be a robust model indicator an increased toxicity when the mixture effect was caused mainly by ZnO, and the positive bmax points 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

TH273 Simplify: reasonable approaches to Mixtox assessment for plant protection products A. Weyers, Bayer AG / EnSa. Ecotoxicology; K. Bender, Bayer AG / Crop Science Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team; A. Gladhbach, Bayer AG / Crop Science, Environmental Safety Assessment

As part of regulatory implementation and risk assessment of mixture of herbicides 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, surfactant or metabolites. While publications on mixture toxicity understandably tend to focus on high risk cases, for low risk cases when a mixture ERA is required it’s implementation should be efficient and identify non-critical areas as early as possible. Simple exclusion criteria and harmonised approaches are used to avoid a waste of resources both for industry and regulators. ERA is a tiered process, where lower tiers (steps) are designed to identify and exclude uncertainties so that only potentially critical scenarios need 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
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PPPs are part of a crop protection programme and thus should be evaluated in this context. Therefore, for the risk assessment of PPPs it needs to be considered that actual standard practices and key research needs were identified at the workshop to support risk management decisions, 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, a top-down strategy to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMO model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in double doses, to ensure the selected pesticides were 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.

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. Manuela Olga, UR / Environmental Risk Assessment Team; J. Van de Zande, Wageningen University & Research / Agrosystems Research; L. Wipfler, Alterra Wageningen University / 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 characterisation 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 Cegib (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 Assessment 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, a top-down strategy to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMO model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in double doses, to ensure the selected pesticides were 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
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In Bolivia, pesticides are widely used in agriculture. There is a lack of regulation of their imports and farmers ignore the toxicity of these compounds. Thus, cases of pesticide intoxication and pollution of natural ecosystems are common. In this study, we performed a cumulative risk assessment of measured concentrations of atrazine, 5 organochlorines and 5 organophosphates (many of them banned) in water and sediment samples from the Pucara river basin. Samples were obtained from 11 sampling points in the river basin. Pesticides from water samples were extracted by liquid-liquid extraction and from sediment samples by Soxhlet extraction. They were then quantified by gas chromatography. The toxicity data of each pesticide were obtained from online databases. Combining the exposure and toxicity data, the environmental risk (sum of toxic units (SumTU)) was calculated for four target organisms: Daphnia magna for water concentrations, and the meidged larvae Chironimus riparius for the sediment concentrations. The human risk (habitat index (HI)) for chronic and acute exposure was calculated for children and adults who would drink the water from the river. Pesticide concentrations exceeded the current risk safety thresholds for the environment and the human health at approximately 50% and 20% of the sampling points, respectively. The thresholds were especially surpassed at the discharge zone of the river basin, where SumTU reached values of approximately 0.5 for D. magna, fish and C. riparius, and HI for chronic exposure reached values of 4.70 and 1.57 for children and adults, respectively. The results suggest that pesticide pollution likely impaired the stream system biota in multiple points, while water was not acceptable for a human daily intake in two sampling points, especially for children. The detected pesticides that caused most concern were heptachlor (banned) and dimethoate (approved). Based on these results, risk management strategies should be highly prioritized in order to reduce the risk posed to the ecosystem and the human health in the studied area. However, further studies should analyse the pesticide levels in other times of the year to see if the present results are representative. It is also necessary to analyse a higher number of pesticides which include an even representation of herbicides, fungicides and insecticides, to be sure that risk is not underestimated.

TH278 Developing a strategy to improve the environmental risk assessment of pesticides to test multi-component substances: a new HESI Emerging Issues Committee
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An international workshop was held in 2016 to address challenges in assessing ecological risk of complex mixtures, such as formulated products or complex mixtures. Many European and international regulations (e.g., the European Chemicals Regulation) apply to complex mixtures, but the methodologies to characterize and analyze these complex substances, and best practices and key research needs were identified at the workshop to support the development of a strategy to improve the environmental risk assessment of pesticides to test multi-component substances: a new HESI Emerging Issues Committee.
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
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With the increasing proportion 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 substance classification alone is not sufficient and additional tools are needed. The discussion of the present proposal of several new prioritization criteria based on substance classes and its application as an initial screening tool will be presented. Furthermore, the importance of the existing REACH data for mixture assessments will be highlighted.

TH280
Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?
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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: monococonstituents, multiconstituents, & UVCBs. Amongst these substance types, there were clear differences in the presented challenges to testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals fall under multiple categories: natural, synthetic, monococonstituents, multiconstituents or considered as UVCBs. One group of fragrances that fell under the title of multiconstituents/UVCB were known to be particularly difficult to assess: Essential oils (EO). EO are complex mixtures, with differing but often low solubility, high volatility and are known to contain some toxic constituents such as terpenes. We met some even more complex substances in this family: gums, resinoids and concretes, sub-categories of essential oils. They were as complex as EO but their composition was mostly unknown and their physical state leads to further difficulties for ecotoxicity testing: they were (mostly) solidifying extremely viscous resins, with a frozen honey-like texture. We tested hypotheses and performed ecotoxicology and e-fate studies on all the different classes of these substances (gums, resinoids, concretes and everything in between) to optimize our testing strategies for such compounds: we will present the avoidance of using some studies using alternative approaches. We will present our hypothesis and overall conclusions on the probable next steps for these complex substances.

TH281
Testing chemical mixtures: how to determine the effects concentration(s)?
G. Deviller, DERAC / TERA PRAPS HSE

When the properties of a mixture cannot be estimated from the related properties of its components then testing on the mixture is required under most chemical regulations. However, the available standard methodologies to assess the environmental fate and toxicity have been developed for single substances and are often not directly applicable to mixtures. The first issue is related to the identification of the relevant constituents to monitor during the tests (e.g. composition main constituents, bioavailable fraction...) which may differ according to the substance regulatory frame(s). Second, the development of a specific and quantitative analytical method for each relevant constituent could be technically challenging because (1) all analytical standard substances might not be available since some constituents of the mixture are produced by reaction and (2) the different chemical nature of the constituents may require different type of analytical techniques that might not be (all) available in (the same) GLP testing laboratory. Once the analytical setup was built up, the determination of how much materials may arise during toxicity tests if one or more constituent's concentrations vary during the exposure time. Indeed, if the constituents are found to be all stable, then the effect concentrations (e.g. ECX or NOEC) can be based on the nominal concentration of the mixture. But, in case the constituents have different degradation patterns during the test then, how the recommendation for single substances to base the effect levels on the measured 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
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The Product breakdowns that were identified include footprint (PEF/OEF) methods form a core part of the European Commission (EC) Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). Based on these methods, the potential impact on humans and ecosystems of chemicals emitted during the life cycle of a product is assessed via the USEtox model. To this aim, USEtox determines the mode of entry for a chemical. Focusing on human health (HH), the EC Joint Research Centre has recently obtained from the European Chemicals Agency (ECHA) genotoxicity and repeated dose toxicity (RDT) data (41 ‘381 test results, as of March 2017) generated under the REACH Regulation. Based on these data, data-selection criteria were defined to automatically derive non-cancer HH toxicity effect factors (using R-studio) for thousands of chemicals in USEtox. Genotoxicity data were not retained in the assessment, being associated with qualitative outcomes, and rules for cancer HH effect factors were not derived, since the USEtox ED50, and cancer-ED50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ERSRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, KLinch 1/2) were included in the first two levels. The main challenges that were identified include the way of data reporting and detailing in ESRs, especially for some critical fields, e.g. endpoint, unit, test duration, of exposure, thus leading to the use of either general rules for computing reasons, or other fields in their substitution. Nonetheless, the final effect value per chemical (e.g. NOAE), automatically derived from REACH data based on the developed criteria, coincided with the critical endpoint value chosen in the ESR in the majority of cases. Based on this work, RDT REACH data for thousands of chemicals can automatically be selected and used for their life cycle assessment in USEtox.
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. Finally, 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 risk from food contact materials K. van Wezel; F. Esselink; E.I. Muncke; Food Packaging Forum Foundation / General Management Food contact articles (FCAs) are made from highly diverse materials, and they are chemically complex. FCAs can transfer their chemical constituents, the so-called food contact chemicals (FCCs), into foods. Exposure to FCCs is assumed to be highly relevant in the context of human exposure to (synthetic) chemicals. To assess the risk to human health from chronic ingestion of FCCs, basic information on migrating chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCCs, especially the non-intentionally added substances (NIAS), as some or most NIAS typically remain unknown, depending on the type of FCA. Furthermore, the current approach to chemical risk assessment is focused on single substances, while it is known that many FCCs migrate simultaneously, forming the ‘overall migrate’ and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCAs is to assess biological effects of the overall migrate. In addition to assessing mixture toxicity this approach also includes effect-assessment for unknown NIAS which otherwise remain unassessed. We review this approach, discuss benefits and disadvantages, and highlight future research needs.

**TH285** A unique index to characterize the global noxiousness of stable and radioactive substances for both human health and ecosystems K. van Wezel; E.I. Muncke, Institut de Radioprotection et de Sûreté Nucléaire / SRTE; R. Gilbin, Institut de Radioprotection et de Sûreté Nucléaire / PSE-ENV/SRTE; S. Reygrobellet, Institut de Radioprotection et de Sûreté Nucléaire / PSE-ENV/SEREN; J. Garnier-Laplace, Institut de Radioprotection et de Sûreté Nucléaire / PSE-ENV

Inspired by methods and tools developed in the field of life cycle analysis (LCA), we use the risk to human health from chronic ingestion of FCCs, basic information on migrating materials and wastes for human and environmental health. Six impact categories were considered: human cancer and non-cancer effects on one hand, and ecotoxicity on the other hand, both considering chemotoxicity and/or radiotoxicity. For ecosystems, a comparative toxic unit has already been defined from which we derived our noxiousness index. It is based on the concept of Potentially Affected Fractions (PAF) used here as a damage indicator at the ecosystem level. This concept expressed initially the toxic pressure on the environment due to one chemical. It has been enlarged to mixtures of substances as multi-substances PAF (ms-PAF), and yet applied to a mix of stable and radioactive substances. Combining ecotoxicity data and a simplified model of exposure of fauna and flora, we proposed a chemotoxicity index and a radiotoxicity index, which definitions ultimately allow the calculation of a single index. According to acknowledged practices in LCA and corresponding available data, we suggested declining this approach to human health, taking into account exposures resulting from both ingestion and inhalation pathways. This led to eight basic indexes, which may be aggregated on substances, effects categories or exposure pathways to produce intermediate indexes. The principle of additivity that underlies the whole proposed approach may authorize their complete aggregation in order to produce a unique index also for human health. Different source terms may be then easily directly compared in terms of human and ecological noxiousness.

**TH286** Solution-focused application of mixture modelling and chemical footprints M.C. Zijg, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTARES; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; D. De Zwart, DiZ Ecotex / 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 100x 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 (group) contribute most to local impacts). Collaboration with the FP7-project MARS (on multiple-stress effects on ecological status) forms a multi-stress, multi-chemical integration. In SOLUTIONS, the modeling train will result in complex chemical footprints (ChF). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current presentation, ChFs are evaluated in terms of the net contributions to predicted mixture impact of emissions in one region, e.g., a sub-catchment, on the mixture toxic pressure in the total river downstream, including the estuary. Hence, it exemplifies the potential transformation of one complex dataset for communicating the information that can be obtained by single-chemical risks, chemical footprints indicate which combination of chemicals and locations require priority for abatement. We present ChF-analysis results for the river Rhine. The river basin was divided in more than 800 sub-basins and chemical footprint information resulting from the emissions of a large amount of chemicals are derived from hydrology driven spatially and temporally explicit modelling for the whole catchment. Subsequently, abatement priorities are proposed, based on the ChF results, that act on the most severe combinations of chemical and region of emissions. The effects of local risk management are expressed in reduced toxic pressure in all downstream sections of the river.

**TH287** One-week observation of phthalate metabolites in urine from 12 Korean adults: Exposure levels, profiles, and source identification J. Lim, Hanyang University; S. Kim, Seoul National University Graduate School of Public Health; I. Lee, Seoul National University / Department of Environmental Health Sciences; A. Lee, Soonchunhyang University; S. Kim, Y. Kho, Eulji University; J. Park, SOON CHUN HYANG UNIVERSITY / Environmental Sciences; D. Martinovic, University; J. Park, SOON CHUN HYANG UNIVERSITY / College of Natural Sciences; K. Choi, Seoul National University / Environmental Health Sciences; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

The esters of phthalic acid (phthalates) are representative endocrine disrupting chemicals (EDCs) to cause a variety of adverse health effects to humans. Phthalates have been primarily used as additives of the plastic products, cosmetics and personal care products (e.g., DEP). Phthalates are metabolized and eliminated in urine within few hours after human exposure. Due to a short half-life of phthalates, the urinary phthalate metabolites are utilized as an indicative for integrative exposure to phthalates from multiple sources and pathways. In this study, all of the urine samples for 7 days (n=401) were collected from 12 adults to identify the identification of phthalate exposure levels and exposure profiles, which differ for different population groups. Eighteen phthalate metabolites include mono-ethyl phthalate(MEP), mono-ethyl phthalate (MEP), mono(2-ethyl-hexyl) phthalate (MEHP), mono(2-ethyl-5-oxoexyl) phthalate (MEHOEP), mono-2-ethyl-5-hydroxyethylx) phthalate (MEHHP), mono(2-carboxyethyl) phthalate (MCEP), and mono(2-ethyl-5-carboxy pentyl) phthalate (MECPP) were analyzed. Among 18 phthalate metabolites, MEHP, MEHHP, MCMHP, MECPP, MBP, MEP, and MBzP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPPh, MiNP, MOP, and MEP were rarely detected in all of the urine samples (< 10%). Total concentrations of phthalate metabolites ranged from 3.12 to 6300 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites include mono(3-hydroxyhexyl) phthalate (MHP) and mono(2-ethyl-5-oxoexyl) phthalate (MEHOEP), mono(2-ethyl-5-hydroxyethylx) phthalate (MEHP) and mono(2-carboxyethyl) phthalate (MCEP), and mono(2-ethyl-5-carboxy pentyl) phthalate (MECPP) were also measured. Tracking the exposure source of phthalates suggests that the major contribution of the phthalates exposure pathways was different depending on chemical properties (e.g., molecular weight) and usage of phthalates. The exposure of lower-molecular-weight phthalates such as DEP and DMP was associated with the consumption of cosmetics and personal care products, whereas the urinary DEHP exposure levels varied with the dietary intake. The present study provides an important information for intervention study to reduce phthalates from humans.
the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessment; 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, NaOH/salt chemistry and public bio-effects data for individual chemicals were integrated to prioritize chemicals and predict biological targets of detected chemicals for each site. Partial least-squares (PLS) regression and association rule learning (AR) were used to identify associations between in situ chemistry and in situ transcriptomic effects. At most sites, both prior knowledge-based predictions and fish transcriptomics, indicated activation of estrogen receptor alpha and peroxisome proliferator-activated receptors; their predicted chemical initiators were bisphenol A, 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 signalling. Collectively, and investigated to be associated with increased bio-effects. These three health data trends, 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: OBSOLETE TAILINGS, OBSOLETE PESTICIDES, OBSOLETE GASOLINE AND HUMAN HEALTH DISORDERS

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We study the radioactive and toxic wasteage health impact: in areas of tailings and obsolete pesticides, and severe air-environment pollution by obsolete gasoline. They all have the same targets – immunity, genetic, endocrine system. The old uranium mining sites of former USSR military industry in Central Asia (North Tadjikistan (tremendous Degnay); in Kyrgyzstan – 29 tailings (high concentration in MailuuSuu river cost), in Uzbekistan 11 tailings and mines. Total radioactive wastages volume of three CA countries – 700 mln ton. There are 268 warehouses of obsolete pesticides and abandoned airfield used for agro pulverization. These warehouses and tailings could pollute distant areas of CA by infiltration by rivers. Additionally, toxic gas is discharged from abandoned oil- and mineral cars. These three health data trends, 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 Catchment using monitoring & high tier modelling tools

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Freshwater ecosystems are receivers of chemical pollution, which has been recognized as one of the major causes of river impairment. Wastewater treatment plants (WWTP) are point sources of contaminants in natural receiving waters, which can affect river ecosystems. This study is thus to verify how robust and resilient is an ecosystem to WWTP effluents using a mesocosm experiment which have been revealed as particularly convenient tool to study biological communities' responses. We exposed twenty-four artificial streams to a range of WWTP effluent concentrations, from no effluent to pure effluent and under controlled conditions of light and water flow (during 34 days, followed for 22 days of recovery) for no effluent conditions. We analysed river biofilm inhabiting in sediments and cobbles surface because of its major role in ecosystem functioning. To assess impact and recovery we measured Chlorophyll-a content, Chlorophyll-a fluorescence measurements, extracellular enzyme activities (APA and LAP), algal community and metabolism at weekly scale. Pollution load associated to the WWTP effluent was characterized analyzing physical-chemical parameters (pH, dissolved oxygen, conductivity and temperature), nutrients, organic matter, heavy metals and microorganisms in the water phase. Our preliminary results indicate a complex response of stream ecosystem functioning in front of the WWTP effluent. We notice changes on the system balance and the final return to equilibrium. Acknowledgements - The research leading to these results has received funding from the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua

TH291

Risk assessment of chemical mixtures in the Erft river basin

U. Rose, M. Trimborn, Erftverband

Mixture toxicity was assessed using extensive chemical monitoring data from the river Erft, its tributaries, and ten municipal waste water treatment plants (WWTPs) discharging into the Erft. Toxic Unit (TU) based risk assessment, assuming concentration addition and using acute toxicity endpoints for algae, macrophytes, daphnia and fish. Substances with high TU as well as the taxonomic groups displaying highest added up TU response (SUM TU) were determined. The chemical inventories of WWTP effluents were analysed to gather information on non-detects i.e. potentially ecotoxicologically relevant substances which are present in surface waters in concentrations below the analytical limit of detection (LOD). Additionally, single substance risk assessment was performed by determining risk quotients (environmental concentration/PNEC). Risk quotients larger than one indicate a possible risk for aquatic organisms. SUM TU were mainly

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explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, 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 as a major toxicant in the aquatic environment even at concentrations below LOD. Pesticides often generated high TU but due to the seasonal application substance patterns varied strongly between sampling dates and different locations. Highest pesticide concentrations in surface waters were measured during heavy rainfall which caused run-off from arable land. Single substance risk assessment identified mainly Triclosan, Ibuprofen and Dichlofenac as substances with a possible risk for the aquatic environment. In waterbodies strongly influenced by WWTP discharges Dichlofenac and Ibuprofen were nearly ubiquitous and caused high chronic toxic stress to fish. It was concluded that a combination of single substance risk assessment and mixture toxicity assessment is a suitable tool to evaluate complex monitoring data. Monitoring of substances with high TU (contributing mainly to mixture toxicity) could help to identify surface water for a more extensive monitoring and support specific management planning.

TH293 Assessing groundwater toxicity of emerging contaminant mixtures
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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 NEED – Water JPI – WATERWORKS2014 ERA-NET focused on developing new management strategies to sustainably exploit groundwater resources. A thorough identification of emerging contaminants took place in two well-characterized case-studies, the Bologna and Cremona aquifers. For that, four priority contaminants identified in the two aquifers were chosen as model chemicals and synthetic water was built to mimic the contamination from these 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 217). The use of the binary mixtures was to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicate interaction between the contaminants in D. magna and D. rerio.

TH294 Mixtures effects of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
C. Jonander, University of Gothenburg; I. Dahlöff, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

In coastal ecosystems nanoparticles 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 dead/alive staining of zooplankton with neutral red after the exposure. Additionally, we analysed the community structure before and after chemical exposure by image analysis, comparing images of the exposed samples and untreated controls to a manually classified reference library of mesozooplankton taxa. Single substance experiments show toxic effects on the zooplankton communities by decreasing copepod egg production and hatching success in a concentration-dependent manner, with first effects becoming visible at concentrations of 0.20 µmol/L (SDS) and 0.32 µmol/L (DBP), respectively. The interaction of structural endpoints as well as toxic mixture experiments are currently (Nov. 2017) ongoing and will be presented on the poster.

TH295 Analysis of the Mixture Toxicity Burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef
E. Seibsl, 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 these pesticides on marine ecosystems in the river 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, multiple pesticide were routinely detected in the 25% of the river water samples taken in the various monitoring years, with the percentage of samples containing more than 2 pesticides increasing over time. We also calculated toxicity thresholds for 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, multiple pesticide were routinely detected in the 25% of the river water samples taken in the various monitoring years, with the percentage of samples containing more than 2 pesticides increasing over time. WE also calculated toxicity thresholds for the 38 pesticides detected. We also calculated toxicity thresholds for the 38 pesticides detected.

TH296 Physiological and transcriptomic responses in the tropical coral Stylophora pistillata to inorganic sunscreen exposure.
A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences

The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. Over the past 5 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 these pesticides on marine ecosystems in the river 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, multiple pesticide were routinely detected in the 25% of the river water samples taken in the various monitoring years, with the percentage of samples containing more than 2 pesticides increasing over time. WE also calculated toxicity thresholds for 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, multiple pesticide were routinely detected in the 25% of the river water samples taken in the various monitoring years, with the percentage of samples containing more than 2 pesticides increasing over time. WE also calculated toxicity thresholds for 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, multiple pesticide were routinely detected in the 25% of the river water samples taken in the various monitoring years, with the percentage of samples containing more than 2 pesticides increasing over time. WE also calculated toxicity thresholds for the 38 pesticides detected.
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. Scipio, University of Liège / Department of Food Science, FARAH. AhR agonistic activity was observed in all cell lines. In the presence of mixtures, 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 mg/L, which is higher than the tested mixture. For the evaluated POP mixture, the determined values were 14.7 mg/L for 1-Octanol and 17.3 mg/L for Di-n-Butyl. Both biofuels led to teratogenic and lethal effects in the FET (LC50, dodecane: 24.7 mg/L; LC50, Octanol: 11.3 mg/L). Especially in the study of Di-n-Butyl was a low hatching rate, while embryos were often observed at the pericardium of the hatching larvae. Testing the mixture in the FET revealed a LC50 of 14.7 mg/L. The acute immobilization test resulted in an EC50 of 25.6 mg/L. The determined EC50/LC50 values in both bioassays suggest an additive mode of action of the compounds. The comparison of the determined values with data of other biofuels (2-methylfuran, 2-methyltetrahydrofuran) showed a higher toxicity of the mixture. Di-n-Butyl 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 “Tailoring of biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

Mixtures

Mixtures of propiconazole and ZnO (bulk and nano form) on various biomarkers and reproduction in Enchytraeus albidus

N. Ćurčić, L. Lonńarḯ, University of Osijek / Department of Biology; D. Hackenberger, Department of Biology; University of Osijek / Department of Biology; L. ZelíDŽ, University of Osijek / Department of Biology; B. Seifert, Department of Biology; University of Osijek / Department of Biology. Single and combined effects of propiconazole and ZnO (bulk and nano form) on various biomarkers and reproduction in Enchytraeus albidus were investigated. In a preliminary experiment an EC50 value for reproduction for each compound was calculated (480 mg/kg ZnO and 40 mg/g PCZ). In the second experiment enchytraeid were exposed to five concentrations in following ratios: 1:9, 1:3, 1:1, 3:1, and 9:1. The EC50 values were 14.7 mg/L for 1-Octanol and 17.3 mg/L for Di-n-Butyl. Both biofuels led to teratogenic and lethal effects in the FET (LC50, dodecane: 24.7 mg/L; LC50, Octanol: 11.3 mg/L). Especially in the study of Di-n-Butyl was a low hatching rate, while embryos were often observed at the pericardium of the hatching larvae. Testing the mixture in the FET revealed a LC50 of 14.7 mg/L. The acute immobilization test resulted in an EC50 of 25.6 mg/L. The determined EC50/LC50 values in both bioassays suggest an additive mode of action of the compounds. The comparison of the determined values with data of other biofuels (2-methylfuran, 2-methyltetrahydrofuran) showed a higher toxicity of the mixture. Di-n-Butyl 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 “Tailoring of biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

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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; 2.4; 5.3 and 11.7 mg L⁻¹ of abamectin and 0.2; 0.5; 1; 2.3 and 5.0 mg L⁻¹ of difenoconazole. The factorial design was used to conduct 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. The EC₅₀ values that were calculated using the bimodal models of abamectin and difenoconazole promote in Danio rerio embryos the antagonistic effect in the lower concentrations, but in higher concentrations the produced effect is synergic. This means that, at lower concentrations the interaction of abamectin + difenoconazole seems to decrease the toxicity of pesticides to Danio rerio embryos, but the toxicity of the compounds is potentiated at higher concentrations of the mixtures. Similar results have been found in other studies with monocultures and in biocultures exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

**Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking (P)**

**TH306 Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment**

A.G. Renteria Gamiz, Ghent University / Department of Sustainable Organic Chemistry and Tecnology; W. De Soete, Ghent University / EnVoC; B. Heirman, Johnson and Johnson / EHSS Product Stewardship; J. De Graaf, Janssen Biologics / Safety Health Environment; S. De Meester, Ghent University / Department of Industrial Biological Sciences; J. Devul, Ghent University / Department of Sustainable Organic Chemistry and Technology

Most Life Cycle Assessments (LCAs) performed in the pharmaceutical sector have been done on chemically synthesized drugs, leaving biopharmaceuticals aside. The fact that sustainability assessments of biopharmaceutical products and technologies have been rarely done is probably a consequence of the major challenge that building a robust Life Cycle Inventory (LCI) represents for the upstream and downstream processes of biologics. However, the low number of LCAs performed on biopharmaceuticals does not reflect the current reality of the pharmaceutical sector, as its market is rapidly growing at an annual rate of around 9%. Therefore, this study focuses in performing a resource based LCA to measure the environmental impact of a biological Active Pharmaceutical Ingredient (API). A resource-based methodology is used to address the task that addresses both the impact 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.

**TH307 LCA methodology: a case study of the industrial production of terephthalic acid from renewable sources**

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Cavani, Toso Montanari Department of Industrial Chemistry, University of Bologna / Dept. of Industrial Chemistry; P. Mizsey, D. Fozer, Budapest University of Technology and Economics / Department of Chemical and Environmental Process Engineering

The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved for the traditional way with those of three bio-based routes. The aim of the study is to identify which of the selected pathways has the lowest environmental load. Below the four routes selected are briefly described: Traditional way: p-xylene is obtained from catalytic reforming of crude oil as part of extracted BTX (benzene, toluene and xylene isomers); GEVO’s process: isobutanol from the fermentation of biomass is converted into hydrocarbons, iso-octene and p-xylene; Ferrum: HMF, ethylene and xylene; it involves the production of HMF (5-hydroxymethylfurfural) from starch, its conversion to DMF and the Diels–Alder reaction with bio-ethylen 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 an industrial level; the others are still under development. Therefore, in order to estimate the energy requirements of the scenarios, a simulation of the chemical processes was carried out using ChemCad software. The first three syntheses are based on the production of p-xylene, subsequently oxidized to TA through the Amoco process. On the contrary, the last route is proposed as an alternative way, since it uses p-cymene as a precursor of TA. In order to perform the comparison, a LCA (Life Cycle Assessment) methodology has been used as a scientific tool of energy capacity, residence of a potential wafer or each skalaprol. LCAs can evaluate the environmental impact of the whole life cycle of a product, in our case 1 ton of terephthalic acid. The model was developed by the use of SimaPro software and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that only the alternative way from orange peels has lower environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

TH308 Environmental assessment of vanadium redox flow batteries
C. Minke, Technische Universität Clausthal / Energy Research Center; J.F. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HHI; M.J. Baumann, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

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, it is an appropriate technology for grid applications. From the environmental point of view, the VFB has the advantage of being designed for the usage of aqueous solutions, which can be replaced. The VFB has been evaluated with VFB software and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that only the alternative way from orange peels has lower environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

TH309 Towards the Life Cycle Assessment of engineered nanoparticles production: a comparison between batch and continuous flow synthesis
F. Grimaldi, University College London / Department of Chemical Engineering; M. Pucciarelli, University College London / Chemical Engineering; A. Gavrilidis, University College London / Department of Chemical Engineering; P. Lettieri, University College London / Chemical Engineering

The aim of the 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 translation, 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. These ENPs include Cu, Au, Fe, Ag and iron oxide. The CF syntheses are modelled on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.

TH310 LCA of nanomaterials production for the emerging technology: the case of printing batteries
J. Gómez-Calvet, LEITAT / Sustainability Division; C. Hidalgo, Leitat Technological Center / Sustainability Division; M.R. Riera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE / LEITAT TECHNOLOGICAL CENTER / Sustainability Division

BASMATI is an ambitious project which main goal is to develop active nanomaterial and electrochemical inks for printing technologies to transfer and upscale to pilot lines at SMEs and industry facilities. This project is co-funded 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 quantifying 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 calculated for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks comparative, and results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu Inks. A high potentiality of the new generation of printed batteries 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 translation, 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. These ENPs include Cu, Au, Fe, Ag and iron oxide. The CF syntheses are modelled 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.

TH311 Life Cycle Assessment (LCA) applied to new and advanced material solutions in Concentrated Solar Thermal technology
A. Claret, 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 concentrated solar plants. Nonetheless, the production cost of this promising technology have to be improved. The aim of IN-POWER project is to develop high efficiency solar harvesting CSP architectures based on holistic materials and innovative manufacturing processes while reducing the environmental impact associated to CSP architectures and the energy production cost. To achieve this objective IN-POWER develops a set of advanced solutions: Polymeric Smart light mirrors with high optical and mechanical performance. An optimized and lighter mirror support structure. High-operational-temperature absorber coating in new vacuum-free-designed receiver. A novel modular solar field architecture and design reducing the land use requirements by 4 times.
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. The design of the process looking for high performance without, but environmentally friendly. Some improvements are being made such as: use of aluminum instead of silver in the mirror reflective coating, to meet the European requirements for use of non-critical materials; the reduction of materials weight; and the increase in materials robustness. The expected results are to: Obtain a complete environmental profile of IN-POWER CSP architecture. Calculate the environmental impacts associated to: new polymeric materials for mirrors; 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 Eisenerz, Austria. The case of RICAS2020 PROJECT. A. Clare, Leitat Technological Center / Sustainability Division; G. Ferrer, Leitat Technological Center / QuantitX; J. De Mora, RD Sustainability Division; M. Riera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division European society has a highly dependency on electric power. In 2009 European Union fixed that at least 20% of EU gross final energy consumption have to come from renewable energy sources until 2020. The increasing use of renewable energy sources to produce electricity has generated a worldwide challenge 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: (i) compare the environmental impacts generated in the different stages of the case study (from the extraction of raw materials to the end of life of the storage system with respect to the conventional setup. Policy tradeoffs will also be assessed. This wastewater treatment plant originally benefited from cogeneration, but eventually decided to use biogas flare systems due to the taxes on self-supply of electricity imposed by the Royal Decree 900/2015 approved by the Spanish Parliament. As a result, we need to determine if applying technologies that generate more biogas will result in larger impacts than the current scenario if the biogas cannot be used for cogeneration.

TH314 Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for greenhouse glass. N. Tsay, CML Leiden University / CML; J. Quist, Delft University of Technology / Technology, Policy, and Management; A. Wypkema, M. Mourad, TNO / Materials Solutions; V. Prado, CML Leiden University Technical solutions in coating glass could support 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 in a proactive way, anticipating the consequences of the technology. The LCA of the Anticipatory application of TNO as a case study is being presented. The LCA of this coating is performed using the Anticipatory Life Cycle 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 surface 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 glasshouses 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 is being performed using the conventional coatings, and this could be due to the simplicity of the coating method applied by TNO. Also, it was revealed that the coatings do not bring significant environmental benefits rather they bring economic benefits in terms of increased yield of tomatoes. Finally, the sensitivity analysis showed that electricity used for the production of glass has higher impacts than transmittance or degradation time of the coatings.

TH315 Combine process simulation analysis with Life Cycle Assessment method in polyurethane rigid foam production A. Bordignon, M. Fermeglia, Università di Trieste; A. Bortoluzzi, S. Rondinini, C. Locatelli, A. Vertova, Università di Milano Process simulation is a computational technique used in several sectors of process engineering. It is very useful at design stage, for defining the feasibility of a new process, as well as in the process optimization stage, where the optimum value of the production is pursued and, last but not least, in the process analysis stage for understanding the potential improvement of an existing process. It consists in the coupling of simulation using algebraic and differential equations of the production process 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.

TH316 Life Cycle Assessment of CO2-based Methanol Production using Captured CO2 from Fossil Fuel Power Plants C. Lee, University College London / Department of Chemical Engineering; R.
Catlow, Cardiff University / School of Chemistry; P. Plettiere, University College London / Chemical Engineering

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 conversion 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 their utilization 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 are production of methanol, and supply of electricity to the UK electricity grid. To quantify the main functions, we choose 143.7 MJ methanol (655 g) as reference for the function ‘methanol production’. The second function ‘electricity supply’ can be quantified through the amount of CO2 that is captured to produce equivalent amount of methanol. CO2-based and fossil-based methanol production processes are analysed 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 environmental performance of the intermediates and steps are improved, 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-ethinylestra diol, levonorgestrel and diclofenac, to disrupted periconception

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Embryotoxicity indexing is a high-throughput alternative to using the whole fish model. Previous studies in laboratory have demonstrated that embryonic exposure to pharmaceutical compounds capable of disrupting the endocrine system such as 17α-ethinylestradiol, levonorgestrel, and diclofenac, both alone and in mixtures, can impair swim bladder inflation of Japanese medaka (Oryzias latipes). Failure of swim bladder inflation can have serious long-term effects on fish populations and is related with increased mortality. A chronic exposure to xenobiotic compounds are able to cause swim bladder inflation is not fully understood; however, it is possible that compounds are able to cause their effects through a disruption of embryonic cell signalling pathways. The canonical Wnt pathway plays a crucial role in fish swim bladder development, and the disruption of Wnt signalling during swim bladder organogenesis could lead to improper swim bladder formation. The effects of two Wnt modulators IWR1 and IWR7 on gastrulation timing have been measured. Both levonorgestrel and 17α-ethinylestradiol also significantly downregulated the expression of wnt1 and wnt5b (β-catenin/Wnt transcription factors), but not the expression of the Wnt ligand wnt5b. Thus demonstrating that these compounds may be altering swim bladder inflation through a disruption of a β-catenin/Wnt signalling during early embryo development.

TH318

Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor

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Lemma minor is an aquatic plant commonly used in laboratory phototoxicity testing due to its rapid reproduction capacity, resource-effective exposure format and central function in the aquatic ecosystem. Several standard methods have already been adopted by international standardization organisations using this species as an ecotoxicological model. Although being highly useful for regulatory purposes focusing on traditional aquatic responses, there are some gaps in the information about the toxic mechanisms and modes of action (MoA) and rarely address complex environmental issues such as exposure to multiple stressors. The present study aimed to use selected functional assays in L. minor after exposure to 3,5-dichlorophenol (3,5-DCP) as a model to characterize the toxic mechanisms causing growth inhibition and lethality in primary production. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophylls content, reproduction rate and frond size are more sensitive to 3,5-DCP compared to other responses as well as reactive oxygen species (ROS) formation, lipid peroxidation (LPO) and impairment of photosynthesis efficiency. Principal component analysis (PCA) indicated that suppression of photosystem II (PS II) efficiency, electron transport rate (ETR), ROS production and LPO, pigments content and growth were strongly correlated while inhibition of oxidative phosphorylation (OXPHOS) which was more closely correlated with growth parameters. A set of conceptual Adverse Outcome Pathways (AOPs) were developed by using Bayesian network model to decipher the causal relationships studied in previous investigations. The AOPs could be used as a framework to direct future hazard and risk assessment of oxidative stressor-mediated adverse effects in ecologically relevant species.

TH319

Development of adverse outcome pathways for oxidative stressor-mediated reproductive effects in aquatic invertebrates

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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 toxicants can impact ROS generation and ROS-related damage. ROS can cause oxidative damage to lipids, proteins and DNA, as well as induce a range of adverse effects such as cancer, cardiovascular diseases, neurodegenerative diseases and many others. A set of oxidative potential 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 event (KE) relationships in the AOPs using the forecast predictor 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 membrane potential, BODA, and lipid storage, and abnormal ovary structures and oogenesis in D. magna, thus verifying several KEs in the conceptual AOPs. This study has for the first time systematically linked excessive ROS production to reproductive effects in aquatic invertebrates using the AOP concept, thus providing mechanistic knowledge for future hazard and risk assessment of oxidative stressor-mediated adverse effects in ecologically relevant species.

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 molecular 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 AOP is 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 BN model. In this BN version, the BN was run by changing DCP concentration and inspecting the changes in all subsequent nodes. Qualitatively, the model predictions were as expected: increasing the DCP concentration caused reduced OXPHOS, reduced ETR and reduced fronds number. For example, when DCP was increased from 1 to 2 mg/L, the probability of fronds number being in the lowest (worst) state increased from 6% to 30%. Fine-tuning of the intervals of some nodes is needed to make the BN more responsive. Moreover, we will use statistical approaches to obtain more credible CPTs, such as estimation of dose-response curves with uncertainty. Other planned developments include linking the AO to an endpoint with regulatory relevance, and linking the chemical stressor to an Aggregate Exposure Pathway.

TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effect copedia
J. Jeong, University of Seoul; N. Chatterjee, University of Seoul / Environmental Engineering; S. Choi, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering
Pulmonary fibrosis (PF) is a chronic and progressive lung disease where the scars are formed in the lung tissues and the air sac in the lungs (alveoli) becomes stiff leading to serious breathing problems. Several substances are identified as inducer of PF, but high cost of inhalation toxicity studies refrain to conduct systemic studies of all those substances. Hence, the regulations of these substances become obscure. To solve this problem, Adverse Outcome Pathway (AOP) concept has been emerged. AOP is a framework that organizes existing knowledge about linkage between molecular-level perturbation and an adverse outcome. To facilitate the development of AOP, OECD launches AOP knowledge-base (KB). In recent years, the application of quantitative AOP (qAOP) which provide dose-response and time-course prediction, has been gaining much more attention in regulatory decision-making field. To develop the AOP of pulmonary fibrosis, in one hand, we made preliminary AOP from literatures, which constitutes the PPARγ interaction as Molecular Initiation Event (MIE), Collagen activation, Inflammation and EMT-Fibrosis activation as Key Events (KEs), and Cytotoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelium cell (Beas2B). Beas2B cell was exposed to CMIT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis of the KEs was performed using Effectopedia platform of AOP-KB. For further study, we are planning to do various dose- and time response test (using qPCR and ELISA) for each potential KEs, so that we can integrate data for building qAOP model with the network between MIE-KEs-AO. Acknowledgment: This work was supported by a grant from the Korean Ministry of Environment through ‘Environmental Health R&D Program’ (201700137001).

TH323 Exploring Potential of Knowledge Databases for Adverse Outcome Pathway Discovery
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Adverse outcome pathways (AOPs) have potential to support and enhance the use of mechanistic data in regulatory decision-making. AOPs organize existing knowledge about relationships (Ideally causal ones) between initial chemical-biological interactions (molecular initiating events (MIEs)), intermediary key events (KEs), and adverse outcomes (AOs) relevant to risk assessment. Efficient ways of AOP development and weight of evidence assembly are lacking. This study evaluated potential of the existing knowledge databases (Unified Medical Language System - UMLS, and National Library of Medicine – NLM) for AOP discovery and development. UMLS contains more than 68-million relationships among more than 3-million unique biomedical concepts (or terms). The NLM literature database contains more than 100-million relationships among similar 3-million biomedical concepts extracted from the abstracts of more than 16 million biomedical journal papers. First, AOP network was downloaded and parsed from AOP Wiki (https://aopwiki.org/). We found that there are 3,084 relationships among stressors, MIEs (main initial events), KEs (key events), AOs (adverse outcome), stressor-chemicals, and stressor-events. High performance graphic processing unit (GPU) was used to determine which of 3,084 relationships can be found in hundred million of relationships in UMLS and NLM databases. 610 (20%) relationships were found in the UMLS database. About 1,837 (60%) relationships were found in the abstracts of 16 million biomedical papers on NLM. When combining our searches over both the UMLS and NLM databases, 1,983 (64%) relationships from AOP wiki were found; relationships in some sub-categories such as stressor-chemicals had much higher hit ratio - 78%. These findings indicate that AOP-discovery system that uses UMLS and NLM to predict new probable AOP relationships (that can connect to objects in the AOP Wiki) could substantially accelerate AOP development and contribute to weight of evidence analyses. The confidence of the predicted relationships could be calculated based on frequency of the relationships, whereas the quality of the predicted relationships could be further determined by running training deep learning models with knowledge curated in databases such as The Comparative Toxicogenomics Database, ECOTOX and ICSS ToxCast Dashboard.
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 discharges 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 presynaptic markers were studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (responsible for the inhibitory neurotransmitter GABA) and various drugs), synaptotagmin 10 (integral protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelination of axons and neuroprotection). The activity of acetylcholine esterase, enzyme that terminates action potential transmission in chemical synapses of cholinergic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin 3a and tachykinin 3b, GABA a1 receptor and synaptotagmin 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream, and significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603437.

MOPC02
Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model

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The alcoholic 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 macronutrients. However, the amount of vinasse used in the fertilization should not overcome the ion retention capacity of the soil, since the dosages should be directed to the specific characteristics of each soil. When used in unbalanced proportions can impair to the soils and the plants, and in addition to be able to reach water resources. Considering studies that prove the toxicity of vinasse in nature, the use of treatment systems has become quite interesting. The integration of systems such as natural attenuation, filtration and phyto remediation 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 can also act as bioconcentrators for transformation reactions that usually, occur in the rhizosphere of plants, are part of the alternative treatment for vinasse. Fish are excellent experimental models for aquatic toxicity studies because they warn of the potential danger of chemicals reaching water resources. Therefore, this study aimed to verify the efficacy of sugar cane vinasse treatment in reducing its toxic potential by histological and histochemical tests on tilapia gills. The animals were submitted to two different dilutions of the treated vinasse for 96 hours; after this period the gills were removed and submitted to standard histological routine. Morphological analyses of the gills revealed that the cellular pattern described for the species was not altered and histochemical tests showed a decrease on number of mucous cells, thus attesting to the decrease on toxicity of the treated vinasse. Thus, it can be inferred that integrated treatment systems were effective in reducing the polluting potential of vinasse, since the animals did not present histological changes.

MOPC03
Assessing toxic effects in the fish Violet Goby (Gobiobdices broussonetti - Gobiidae) from one of the most productive estuaries in Brazil

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The Pará-Araguaia-Lagoon Complex of Iguape (São Paulo – 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 (Gobiobdices broussonetti - Gobiidae) is a demersal fish of a social and economic importance to traditional fisheries. Over the last decade the regional disappearance of this fish species has been reported, including events of high mortality. The contamination by the RIR has been referred as one of the causes of the decline of that population. Therefore, this study aimed to observe possible toxic effects in G. broussonetti 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 cerebral AChE were lower in Subaúma in winter. Hepatic and renal GPx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxicity in the liver and blood in summer. In winter, nuclear morphology alterations were identified in erythrocytes more frequently in fishes of Cananéia. The results suggest that contaminants such as metals and HPAs previously reported in the sediments may have been stress this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall and the bioavailability of the contaminants may interfere in the responses. No significant antropic 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 Estuarine Lagoon Complex of Iguape (Pará, Brazil) is one of 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 (Gobiobdices broussonetti - Gobiidae) is a demersal fish of a social and economic importance to traditional fisheries. Over the last decade the regional disappearance of this fish species has been reported, including events of high mortality. The contamination by the RIR has been referred as one of the causes of the decline of that population. Therefore, this study aimed to observe possible toxic effects in G. broussonetti 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 cerebral AChE were lower in Subaúma in winter. Hepatic and renal GPx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxicity in the liver and blood in summer. In winter, nuclear morphology alterations were identified in erythrocytes more frequently in fishes of Cananéia. The results suggest that contaminants such as metals and HPAs previously reported in the sediments may have been stress this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall and the bioavailability of the contaminants may interfere in the responses. No significant antropic 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.

Poster Corner Abstracts
during late summer in 2017 to evaluate the status quo of the stream and the performance of the "Aachen Soerni" 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 and pesticides have been identified with anti-androgenic effects. However, due to the absence of medium-throughput in vivo assays for androgen axis disruption, the effects of many of these pesticides have yet to be confirmed in vivo. We developed a transgenic medaka line harbouring a portion of the spg11 gene promoter driving expression of GFP. We have previously demonstrated that this line is capable of correctly identifying androgens and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic stage 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 congenital malformations. The number of pesticides and chemicals identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput tool which can be applied within a variety of environmental scenarios in order to identify androgen axis disruption, such as environmental monitoring, identification of unknown toxicity drivers and testing of pure chemicals in a REACH context. In addition, this model, based on the use of early life stages non-compliant with the EU definition of a laboratory animal, provides ethical advantages in line with the three R’s principle of animal replacement.

MOPC06

Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae (Oncorhyncus mykiss) and liver cell line

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Waterborne and sediment samples collected in May (during spreading season). Different toxicity criteria as defined in the study, water column had been extracted by SPE (Solid Phase Extraction) method, and pollutants from 1 parcel on rainbow trout larvae (Oncorhynchus mykiss) and liver cell line (MOPC06) MOPC03 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 congenital malformations. The number of pesticides and chemicals identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput tool which can be applied within a variety of environmental scenarios in order to identify androgen axis disruption, such as environmental monitoring, identification of unknown toxicity drivers and testing of pure chemicals in a REACH context. In addition, this model, based on the use of early life stages non-compliant with the EU definition of a laboratory animal, provides ethical advantages in line with the three R’s principle of animal replacement.

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) are an environmental concern as resulting from both industrial processes and 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 ( < 5mm) and potentially nano plastics (< 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 microcrystals of PE with sizes between 0.7 μm to 3 μm. These particles were obtained by dissolving PE in chloroform using ultrasoundation. 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 (Twee60, Tween20 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

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Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradability facilitates accumulation of plastic materials 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 metals to the surface of plastic materials influence the sorption.

This study should provide a tool for predicting sorption behavior of MPs in the marine environment, and in particular, micronized tire rubber, in an effort to be a contributor of non-biodegradable pollutants, metals and additives. Hydrophilic persistent organic pollutants such as PAHs, PCBs, PBDEs, BPA, and hyaluronic acid were measured to establish the adsorption and leaching kinetics in seawater in situ conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by HPLC 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.

**MOPC11**

Crumb rubber in sports fields - Advances in environmental chemistry

D. Herzog, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; C. Halsband, Akvaplan-niva; L. Særensen, A. Booth, SINTEF Ocean / 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 facilitates accumulation of plastic materials 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 metals to the surface of plastic materials influence the sorption.

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**MOPC12**

Nonplastics analysis with Nano-FTR

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The distribution of microplastic particles in marine environments and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the macro scale. This hypothesis is supported by results of our group that were obtained from various environments (e.g. North Sea sediments and arctic ice). A mathematical extrapolation of size dependent particle abundances in the samples returns abundances of up to 3.6 x 10^13 m^3 for particles with diameters of 0.5 µm. This circumstance raises concerns as particlesaspectraoptics. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from sample instabilities and small aliquot sizes and does not provide the opportunity to simultaneously size and identify plastic samples. Nano-FTR is a novel technique combining the nanoscale local resolution of AFM imaging with near-field infrared measurements resulting in unprecedented material differentiation on a nanometre level. In our proof-of-principle study, we show measurements with defined nanoscale polymers. To demonstrate the detection of nanoparticles in environmental matrices we analysed samples obtained from arctic sea ice. The Nano-FTR 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.

**MOPC17**

Neonicotinoid insecticides in surface waters discharging into the Great Lakes of Southern Ontario, Canada

T. Sultana, Trent University / Environmental and Resource Studies; P. A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre Neonicotinoid insecticides (NNIs) are a large part of the global pesticide market, as they are very effective at controlling a wide range of insect pests. In Canada, NNIs are used extensively in agricultural regions of southern Ontario to control insect pests on field and greenhouse crops, orchards, nurseries and woodlots etc. Because of their persistence and high solubility in water, there is potential for NNIs to be transported from agricultural fields into surface waters. The objective of this project was to evaluate the distribution of NNIs in surface waters located in areas of intensive agriculture in southern Ontario, Canada that discharge into the Great Lakes basin; specifically into Lake Erie, Lake Saint Clair, Lake Ontario and Lake Huron. Passive sampling with Polar Organic Chemical Integrating Samplers (POCIS) was the principal monitoring technique. To correct for the effect of environmental factors on the rates of uptake of the target NNIs into POCIS, Performance Reference Compounds (PRCs) were spiked into some of the POCIS deployed at each of the monitoring sites. POCIS were deployed for 2 weeks over two treatment periods and grab samples of each of the surface water were also collected three times over the deployment period. The sites monitored were located in 5 major rivers and 11 smaller creeks in the Great Lakes basin. Static, renewal
experiments were conducted to estimate sampling rates of NNIs and to estimate elimination rates of PRCs. These experiments were conducted using synthetic water at 15°C over 14 days. Extracts were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) using an AB Sciex QTrap 5500 instrument with electrospray ionization coupled with an Agilent 1100 HPLC. Nine NNIs were detected, but the concentrations varied widely from 2 ng/L to 4.6 µg/L. Fluralaner and thiacloprid 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.

**MOPC19**

The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation

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Micropollutants such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) have been detected in all water compartments and the European Union is therefore updating its legislation to limit the release of emerging contaminants. Numerous micropollutants with the environmental engineering groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carboxyl, sulfonamide, etc.) tended to show poor removal under anaerobic conditions, pH 8, but 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.

**MOPC20**

Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream

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The widespread use of pharmaceuticals has caused a growing concern on the presence of pharmaceuticals such as the antibiotic ciprofloxacin (CIPRO) in the aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofluids (plasma and bile), metabolism and elimination of CIPRO in gilt-head bream (Sparus aurata), controlled dosing experiments for 8 days at 200 µg/L concentration were carried out. CIPRO was only observed in bile, probably due to its low octanol-water partition coefficient and the zwitterionic behaviour. CIPRO by-products (BPs) were also identified in seawater environment, both in presence and absence of fish. The analysis done by means of liquid chromatography–high resolution mass spectrometry permitted the annotation of up to 35 BPs of CIPRO in seawater and bile, from which 30 structures were reported for the first time. Up to 20 BPs were annotated in the absence of fish. The phase I degradations suffered by CIPRO in seawater were oxidation, methylation, oxidative defluorination (in 3 BPs out of 20), reductive defluorination (1 BP out of 20), dehydrogenation of the piperazinyl ring (in 2 BPs) and the cleavage of the oxazoline ring with (1 BP) or without (2 BPs) the loss of the primary amine formed during the cleavage. The only phase II transformation of CIPRO observed was BP18 that, apart from the oxidative deamination of the piperazinyl ring, also suffered the glyoxime 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 glyoxime and gluoxime 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-glucuronide conjugates were observed in bile BPs. This work was financially supported by the Ministry of Economy and Competitiveness through the project CMT2014-56628-C3-1-R. H. Ziaurieta 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 the extent to which these contaminants may have on local ecosystems and seafood production activities, and eventually on human health. To end this, an analytical method based on on-line solid-phase extraction-lurominated 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, acetanilides, acidic herbicides, oxadiazoles, carboxamides, benzoazinidazoles, nitriles, diphenyl 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 BECAS (grant number: CTM2016-75587-C2-2-R), and to Merck for the gift of LC columns.

MOPC22 Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montecagudo, University of Castilla-La Mancha; H. El-taliawy, Aarhus University / Department of Environmental Science; A. Durán, 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 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 $\text{SO}_5^2-$ (with no generation of the very effective $\text{SO}_4^-$ ). Sulfate and hydroxyl radicals were involved in the main reaction pathway of diclofenac. Diclofenac amide and three hydroxy-diclofenac isomers (3-hydroxy-diclofenac, 4-hydroxy-diclofenate) were identified as reaction intermediates. The obtained results demonstrated that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as diclofenac from wastewater.

Mercury Biogeoosciences - Fate, Effects and Policy (PC)

MOPC23 Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks

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The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce time-averaged concentration data over long deployment periods and are therefore particularly well suited for mapping gaseous Hg concentrations, identifying and locating unknown Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (GTA) in Canada and the Monte Amiata mining area in Italy to illustrate this approach to Hg source characterisation. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radial diffusive barrier to control uptake kinetics. 145 PASs were deployed across the GTA in July and August 2016 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km$^2$ 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 grid was sampled twice with one-month each. Mean gaseous Hg concentrations in downtown Toronto (1.42 ± 0.20 ng m$^{-3}$) reached as high as 12,500 ng m$^{-3}$. Concentrations were higher in July than in October. At both spatial scales, concentrations declined less steeply towards the East, consistent with prevailing westerly winds. Atmospheric emission from the mine was estimated to range from 50 to 100 kg annually. Clearly, the PAS’s ability to precisely and accurately discriminate small differences in gaseous Hg concentration (< 0.2 ng m$^{-3}$) across a wide range of concentrations, including at and near global background levels, enables the mapping of the spatial concentration variability and the identification, characterisation and quantification of both fugitive and major Hg emission sources.

MOPC24 Mercury trend as a possible result of changes in cod age distribution

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Mercury (Hg) enters the biosphere from natural and anthropogenic sources. Methylmercury is the most toxic form of Hg and has a high bioaccumulative potential, thus high concentrations of Hg may accumulate in fish tissue. Mercury in Atlantic Cod (Gadus morhua) is one of many things that are monitored through the Norwegian contribution to the Coordinated Environmental Monitoring Programme (CEMP) carried out by the Norwegian Institute for Water Research (NIVA) by contract from the Norwegian Environment Agency. CEMP is administered by the Oslo and Paris Commissions (OSPAR), and the results from Norway and other OSPAR countries provide a basis for a paramount evaluation of the state of the marine environment. Contributions from biomass burning to mercury emissions at Cape Point, South Africa

V.S. Somers et, CPUT / Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; L.G. Martin, South African Weather Service; C. Walters, CSIR / Natural Resources and the Environment

Mercury (Hg) is known to be a persistent and toxic heavy metal that can bio-accumulate in the aquatic environment and lead to serious human health effects. Hg is released into the atmosphere from both natural and anthropogenic sources, wherein the atmosphere it can be present in a gaseous phase or in particulate matter. Results of some work have been conducted in the Inner Oslofjord the emission of cod recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalised Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from provides a quantified assessment of the linear events from 2006 to 2017, sampling of larger fish. This again may result from changes in the population structure (e.g. repeated recruitment failure), or changes in sampling bias. These findings point to the need for uncovering the effect of cod length/age on the mercury concentration trends also on other localities along the Norwegian coast. The results from this analysis is now finalized and will be presented.
photodestruction 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 metal air pollution and its concentrations and thus lead to browning of freshwater and further inhibition to the photodestruction pathway at the base of the food-webs and the impact in the environmental systems.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (PC) TUPC01

On the risks from fungicides for aquatic organisms

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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 organism groups (microorganisms, plants, as well as invertebrate and vertebrate animals) with a particular emphasis on the functional and ecosystem level. Related contributions reviewed fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional interactions in aquatic fungal communities have been reported in field and laboratory studies. As fungi positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct effects of fungicides have been observed as antimicrobial toxic mode of action of the evaluated fungicide 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 toxicity, species, and exposure durations. In this study we evaluated the sensitivity and relative tolerance of non-target aquatic organism groups to fungicides. Fungicide compounds are routinely used in intensive agriculture production to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. In this study we evaluated the sensitivity and relative tolerance of non-target aquatic organism groups to the standard test species (Daphnia magna, Ochetorhynchus mykiss) and the most sensitive fish species to fungicides. Regardless of fungicide mode of action that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss these effects for several fungicide/mode of action groups that were identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.

MOPC27

Polymer inclusion membranes followed by X-ray fluorescence analysis as a new methodology for mercury monitoring in natural waters at low concentration level

G. Elias, University of Girona; E. Margui, University of Girona / Department of Chemistry; S. Díez, IDAEA CSIC Barcelona; C. Fontas, University of Girona / Department of Chemistry

At present, there is a considerable interest in mercury (Hg) monitoring due to its widespread occurrence and high toxicity of most of its compounds. Due to the low concentration levels, the complexity of some natural waters and the poor stability of the metal during sample storage, methodologies overtaking these problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide elasticity. The stability, versatility and easy manufacturing make PIMs as a useful separation technique to be taken into account. In this work, PIMs have been prepared fixing cellulose triacetate as the polymer and the ionic liquid trioctylmethylammonium thiosalicylate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were washed and incorporated in the energy dispersive X-ray fluorescence (EDXR) 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 ng Hg L⁻¹ in water. Moreover, no water matrix effects where 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 PIMs were considered 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

V. Yáñez, University of Geneva / Département FA Forel; M. Daam, New University of Lisbon / Department of Chemistry

Mercury (Hg) is a priority toxin of global concern, which concentrates in biota and biomagnifies in the aquatic food webs. However, mercury interaction with phytoplankton, central for its incorporation in the food webs, and in particular the role of dissolved organic materials (DOM) in modifying mercury bioavailability (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 proportionally to the fraction of the Hg being complexed by DOM. To get insight into the role of DOM in Hg uptake, C. reinhardtii was exposed to two concentrations of Hg in the presence of standard Suwannee River humic acid (SRHA) and in natural water rich in DOM from Onego Lake, Russia. Water was sampled from five sites representing the DOM gradient and was contacted with Hg in natural waters and, once the metal was collected, membranes were washed and incorporated in the energy dispersive X-ray fluorescence (EDXR) 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 ng Hg L⁻¹ in water. Moreover, no water matrix effects where 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.

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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 organism groups (microorganisms, plants, as well as invertebrate and vertebrate animals) with a particular emphasis on the functional and ecosystem level. Related contributions reviewed fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional interactions in aquatic fungal communities have been reported in field and laboratory studies. As fungi positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct effects of fungicides have been observed as antimicrobial toxic mode of action of the evaluated fungicide 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 toxicity, species, and exposure durations. In this study we evaluated the sensitivity and relative tolerance of non-target aquatic organism groups to fungicides. Fungicide compounds are routinely used in intensive agriculture production to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. In this study we evaluated the sensitivity and relative tolerance of non-target aquatic organism groups to the standard test species (Daphnia magna, Ochetorhynchus mykiss) and the most sensitive fish species to fungicides. Regardless of fungicide mode of action that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss these effects for several fungicide/mode of action groups that were identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.
TUPC03 Fungicide effects propagate through the detrital food chain in streams
J. Rasmussen, Aarhus University / bioscience; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; M. Skov Pristed, Aarhus University / Department of Bioscience
Fungicide use in Europe equals that of herbicides, but the amount of studies addressing ecological effects of fungicides is disproportionately low. Recent studies suggest that particularly freshwater fungicide may be susceptible to fungicide exposure leading to changed fungal community structure and reduced fungal biomass. These effects may negatively influence the food quality for higher level consumers, e.g. invertebrate shredders. Fungicides occur rather continuously in low concentrations in agricultural streams especially during cropping seasons suggesting that long-term chronic exposure scenarios should be covered in ecotoxicological research. We conducted a 5 month stream channel experiment using two environmentally realistic concentration levels of a quaternary fungicide mixture to investigate long-term effects of chronic fungicide exposure of a leaf decomposer assemblage containing fungal communities and two species of catastically shredders: Chaetopterus villosus and Anabola nervosa. Food availability was additionally manipulated ranging from excessive to limited food availability (three treatment levels). Fungal biomass significantly decreased with increasing fungicide concentrations, and the fungal community structure was significantly different in the highest fungicide treatment compared to the lowest fungicide treatment and the untreated control. Fungal species richness was consistently and significantly lower in the detrital food chain in streams at concentrations that are well below the Regulatory Acceptable Concentrations. Hence, supplemental ecotoxicity tests (e.g. based on aquatic fungi) are probably necessary for sufficiently safeguarding stream ecosystems in the risk assessment of fungicides.

TUPC04 Mitigation of fungicide exposure of stream ecosystems within agricultural catchments
M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences
Fungicides are a vital part of the agricultural pest management. As a consequence, fungicides – such as all pesticides – reach surface water bodies mainly through spray drift, row drift, and leaching. To mitigate fungicide exposure, a range of techniques have been developed based on certain assumptions. In this study, results of different fungicide spray drift models have been compared to determine the fungicide concentration at stream level under limited and adequate fungicide application. In the future, fungicide spray drift is a relevant source for fungicide exposure to aquatic ecosystems and should be considered in the risk assessment process.

TUPC05 Towards a better exposure assessment of antifungal azoles
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EAWAGEPFL; S. Fischer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; N. Munz, Eawag / Environmental Chemistry; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; S. Spycher, B. Spycher, Eawag Swiss Federal Institute of Aquatic Science and Technology; C. Stamm, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Tlili, Eawag / Department of Environmental Toxicology; J. Wittmer, Plattform Wasserqualität VSA; F. Meier; J. Hollender, Eawag / Environmental Chemistry
Antifungal azoles are a class of contaminants of emerging concern since increasing evidences highlight their potential effect on aquatic organisms at different trophic levels, raising the need to evaluate the associated environmental risk. Although a few of these compounds are routinely investigated, an accurate exposure assessment of most of them is still lacking to evaluate this risk. To address this issue, we first defined a list of 60 antifungal azoles including pesticides and pharmaceuticals based on the use/consumption of these compounds in Switzerland and Germany. We then performed a retrospective suspect screening on a set of data acquired with liquid chromatography-high-resolution mass spectrometry (LC-HRMS) from a large panel of environmental samples to complete previously targeted analyses on azoles. Since antifungal azoles are used both as pharmaceuticals and pesticides these samples included wastewater treatment plant effluents (WWTPs), river surface waters, biota from rivers (fish, gammarids, biofilms), river and lake sediments, soils and groundwater from various sites allowing to encompass different sources of anthropogenic pressures. The results revealed that antifungal azoles are widely distributed in aquatic ecosystems (e.g. from

TUPC06 Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems?
A. Dam, CENSE & New University of Lisbon, Lisbon; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology
In Europe, the EFSA Aquatic Guidance Document describes the procedures for the derivation of regulatory acceptable concentrations (RACs) for pesticides on the basis of tier-1 (standard test species), tier-2 (genotoxicity 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.

TUPC07 Ecotoxicological studies performed to assess the potential of a yeastlike fungus, Aureobasidium pullulans, and the response of evaluating authorities
C. Donat, bio-fem 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 fungus. Back then no methods designed for the evaluation of microorganisms as active substances did exist. Methods were based upon certain parts of OECD methods (Section 2) and some advise was found in the EPA OPPTS Series 855 Microbial Pesticide Test Guidelines published by US EPA. However, in some test systems it seemed appropriate to work with scientists of the university to find adequate solutions. Hence some additional “unconventional” results like the Flying doctors experiments with bees as well as an a

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (PC)

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Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (PC)

References:
scientific sound, since it is not predictable in which quantities, the microorganisms might or might not be present in the environment at certain time points after application.

**TUPC08**

**Ecological testing and risk assessment considerations for microbial active substances**

E.A. McVey, J. Wassemberg, CtgBy

For some types of biological pesticide active substances, the same testing schemes and methodologies as used for chemical active substances suffice. However, for others (for example, microbial active substances), the unique properties of the substances and resulting risk assessment questions result in the need for a different perspective on the appropriate testing guidelines and programs, as well as different considerations for the risk assessment assumptions and methodologies. Comparing and contrasting the risk assessment theories and available testing methods, it is clear that while some areas of the risk assessment can be translated between chemical and biological actives, the majority require unique and thoughtful innovations to address the risk assessment objectives. This is particularly well illustrated in the ecological risk assessment schemes for microorganisms, where testing should be performed under conditions such that both the (various) test organisms and also the microbial active are in an optimal environment. Unique and unknown mechanisms of action and toxicity may also present, and be dependent upon the exposure conditions. Similarly to chemical actives, exposure estimations with microbials are also highly dependent upon environmental conditions, however, microbial actives may have a much greater potential to increase above initial 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 utilised to advise more appropriate and adequate testing for microbial active substances.

**TUPC09**

**Health and environmental Risk assessment for microorganisms - to what extent?**


Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (SUD 2009/128/EC) strengthens 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 specifies the scope of the data required above and regulates the approval. Series of guidelines published by OECD, SANTE, or EPPO 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 which do not meet the acceptance’s criteria 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-microbial pesticides based on bacteria, fungi, viruses or protozoans as their active ingredients in biopesticide products are accompanied by guidance’s and models that are not developed for microorganisms. In order to address the data requirements in a feasible manner, the biological properties of the microorganisms have to be taken into account, instead of strictly applying to current test guidelines. It is important to note, that testing is strongly influenced by physico-chemical properties of mBCAs. Microorganisms, i. a. with frequently used co-formulants, are not soluble which results in alteration of the test conditions (i.e. turbidity, O₂ demand, spray layers). Furthermore, organic components of the formulated product (i.e. yeast, starch) may lead to increased fungal growth in soil or test media. Additionally, the need to test at high concentration levels, lead to negative effects of particles (i.e. spores or co-formulants like kaolin) on the test organisms which are not related to the active substance and are difficult to interpret. Differences between OECD and OCSP (formerly OPPTS) guidelines, and requirements of the analytical verification in the test medium are addressed as part of the development of alternative ecotoxicological testing approaches. The findings of our ecotoxicological expertise presented in this poster can be considered as basis for further discussion in proposing different test designs addressing mBCA and mBCP requirements.

**TUPC11**

**Microbiological Quantification Methods for MPCAs - Applicability to a Range of Microorganisms and Different Substances**

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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/3030/99 rev.4 and OPPTS 885.1400 (1996), but verification procedures need to be adapted on a case by case basis, as each microorganism possesses its own chemical properties and different growth conditions. Just as chemical methods, microbiological methods need to be robust, reproducible and specific. 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 greater 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 PCNs, HBCDs, Dechloranes, polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the maritime ecosystem in King George Island, Antarctica. The samples were collected in the Baton Peninsula in King George Island, Antarctica. From December 2013 to January 2014, and included Antarctic cod, icefish, limpet, amphipods, leopard seal, Gentoo penguin, Chinstrap penguin, kelp gull, and south polar skua. PCNs, HBCDs, Dechloranes, DDTs, HCHs, Pentachlorobenzene (PCBz), Hexachlorobenzene (HCBz), Chlorodanes, PCBs were detected in all samples, and the levels were the detection rates for the legacy POPs were more than 90 %, but those of some new POP compounds were only 50%. The detected POP levels in this
study were much lower than the levels in the previous study in low and mid latitude region, and even those in the Arctic. The trophic magnification factor (TMF) of each POP compound were calculated based on the ratio of stable isotope nitrogen and the log-transformed POP concentrations. Some of the compounds, OCPs, HBCDs and highly chlorinated PCBs and PCNs, showed significantly positive correlations, suggesting biomagnification of the chemicals. DPs, however, showed insignificant correlation with trophic level. After the trophic magnification analysis for aquatic and terrestrial food web models, TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of migratory animal, such as south polar skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Arctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranones, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranones, compexity of the food web structure, and the overestimation due to migratory animals arose the uncertainties in TMFs, and therefore need to be taken into consieration to interpret the TMF results in this study.

**TUPC19**

Bioconcentration as the predominant mechanism for fish PCB contamination in alpine lakes.

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Bioconcentration and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator-PCB concentration and liquid 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 δ15N and δ13C) and the influence of trophic parameters using δ15N and body size. Results showed a decrease of PCB burden in fish after the clean-up of the major input source of PCB in the lake and a steady situation since then. Arctic char was found to be significantly more contaminated than whitefish with a mean concentration of 25±132 ng g⁻¹ w/w and 45±28 ng g⁻¹ w/w respectively. Individual’s PCB contaminations in both species were not tied to feeding habitats (p>0.05). Trophic position (characterized with δ15N) was also not correlated with intra-species concentration variabilities for the char and was only slightly positively related to concentration variabilities for whitefish (p=0.04), dismissing the importance of biomagnification as PCB accumulation process. However, fish body size seemed to be a potential explanatory variable for individual’s PCB concentration discrepancies in arctic char (p=0.002) and whitefish (p=0.10). 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. Love, The Norwegian University of Science and Technology / Biology; N. Briels, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; T. Nygård, T.V. Johnsen, J.O. Bustnes, Innforge, Universitet of Antwerp / Biology; J. Halkoaho, University of Turku; M. Hattula, University of Turku / Toxicological Center; A. Covaci, University of Antwerp / Toxicological Center; A. Covaci, University of Antwerp / Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B.M. Jenssen, Norwegian University of Science and Technology / Biology; V. Jaspers, Norwegian University of Science & Technology / Biology. Occupying a high trophic level, the white-tailed eagle (Haliaeetus albicilla) can accumulate a wide range of organohalogenated contaminants (OHCs), even at an early age. Their diet consists mainly of fish and seabirds; thus, a long food chain potentially resulting in biomagnification of OHCs. The nestlings can be exposed to OHCs through maternal transfer from the egg, and later through the diet. As nestlings develop and grow, concentrations of maternally derived compounds are expected to increase for the biological development of age and increase in body mass when monitoring OHCs in nestlings. The aim of the present study was to investigate how differences between years, locations and dietary tracers can explain variation in OHC accumulation in plasma of WTE nestlings. Stable isotopes (SI) of nitrogen (δ15N) and carbon (δ13C) were used as proxies for trophic level and dietary carbon source, respectively. In addition, we included the possible confounding effects of age and body mass on the contaminant variation. Samples were obtained in 2015 and 2016 from 70 WTE nestlings from two archipelagos in Norway, Smøla and Steigen. In total, 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polybrominated diphenyl ethers (PBDEs) and 8 per- and polychlorinated substances (PFASs) were quantified in over 50% of the analyzed plasma samples at each location and year. The WTE is a marine top predator; however due to the topography of the island Smøla WTEs may feed on a mixed terrestrial and marine diet. According to our preliminary analyses, WTEs in Steigen are feeding on a slightly higher trophic level than WTEs in Smøla WTEs, and may consequently accumulate more of the investigated OHCs. Therefore, in our analyses the SI values were only important in explaining variation in ppQs but not PFAS levels. We also observed that age sampling is an important factor, as legacy POPs are decreasing while PFASs are increasing with age. However, there are differences between years at each location with higher OHC concentrations for Steigen in 2015 and Smøla in 2016, not explained by age or diet. Our analyses also demonstrate large variations within nestlings, suggesting that siblings may not always share prey. We therefore emphasize the importance of ecological and biological variables when investigating OHCs in an avian top predator.

**TUPC21**

Fate of PAH, phthalates and their metabolites in an urban river food web

M. Chevreuil, EPHE / UMR METIS 7619; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; P. Labadie, UMR CNRS / EPIC Universite Bordeaux / UMR 5805 EPoC.

Trophiic magnification factors have been extensively assessed for persistent organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Polycyclic aromatic hydrocarbons (PAHs) and phthalate plasticizers are continuously released in urban rivers and are rapidly metabolised and excreted by freshwater organisms, thus limiting their bioaccumulative potential. Abiotic and biotic samples, from primary producers to piscivorous fish, were collected in an urban river and analysed for PAHs, phthalates and their metabolites. Stable isotopes of nitrogen were used to determine trophic levels and to calculate trophic magnification factors (TMF) of each compound and its associated metabolite. Our results highlight a trophic dilution (TMF < 1) of all PAHs and phthalates, meaning that predators were less contaminated than their preys. When taking into account the associated metabolites, total body burden of PAHs still declined with increasing trophic levels, confirming the rapid transformation and excretion of these compounds within organisms and a very limited trophic transfer. In contrast, the level of phthalate compound and its associated metabolite(s) increased from prey to predators, suggesting a lower clearance rate of phthalates and a slight biomagnification potential across freshwater food webs. At the light of these results, it appears essential to consider phthalate metabolites, instead of phthalate diesters only, in environmental risk assessment.

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (PC)

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Bisphenol A (BPA) is a commercially important chemical used in the production of widely used epoxy resins and polycarbonate plastics and it is ubiquitous in the environment, resulting in widespread exposure of humans and wildlife. BPA was shown to cause reproductive effects via disruption of both the oestrogen and androgen signalling pathways. Recent studies suggest that BPA also affects epigenetic signalling pathways, including alterations in transcription of DNA methylation maintenance enzymes and altered DNA methylation profiles. This study aims to investigate how previous exposure of adult fish to BPA affects their response and the response of their offspring upon re-exposure, and whether there is an epigenetic basis for these effects. Breeding groups of zebrafish (Danio rerio) were exposed to 10 and 100µg BPA/L for 5 days, either once (C-10) or twice (10-10, 100-100) with a 13 day period of depuration in between, and appropriate controls were maintained in parallel. The adult gonads were sampled for transcriptional analysis. Reproduction was quantified over time, and embryos from each treatment group were then exposed to a range of BPA concentrations from 0-72hpf to measure their susceptibility to BPA exposure. There were no effects on reproductive output under our exposure conditions. However, at the transcriptional level, anti-Mullerian hormone (amh) was significantly downregulated only in fish receiving repeated exposures to BPA (100-100). In addition, embryos originating from adults which received a pre-exposure to BPA (100-100) were significantly more tolerant compared to embryos originating from...
naive adults which received a single exposure to BPA (C-100). This suggests that pre-exposure of adult fish leads to a protective effect on their offspring. We hypothesise that these effects may be due to physiological changes or epigenetic memory in the first and second exposure period, and we will now change the promoter DNA methylation of amth to investigate this hypothesis.

WEPC02
Zebrafish as a model to assess transgenerational effects of environmental stress via epigenetic inheritance
J. Kaatstra, 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 evaluate whether these effects are transferred across 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 zebrafish larvae, 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 also found in the parents such DNA damage. Follow up analysis in the second and the third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP. 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

WEPC03
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?
N. Horemans, Belgian Nuclear Research Centre (SCK-CEN) / Biosphere Impact Studies; C. E. M. Feys, SCK-CEN; M. Van Hees, SCK-CEN / Biosphere Impact Studies; S. Gaschak, Chornobyel Center; K. Nanba, Institute of Environmental Radioactivity; R. Nauts, SCK-CEN
In this study the impact on plants of long-term (transgenerational) exposure to radiation coming from nuclear accidents like Fukushima and Chernobyl is investigated and compared with lab experiments in either a chronic, acute, multi-, or single exposure. The transgenerational set up revealed that changes in DNA methylation could be the basis of transgenerational changes found in field or lab conditions. A field campaign was performed in both Chernobyl (CEZ) and Fukushima affected areas (FEZ) in the course of May 2016. Annual Brasicaeae 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. Seeds from Arabidopsis thaliana were harvested in the CEZ and grown for one clean generation under lab conditions to score for multigenerational effects. In addition further lab experiments were performed on wild type plants of Arabidopsis thaliana grown under chronic exposure conditions (at 1 mGy/h) or more acutely (20 to 400 mGy/h) for 14 days in one, two or three generations. Plants were scored for early flowering, photosynthetic performance, oxidative stress markers as well as germination rate and root growth. In general higher differences are found in plants exposed in a multigenerational setup than in a transgenerational one. The field plants did not show any abnormalities that could be correlated with the exposure gradient although some delay in flowering was observed in plants from medium and high radiation levels. The level of total DNA methylation could not be linked to the radiation gradient present in the field but rather to differences in developmental stage of the collected plants. In lab-exposed plants however global DNA methylation showed a significant increase which was both dose and generation dependent. Significant changes in transcription of methylation regulating genes were also measured in the different generations. Highest differences were present in the S1 generation but seemed to be reduced in the S2 generation. Overall the data hint towards a role of methylation in the response to radiation but its use as marker of exposure or in risk assessment needs further experimental evidence and discussion. This work was supported by European project COMET (7th PCRD EURATOM Contract Number: Fission-2012-3.4.1-604794) (www.comet-radioecology.org/egeneration).

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 palaeotaxonomic, palaeoecological, and palaeogenomic techniques to understand historical, current and potentially future trends in environmental contamination and associated impacts on lake systems. Long-term exposure to environmental contaminants can cause genetic adaptations in exposed populations of aquatic organisms. The new research fields of evolutionary toxicology and resurrection ecology offer powerful tools for the investigation of changes in sensitivities and adaptive trajectories of populations exposed to contaminants and environmental stressors over decades to centuries. Dormant resting eggs produced by Daphnia species (Crustacea: Cladocera) as a result of unfavourable environmental conditions are archived in sediments and can be dated and hatched to produce clonal lineages (i.e., same genotypes) of historical populations. This talk will present an overview of the evolutionary tools available and their current and future 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 evolution in response to changes in lab and environmental conditions. 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. Toxicological examinations and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

WEPC05
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations
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Organisms are rarely exposed to only one single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecking, reduction in gene flow of species to altered genetic diversity, or increasing mutation rate. Organic micropollutants such as pesticides, biocides, pharmaceuticals, personal-care products, or industrial chemicals are ubiquitous in the aquatic environment and their effects are considered a relatively new and emerging anthropogenic pressure over evolutionary processes, especially potential effects of pollutants on genetic population structure may be more disruptive regarding ecosystem functioning than individual-level effects. Despite the bunch of investigations on genetic variation in wildlife, our understanding about the individual stressor effects on genetic variation is still limited. Recently, there has been an increased interest to integrate environmental chemistry and evolutionary toxicology approaches into the assessment of direct and indirect effects of 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
D. Schulz, University of Aachen / Institute for Environmental Research, A. Brack, University of Aachen / Institute for Environmental Research, A. P. Inostroza, University of Gothenburg / Effect Directed Analysis, V. S. Borg, University of Gothenburg / Effect Directed Analysis
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
Dangerous misconceptions - Consumers need help!
U. Klawecka, University of Applied Sciences

Previous surveys revealed that average consumers and even more illiterate people are struggling with risk communication instruments for harmful substances in commodities. The majority of consumers do not understand risk communication instruments as intended by legislators or do not use them at all. In contrast, the present survey focused on 'best-case' consumers who are interested in the topic, have a good education or a good self-reported knowledge in chemistry. These 'best-case' consumers use preferentially hazard pictograms in accordance with the Regulation on Classification, Labelling and Packaging (86%) and reports in the media (80%) and information printed on the products (77%) to learn about harmful substances in consumer products. Surprisingly, smartphone applications (<10%) and information by authorities (14%) were not indicated as frequently used information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%) as trustworthy. Interestingly, the respondents considered legislators (94%), consumers (75%), manufacturers (71%) and environmental and consumer organizations (61%) as responsible for risk reduction. It is alarming that many of these 'best-case' participants assumed that food (up to 62%), products with an environmental label (36%), natural personal care products (36%), homeopathic products (30%), natural pharmaceuticals (26%) and products without hazard pictograms (11%) would not contain substances harmful for health or the environment. Nearly one out of ten respondents did not know that consumer products can contain harmful substances. These results show that motivation and knowledge in chemistry help, but are not sufficient. Consumers need support to understand risk communication instruments they need support to understand which products might contain harmful substances, they need support to determine the impact of harmful substances in commodities and they need support for suitable risk reduction behavior.

WEPC08
The European Union Observatory for Nanomaterials (EUON): A new platform for communicating information on the safety of nanomaterials

The REACH and CLP regulations are two key regulations addressing the manufacture and use of chemicals and the impact of these chemicals on human health and the environment. Although these regulations do not contain explicit requirements for nanomaterials, the regulations nevertheless address all chemical substances, including nanomaterials. In addition, over the past years, significant reformation on markets and safety aspects of nanomaterials in the EU market. In spite of this, there is a perception that there is insufficient information available in the public regarding the safety of nanomaterials. As a result, the European Commission entrusted ECHA with the creation, management, and maintenance of the European Union Observatory for Nanomaterials (EUON) [1] via a delegation agreement in December 2016[2]. The aim of the Observatory is “to give objective and reliable information on markets and safety aspects of nanomaterials in the EU market”. The presentaton will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments.
WEPC14 Improving transparency, consistency and efficiency of ecotoxicological testing: development of a tool for training in toxicology

C. Cesare, G. van der Steen, K. Hooijdonk, A. Bortolini, W. van Straalen, K. Summerford, University of Potsdam / Institute of Earth and Environmental Sciences (REFS), University of Potsdam (Germany). Key words: Emerging Contaminants, Technology-Critical Elements, raw materials, science animations, outreach

Although several textbooks are available, teaching environmental toxicology in general seems to suffer from a lack of a well-elaborated, up-to-date and consistent textbook that covers all aspects of the field. As a consequence, every university is developing its own training materials in addition to a textbook, but only little of this material is available online. And if materials are online, they are not consistent, lack novelty or do not cover the entire field. A Dutch consortium therefore took the initiative to develop an open online textbook on Environmental Toxicology that should cover the field in its full width, including aspects of environmental chemistry, ecotoxicology, toxicology and risk assessment. The initiative is sponsored by the Netherlands Ministry of Education. The project aims at developing an open online book on Environmental Toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way. Each module having a clear training goal/assessment level and finished 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 17 members from 10 Dutch universities, 12 experts in environmental toxicologists and chemists from six Dutch universities, does not possess all expertise to cover the width of the field. We therefore solicit contributions from as many colleagues as possible from within the SETAC community. With that, we hope we can produce a book that is written and supported by SETAC, that is covering the entire field, and is useful for training within e.g. the SETAC Europe Certified Risk Assessor (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.

WEPC15 Policy learning through professional forums in the field of environmental toxicology: What role for the Society of Environmental Toxicology and Chemicals (SETAC)?

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Leveraging more than a hundred years of experience and knowledge (Gallo 2008), modern toxicology has crystalized in a set of highly codified and standardized practices that are used by industry and regulatory agencies internationally to assess the risk of chemicals to the environment. Toxicity testing methods used 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 methods are time consuming, and require the 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...
vitrino cell- or genomics-based testing strategies (Waters and Fostel 2004). For more than a decade, these alternatives have been discussed and debated in a range of high profile forums (National Research Council 2007) as offering potential answers to the various challenges facing chemical risk assessment. However, the accepted regulatory approaches to determining the risk of chemicals in environmental toxicology have remained, for the most part, unaffected. This poster explores the role of SETAC in policy learning using primary survey data collected from participants in previous SETAC forums. We will summarize the instrumental and core policy beliefs concerning alternative testing methods of respondents and assess their self-reported policy learning experiences at SETAC. We will then consider the significance of SETAC as a professional forum through which policy actors learn and adapt to emerging challenges in regulatory science.

WEPC16
SETAC Science and Risk Communication Interest Group
T. Seiler, RWTH Aachen University / Ecosystem Analysis

Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WEPC17
Biochar-mortar composites for construction materials
S. Oh, T. Seo, University of Ulsan / Department of Civil and Environmental Engineering; Y. Seo, University of Ulsan / Civil and Environmental Engineering

Feasibility of biochar for construction material was examined through synthesis of biochar-mortar composites and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar composites showed that 3-5% biochar inclusion did not significantly change their flowability, compressive strength, and thermal conductivity. As biochar content increased in biochar-mortar composites, benzene concentration in air was accordingly reduced, suggesting that biochar may be favorable to remove toxic contaminants causing sick building syndrome. Toxicity characteristics leaching procedure (TCLP) and Micotox 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. Schuermann, 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 semiconductor. Dwindling resources and growing demand necessitate new recycling strategies and the reassessment of existing repositories in the light of newly developed technologies. In this context, QSAR methods can be utilized in the development of chemical affinity toward strategic elements. Through this, novel ligand concepts can be rapidly assessed and synthesis can be prioritized towards 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 and Ge complexes. Following a first principles approach, both Density Functional Theory and higher levels of theory have been used for the calculations, also addressing bulk solvation effects. The study focuses on both affinity and selectivity. General trends in binding affinity to selected ions are discussed as related to the electronic structure of the compounds. Chelator selectivity toward In\(^{3+}\) and Ge\(^{4+}\) is investigated in comparison to Fe\(^{3+}\), Fe\(^{4+}\), Cu\(^{2+}\) and Zn\(^{2+}\). The importance of both properties arises from expected high concentrations of these interfering ions relative to the strategic elements of interest. Financial support from the Krüger Research School “Biohydrometallurgical Center for Strategic Elements” BHMZ (Nr. 02110205) is gratefully acknowledged.

WEPC19
Cellulose Nanofibers as building blocks for innovative materials for remediation
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From the point of view of circular economy cellulose is one of the most interesting biopolymer since it derives from renewable sources which, thanks to its peculiar structural properties, it is widely used in the design of simple and advanced materials for different applications. Recently, cellulose nanofibers (CNF) were proven to be versatile building blocks for many preparations. The regioselective oxidation of the C6 primary hydroxyls of the anhydroglucose units, catalysed by TEMPO in the presence of the NaBr/NaClO oxidant system, leads to the formation of TEMPO-oxidized CNF (TOCNF), conferring to the cellulose many interesting properties.\(^1\)\(^2\) We recently report the synthesis of sponge-like nano-structured materials by cross-linking TOCNF and branched polyethyleneimine (bPEI).\(^3\) These new materials were fully characterized from a chemical, structural and mechanical point of view. Quantitative information on their inner microstructure were collected by Micro-Computed Tomography (μ-CT) analysis.\(^4\) In addition the material can be easily modified in order to introduce additional chemical or structural properties. As an example, by functionalizing the bPEI with pNO\(_2\)-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective sensing of fluoro anions.\(^5\) Furthermore, the addition of citric acid (CA) as co-crosslinker enforce the mechanical and structural performances.\(^6\) Another application of bPEI-TOCNF sponges is the controlled release of active principles. They have been used it for adsorption and release of two model drugs, amoxicillin and ibuprofen. The material showed very good performances in adsorbing both model drugs (~200 mg g\(^{-1}\)) from methanol solution. Interestingly, the presence of CA lead to slower kinetic release in aqueous environments if compared with materials obtained without CA.\(^7\) The ongoing NanoBionD 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. p-nitrobenzenesulfonate).\(^8\) It is also known regarding the effects in obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri) and cyanobacteria (Arthrospira maxima), microalgae (Trichodesmium gibba, Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii, Paracentrotus lividus), polychaete (Hediste galloprovincialis), polychaete (Eisenia fetida), crustaceans (Acartia tonsa, Artemia salina and Palaemon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were noted in bivalves and polychaetes. We predicted no-effect concentration (PNEC) of Zn-Al LDH for seawater was set at 0.2 μg/L, based on the lowest NOEC available (Martins et al. 2017). The results suggest that Zn-Al LDH is a promising engineered nanomaterial featuring a very low environmental hazard.

WEPC20
Zn-Al layered double hydroxides: a promising eco-friendly engineered nanomaterial
R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Figueiredo, University of Aveiro / Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Tedim, University of Aveiro / Department of Materials and Ceramic Engineering CICECO; S. Loureiro, Universidade de Aveiro / Biology

Layered double hydroxides (LDH), also known as anionic nanoclays, are a class of inorganic engineered nanomaterials with a plate-like structure featuring a lateral size of 20–40 nm. LDH are characterized by positively charged metal hydroxides (e.g. Zn\(^{2+}\), Al\(^{3+}\)), stabilized by anions (e.g. NO\(_3\)) and water molecules between layers. LDH have remarkable characteristics: non-chemical properties, nanometric size, high surface area and stability. The safe-by-design structure and composition as well as the properties of Zn-Al LDH have led their use in several industrial and material engineering greener applications, as well as in medicine and pharmaceuticals for a safe controlled release of drugs. Despite LDH have been regarded as having low toxicity to humans/organisms,\(^9\) it is known regarding the effects in obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri) and cyanobacteria (Arthrospira maxima), microalgae (Trichodesmium gibba, Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii, Paracentrotus lividus), polychaete (Hediste galloprovincialis), polychaete (Eisenia fetida), crustaceans (Acartia tonsa, Artemia salina and Palaemon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were noted in bivalves and polychaetes. We predicted no-effect concentration (PNEC) of Zn-Al LDH for seawater was set at 0.2 μg/L, based on the lowest NOEC available (Martins et al. 2017). The results suggest that Zn-Al LDH is a promising engineered nanomaterial featuring a very low environmental hazard.

WEPC21
Studying microfibre release from textiles towards improved clothing design
R. Johansson, Helly Hansen; S. Kubowicz, SINTEF Materials and Chemistry; I. Yousef, S.W. Haugen, Helly Hansen; A. Booth, SINTEF Ocean / Environmental Technology

Clothing manufactured from synthetic fabrics such as polyester and nylon can release hundreds of microfibres to waste water systems when washed in domestic washing machines. Fleece fabrics have been of particular focus, however, fleece clothing can be made from a wide variety of different fabric constructions, which may exhibit different microfibre release characteristics. Mechanical and chemical finishing of the yarn and fabric will influence the size and
volume of the microfibres released. In the current study, we assess the release of microfibres from different fleece fabrics with the aim of identifying production methods and fabric properties that release the fewest microfibres during domestic washing machines. A filter unit consisting of a 300 µm filter and a 100 µm filter in series was connected to the effluent pipe of a domestic washing machine. Each fleece test fabric (140 cm x 90 cm) was prepared by overlocking the edges to prevent 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-weighted sub-sample of the microfibres. Preliminary results show that ~80-90% of fibres in the effluent water are trapped by the 300 µm filter. Furthermore, the fibre release declines with successive washings. A detailed study of the underlying mechanisms is currently ongoing and the results will be used as a basis for ranking.

WPEC22 Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)


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 (SiO$_2$-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO$_2$-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO$_2$-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substances for conventional pesticides, the broadspectrum fungicide tebuconazole was tested. Seed germination and infection tests, and a plant growth test were conducted. The Si was quantified by inductively coupled plasma – optical emission spectroscopy (ICP-OES). Beneficial effects of SiO$_2$-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)$_4$) acting as a phytostimulative micronutrient. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops.

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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. Laurena, 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, several Italian companies of pasta producers (Barilla, Pasta Zara and Garofalo) decided to be directly part of the Technical Secretariat. The proponents of the pilot for pasta together represent about the 30% of the total production of pasta in the European Union. The PEF pilot, while encouraging the development of sustainable production all over the supply chain from farm to fork, enhances fair competition across the EU to determine reliable and transparent indicators of environmental impact. Setting up and validating the developments process of product group-specific rules (PEFRC), 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 in collaboration with stakeholders. The secretariat sees the PEF pilot as a big opportunity for the pasta sector since there are some pasta producers that already measure and communicate the environmental impacts through voluntary certification schemes. A methodology promoted by the European Commission can encourage other producers to communicate the environmental footprint of their pasta, making PEF a tool able to increase competitiveness with important benefits for sustainable agriculture and food production. This approach would be good also for consumers. Giving people reliable and comparable information about the environmental impacts and creating sustainable products and organizations would chose those 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 addressed rules and hypotheses in the PEF pilot documentation have been established through 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 methodolgy and tool development

H. Bosch, DSM Nutritional Products; A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH; F. Ziegler, RISE Research Institutes of Sweden

In combination with vegetable crops enables growth of salmon aquaculture that is independent of limited 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 can provide a competitive alternative, 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

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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, while 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 noncommunicable diseases related to low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in an example of whole grain consumption. Results show that for individuals under-consuming whole grains (less than 125 grams daily), for every 1 micro disability adjusted life year (µDALY) increase in production impacts, there is a health benefit of 141 µDALYS. Similar results were found for all
dietary risk categories in which under-consumption of a particular food group was considered a dietary risk. In cases where overconsumption poses a health risk, as is the case in certain meats, sodium, and sugar sweetened beverages, a 1 µDALY increase in production impacts is associated with increases in health impacts to varying degrees, ranging from 1.2 µDALYs for red meat up to 36.8 µDALYs for sugar sweetened beverages. This study found that for most of the dietary risk categories, health impacts due to consumption far outweighed the environmental impacts (measured in terms of µDALYs), however this study did not include environmental impacts as they are related to other impact categories such as ecosystem damage and resource depletion, which must also be considered to fully capture food production impacts.

WEPC27
What not to waste? Improving decision support for Food Loss and Waste (FLW) mitigation by considering food security and environmental sustainability
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LCA-based methods provide evidence of the largescale environmental impacts of food production. Nearly a third of food produced is lost or wasted, meaning production impacts occur with little to no societal service. The primary focus of response e.g. the UN SDG 12.3 has been on avoiding food loss and waste (FLW) quantities, for example halving food waste by 2030. Decision-makers, thus may prioritize FLW mitigation based on quantity, economical gain, and ease of implementation. To support multi-criteria sustainability decision-making we develop a framework and perform a global screening to prioritise FLW mitigation efforts based on two material issues: environmental impacts and nutrition security. LCA-based methods quantify environmental impacts related to FLW streams, and nutrition and global burden of disease data are used to quantify nutrition security. A global screening of FAO data on food production, supply, and FLW for various food categories (e.g. grains) is performed in 15 countries. Results demonstrate vastly different environmental impacts and nutrition security potential associated with various FLW streams. The results suggest that there is sufficient production of most nutrients globally, suggesting that in most cases food systems do not need to grow, but need to be optimized to reduce FLW and offer appropriate regional supply.

WEPC28
ARIADNA Project. Analysing the sustainability of implementing a mandatory Deposit-Refund System in Spain
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There is currently an ongoing debate in some Spanish regions on whether the implementation of a mandatory deposit-refund system (DRS hereafter) would be appropriate. A DRS can be simply defined as a system in which consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. This is a system in place in some European Countries such as Germany, Finland or Denmark whereas others such as France or the UK have refused its implementation. From a regulatory point of view, the Spanish Law 22/2011 (which transposes the correspondent European Directive 2008/98/CE), clearly states that the implementation of a DRS should be based on the analysis of its technical and economic feasibility, a set of environmental, social and human health impacts and must ensure the proper functioning of the internal market. The study presented here follows this regulatory framework, analysing the sustainability of implementing this new system, combining environmental, economic and social studies in order to get an holistic picture of its feasibility. In particular, the following methodologies were used: (1) Life Cycle Assessment (LCA) for the environmental study; (2) Classic Cost Accounting for the economic study and (3) Social Footprint and Quantification of the Integrated Social Value for the social study. All of them applied using the same data, system boundaries and modelling restrictions. The study clearly concludes that the introduction of a DRS in Spain, under the studied conditions, is not advisable. This is because: a) according to several environmental indicators, although it could achieve an improvement in the overall recycling rate, it carries a higher environmental impact, mainly due to the duplication of collecting systems and the increase demand in transportation; b) represents a 4.6-fold increase in the economic cost to society (11 times if we only consider the management of DRS containers); and c) from a stakeholders’ point of view, it will have a significant increase both in space and time needs, and it will cause a higher Social Footprint.

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Uncertainty.

Urban.

Waste water.

Water quality.

Weight of evidence.

Wetlands.
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