Microplastics in food and beverages - a distorted perspective on risk

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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?**
Bernhard Urf, University of Bergen, Centre for the Study of the Sciences and the Humanities, Norway

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

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

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

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

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

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

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

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

During the 1920s, mutation research was put on a firm basis by H. J. Muller, who developed the concept of “mutation rate” and devised quantitative techniques for its measurement. These techniques allowed the discovery of the mutagenic action of ionizing radiation and paved the way for the pioneering work of C. Auerbach on chemical testing, starting with mustard gas. Since that time, the recognition of genotoxic agents has developed with manufacturing operations.

**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 freshwaters, 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 cyanobacteria only to represent all bacterial diversity. The activated sludge respiration inhibition test (ASRIT), used to identify risk to microorganisms in sewage treatment plants has also been proven to be insensitive for antibiotics. Thus, there is concern that the ERA for antibiotics does not fully consider their potential impacts on microbial community structure, function and resilience. In addition to the risk posed to ecosystem function there is a global concern on antimicrobial resistance (AMR) development and the associated risk to human health. It has been proposed that the risk of AMR development in the natural environment should be included in ERA but there is currently no standard experimental methodology or framework to address this. Recently, a theoretical approach that makes use of minimum inhibitory concentrations (MIC) of clinically relevant bacteria (CRB; using the European Committee on Antimicrobial Susceptibility Testing (EUCAST) database) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species and: 3) how a PNECR relates to the PNEC derived for surface waters (PNECSW) using standard ecotoxicity testing. This presentation will describe (i) the output of this analysis of protection goal data and (ii) how the wider pharmaceutical industry are addressing concerns with antibiotic residues associated with manufacturing operations.
Platform Abstracts

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

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


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

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

C. Poirier, BASF SE; Z. Guo, Bayer AG Crop Science Division; M. Lamshef, Bayer CropScience AG / R&D; M. Reitz, H. Ressler, Syngenta Agro GmbH; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; P. Sweeney, Syngenta; P. Volz, BASF SE; S. Webb, Syngenta Ltd; B. Zillgens, Dupont GmbH

A novel study design to determine plant uptake of chemicals for environmental fate modelling was developed and tested in a tiered approach. Ten laboratory 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: TSCF value for CFK of 1,2,4-triazole from the simplified model of Briggs et al. (1982) and the substance specific TSCF value from “uptake experiments with appropriate and agreed set-up to be developed” (EFSA, 2013; EU Com, 2014). The presented study design was explicitly developed to address the need identified by EFSA and was based on suggestions from the EUregPUF workshop (York, 2015) where participants from academia, authorities and industry met to establish an up to date understanding of plant uptake science. Lessons learned from the testing and continuous exchange with academia and authorities facilitated optimisation of the study design. The current version of the study design is considered appropriate to produce reliable data on plant uptake to be used as input for refined exposure modelling. An explicit guidance, however, on how to integrate the requested study design into the regulatory process is still lacking.

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

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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 A rigid approach is provided to data in study designs. The SETAC EMAG-Pest GW group (a mixture of regulatory, academic, and industry scientists) in 2015 began developing the scientific basis for guidance for use by regulators and industry scientists. Rigid study designs are not appropriate since the study design needs to be tailored to the specific study objectives and should consider environmental conditions, the properties affecting environmental behaviour of the substance being studied, and site and use conditions. To illustrate how study design can vary, the group has proposed general study designs for seven hypothetical exposure assessment options, ranging from protecting all zones of saturation below the soil surface to only groundwater used to supply drinking water. Designs include recommendations on in-field and edge of field studies, as well as studies focused on catchments and aquifers. Examples of protocols 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 method used in the EU regulatory leaching assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a single first-order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstone of the EU regulatory leaching assessment. This approach 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 homogeneous soil profile with pesticide properties that are constant with death and assuming a constant water flow rate and a constant volume fraction of water (other called ‘simplified Freundlich-leaching 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 ever pass. Simulation of exposure of F for a few FOCUS groundwater scenarios were compared to this effect on the percentage leached with this simplified model and qualitatively these effects were found to be similar. Next it was shown that this finite penetration depth after infinite time in the simplified Freundlich-SFO system increases slowly when \(N\) increases from 0.5 to about 0.85; however, when \(N\) approaches 1, this finite penetration depth goes to infinity. This was expected because this finite penetration depth does only occur in a system with a Freundlich isotherm and not in a system with a linear isotherm. It was checked by inspection of a concentration profile of one of the FOCUS groundwater scenarios that these scenarios also show a finite penetration depth for low \(N\) values at the end
5 Bespoke monitoring to support Tier 4 FOCUS groundwater assessment
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Data generated from this bespoke groundwater monitoring programme will offer a solution to address the non-relevance case of pinoxaden metabolites from an exposure side. Median modelled mass flux was determined using GeoPEARL 3.3.3 simulations over 20 years which represent vulnerability to leaching across the EU27 under standard conditions. These data were aggregated to a 10km² level and combined with a shallow groundwater dataset and a cereal land use dataset based on wheat in CAPRI. Those grid cells in the upper 50th percentile for each spatial layer (mass flux, shallow groundwater, and wheat) were considered for the site selection process. Sites identified by modelling were assessed during site walkover surveys. To justify inclusion in the programme, sites had to have a history of pinoxaden use, groundwater less than 10m bgl, no confining layers, and no influential features which may act as preferential flow pathways. In 2015, 70 sites were installed across France, Germany, Italy, Lithuania and the United Kingdom. Each site consisted of three shallow wells installed around the field perimeter. The 70 sites represent all EU FOCUS groundwater scenarios except Jokioinen. The sites have all had a 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 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
A. Paulus, UFZ - Helmholtz Centre for Environmental Research / System-Ectotoxicology; S. Kullmann, K. Foit, Helmholtz Centre for Environmental Research UFZ / System-Ectoxicology; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Liess, UFZ Centre for Environmental Research / System-Ectoxicology
European Union member states aim at reducing ecological risks exerted by pesticides. For this, reliable trend indicators of pesticide exposure and risk are inevitable. Based on this demand we designed a long-term trend indicator of aquatic pesticide risk for Germany. It uses pesticide sales statistics, toxicity data and chemical properties as input variables. The trend indicator was designed by combining the most reliable exposure and effect models. (i) We selected the most from a mimic 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 EXPOSITIVE/ERA (R²: 0.38), followed by the more complex models FOCUS STEP 2 (R²: 0.36), SYNOPT-TREND (R²: 0.24), and GERDA (R²: 0.24). (ii) The translation from toxic pressure to pesticide risk was implemented by applying the field based and validated exposure – response relationship SPEARwater. 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.

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

7 The hydrophobicity delay: symptoms and solutions
A. Celise, Queen’s University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemistry
The objective of this presentation is to set out the conditions under which chemicals of high hydrophobicity are significantly delayed 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 formed common applied to fish biomagnification from water of concentration Cwater to fish concentration Cfish is kfish is kfish/BCF where BCF is the bioconcentration factor. The characteristic time for uptake and loss t is t = Kfish/Kc. Slower uptake and loss will occur if the partition ratio Kc is large, and the fish must contact Kc-L 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 biouptake model for fish. Due to the very high hydrophobicity (log Koc=10²) for D5 and very low water solubilities Cw must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated ~2000 days, to get Cw=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 approximated when log Koc=10² developed and any uptake of hydrophobic chemicals by foliage. This model shows levelling off corresponding to insufficient time to achieve equilibrium. A kinetically limited regime is reached at a Kc=10². 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.

9 Trophic magnification of cyclic volatile siloxane materials (D4, D5, and D6) in a freshwater lake: A Monte-Carlo analysis
The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk of these compounds. In freshwater ecosystems, cVMS specifically octamethylocyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5), and dodecamethylcyclohexasiloxane (D6) was determined for the Lake Pepin, Minnesota (USA) food web. The objective of this work was to determine if cVMS materials are biomagnified in this freshwater ecosystem. To determine whether the benthic influence in the Lake Pepin aquatic food web affected the trophic magnification factor (TMF) values for the cVMS compounds, a companion study was conducted to determine the biomagnification and TMF value of a reference material, 2,2',3',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard
methods involving feeding guild, trophic guild classifications, and the stable isotopes of nitrogen (d15N) and carbon (d13C) to estimate trophic position/carbon flow. The aquatic food web consisting of two benthic macroinvertebrate species and 15 fish species was evaluated for trophic magnification of cVMS materials and PCB-180. Lipid-normalized concentrations of D4, D5, and D6 were greatest in the lowest trophic levels and significantly decreased going up the food web, with the lowest concentrations being observed in the highest trophic levels. The TMsF measured for the three cVMS materials were all99% of the uncertainty for cVMS TMsF 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. TMsFs for the cVMS chemicals and PCB-180 were determined using a Monte–Carlo probability analysis technique, and the likelihood that the values exceeded unity was less than 0.5% for all three cVMS compounds and >99.5% for PCB-180. This evaluation indicates that D4, D5, and D6 do not biomagnify in the benthic–dominated Lake Pepin aquatic ecosystem, a food web which does demonstrate biomagnification of the legacy contaminant, PCB-180.

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

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

The present study reports the discovery of a suite of polyhalogenated carbazoles (PHCZs) in aquatic sediments collected from four watersheds located in the United States and China, including the Gulf of Mexico (USA), San Francisco Bay (USA), Lake Tai (China), and Lake Dianshan (China), and their bioaccumulation in the San Francisco Bay ecosystem. A total of 11 halogenated carbazoles, including 3-chloro, 3,6-dichloro, 1,3,6,8-tetrachloro, 2,3,6,7-tetrachloro, 3-bromo, 2,7-dibromo, 3,6-dibromo, 3,6,9-tribromo, 1,3,6,8-tetrabromo, 1-bromo-3,6-dichloro, and 1,8-dibromo-3,6-dichloro-carbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantification to 515 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 composition differed among species, suggesting that individual congeners may be subject to different bioaccumulation or metabolism in species occupying various trophic levels in the studies system. Toxic equivalent (TEQ) values of PHCZs were determined on the basis of their relative effect potentials (REP) compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The median TEQ ranged from 4.8 to 19.5 pg TEQ/g lipid weight in biological tissues. Our data demonstrated the broad exposure of PHCZs in the studies systems and potentially in global aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

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

C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACE5); M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry

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 substances (NCS) under t...
framework in the daily practice of LCA practitioners needs further work, including implementation in LCA software programs and particularly data.

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

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

Which impact categories are relevant for LCA results interpretation?
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LCA is intrinsically a multicriteria approach comparing (almost) all the potential environmental impacts of human activities. However, multicriteria decision poses 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 R-vector space. This vector space is generated by all the dimensions (i.e. elementary flows) from which the LCIs of the database can be developed. The RI is a proximity measurement between the 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 to as scenarios for the treatment of residual household waste in the municipality of Copenhagen in 2025 were used to test this methodology. The results show that the RI may be useful for comparing the impact categories belonging to the same LCIA method, but that the RI is not a suitable measure for comparing impact categories belonging to different LCIA methods. Further research is needed to assess the relevance of the RI in other cases of LCIA methods.

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

18 Poster spotlight: MO387, MO388, MO389
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (I)

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

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Pollution of aquatic ecosystems with emerging organic contaminants (EOCs) has been intensively studied over the past decades. The vast number of EOCs and their occurrence in complex and variable mixtures is a major challenge for monitoring, risk assessment and management and is beyond the scope of target screening. Thus, novel approaches are needed to characterize these mixtures and identify unknown EOCs including transformation products and natural background. In this study, we propose a novel workflow for unravelling pollution patterns along a river course identifying longitudinal dynamics of pollutant groups, entry pathways and the fate of EOCs along the river course using non-target screening by LC-HRMS and cluster analysis. Sixteen grab samples were taken along the 42 km-long course of the Holtemme River (Saxony-Anhalt, Germany), whereas the first sampling in the national park marked a reference point for pristine conditions. Chemical screening was performed on an UltiMate 3000 LC system (Thermo Scientific) coupled to a high-resolution quadrupole hybrid quadrupole - Orbitrap MS (QExactive™Plus, Thermo Scientific) with a heated electrospray ionization source. MS/MS analysis was performed in a full scan experiment (100-1000 m/z) at a nominal resolving power of 140,000 at m/z 200. Peak extraction including peak picking, gap filling, componentization and target annotation was implemented in R. Cluster analysis was performed using the R package ‘kml’. Four clusters were suggested for the data set representing A: EOCs from treated wastewater input of the two wastewater treatment plants (WWT), B: EOCs specific for first WWT due to specific local emissions, C: EOCs from diffuse (i.e., agricultural and urban surface run-off) and small point-source input (e.g., rain sewers and creeks) and D: low continuous background signals. The identified patterns gave insights into the spatial dynamics of complex chemical mixtures along a river course, highlighting differences in point-sources and areas governed by diffuse input and identifying points of complex mixtures of mixtures (e.g., first WWT). Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

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

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The Holtemme River is the ultimate sink of most of the organic synthetic compounds produced and consumed by humans. Among the different pollution sources affecting this environment, discharge of treated and untreated sewage from mainland is of high relevance due to its continuous input, high volume and poor efficiency of conventional wastewater treatment plants (WWT) to remove many potentially harmful substances. Even after dilution, some of these contaminants may still be detected at low concentrations (ppt-ng/l), 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 WWT 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 (e.g., deconvolution techniques) to tentatively and reliably identify more than 1800 compounds and features persistent enough to be also detected in oceanic waters. These compounds included different classes of surfactants (e.g., linear alkylbenzene sulfonates) and their byproducts (e.g., DATS) and metabolites (e.g., NPEC), polymers (PEG, PPG and many ethoxylated derivatives), pharmaceuticals (e.g., valsartan, diclofenac, carbamazepine, etc.), personal care products (UV stabilizers) and food additives (e.g., sucralose), some of them (e.g., sulfats) 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, ketoconazole, cycloheximide, and sucralose. Except caffeine and DEET, concentrations of other PPCPs and ASWs in river water were found to be higher in densely populated areas. Concentrations of PPCPs and ASWs in the groundwater were lower but on same order as detected in the river water. Similar to river water, elevated concentrations of PPCPs and ASWs in groundwater were detected in middle and lower reaches along the Ganges River. PPCPs and ASWs were not detected below less 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 abundance. Due to biological and/or abiotic processes that the contaminants undergo from the discharge site to the ground or surface water where they are detected, they can be transformed to transformation products (TPs). These TPs are usually detected and identified first at lab-scale in order to evaluate the degradability of a compound. This is typically followed by a targeted method development and it is not up until the compounds have been isolated in some other sample 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 bio-form from the parent compound. Finally, a targeted method was developed for quantification of these compounds in wastewater and surface water. This work was possible due to support from EU-FP7 programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

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


High-Resolution Mass Spectrometry has its benefits but still wastewater samples challenge the analyst on the quest for “unknowns”, metabolites and transformation products of emerging organic contaminants (EOCs). Their detection requires non-target analysis which involves not only costly instrumentation but also scientists with the time to plough through the enormous amount of data collected. An approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and anti-depressant, 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 considered neuro-reactivity to CBZ-10,1-epoxide (ca. 70 %) or 2-hydroxy-CBZ (14 %). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30 – 40 min. run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were reconstituted in 10 μL of phosphate buffered saline (PBS). Mass of TOP-ESI-MS applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chlorine pattern. The compound is cetizine, 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 ELISAgarm. 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 states that drinking water monitoring is performed in a more flexible way, provided protection of public health is ensured. Compared to surface water, groundwater is less intensively studied and monitored. However, groundwater can be highly influenced, by anthropogenic activities related to the land-sagy 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 relected in the spatio-temporal patterns of the chemicals. Treatment technology applied, such as filtration and sorption techniques, determines removal efficiencies during drinking water production for specific compounds. Water utility VitenS services drinking water in a large area in the Netherlands, mostly using groundwater as a source. Their set of chemical parameters in the monitoring program tripled in the last decade. The water utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We propose an approach to this risk-based monitoring program for all 13 supply zones involved, mostly consisting of groundwater. We use both target and non-target/suspect monitoring data and well characteristics. We use clustering techniques combined with prioritization techniques including substance properties and in vitro as well as in vivo toxicity information. We analyse full scale removal efficiencies by the treatment technologies applied. Finally we propose a risk based monitoring program.

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

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

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In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial amphibian life stages from (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and biodegradation modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD₅₀) from standard acute toxicity values (96-h LC₅₀) for fish and biodegradation 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 J 2017; 329 pp. doi:10.2903/j.efsa.2017.50452 [2].EC. 2009. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. OJ L 309/1

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

S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente; I. Caliani, M. Giannetti, L. Marsili, S. Maltese, D. Coppola, N. Bianchi, T. Campani, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment Caretta caretta is the most common sea turtle in the Mediterranean Sea. The IUCN assessment for this carnivorous long-lived reptile underlines the lack of information regarding pollution and pathogens and indicates as a priority efforts to investigate and reduce the impacts of these threats. Up to now very few studies were conducted investigating biological endpoint potentially influenced by contamination on C. caretta. The aim of our study was to conduct the first ecotoxicological assessment of this species in the Mediterranean sea using a non-invasive integrated methodology. We set up and applied a monitoring protocol which also includes endpoints, such as CYP1A, Lipid peroxidation, ENA assay, B esterases, never investigated before in this species. Seventy-five loggerhead turtles were sampled in a monitoring campaign to map the free-ranging among the Spanish coasts. Blood, skin and carapace samples were used to test biomarker responses and contaminant (OCs, PAHs, Pb, Cd, Hg) levels. We measured biomarkers of exposure to lipidic contaminants (CYP1A in skin biopsies), biomarkers of indirect and direct effects investigating neurotoxic (esterases inhibition) and estrogenic (vitellogenin) effects, oxidative stress (lipid peroxidation), genotoxicity (Comet and ENA assays) and liver damage (Gamma Glutamyl Transferase). Elaboration of experimental results was carried out taking also into consideration different age classes of the specimens. Among the main results obtained we should underline the statistically significant correlation between
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 CYPIA1, never investigated earlier in this species. We also evidenced that 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 toxicological stress. This study contributed to expand the knowledge about the ecotoxicology of *C. caretta* in the Mediterranean, the non-invasive protocol could also be applied to other marine ecosystems and other sea turtle species, and implemented with new endpoints in the near future.

28 Sucking clans or hunting 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 contaminants exposure to adverse health effects in polar bears and other marine mammals with their contaminant exposure, there are 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 from Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ13N values in red blood cells and in blubber tissue were positively correlated. High δ15N values in blubber 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 T4 were negatively related to concentration of PCBs. We analyzed transcript levels of 21 target genes in blood cells and 7 target genes in blubber related to endocrine and immune functions by real-time quantitative PCR. The preliminary results indicate few relationships between transcript levels of genes involved in endocrine functions and pollutant exposure.

29 Triclosan-induced embriotoxcity in the yellow-legged gull
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Triclosan (TCS) is a chemical compound extensively used as synthetic and antimicrobial agent in a wide range of personal care products. Because of its hydrophobic nature and its discharge in the sewer system, TCS accumulates in settled sewage sludge and surface water, contaminating aquatic and terrestrial ecosystems. However, data on the potential toxicity of TCS towards wildlife species is very scarce. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the food web and relative long life-span. Their eggs are a useful tool to monitor the levels of environmental pollutants and their potential adverse effects because these chemicals can be maternally-transferred to the offspring. However, such investigation on TCS is lacking. The aim of this study was to explore through *in ovo* injection, the potential embriotoxicity of TCS in the yellow-legged gull (*Larus michahellis*). In a within-clutch experimental design, 150 mg/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 (i.e. ROS), enzymatic activities (SOD, CAT, GST) and the levels of lipid peroxidation (LPO) were measured as biomarkers of oxidative stress, while levels of DNA fragmentation were measured as genetic damage endpoint. To check for the reliability of the injection method, we quantified TCS concentration in the yolk of unincubated eggs, while to assess its transfer to the embryo, we measured TCS in residual yolk and in the liver and brain. TCS concentrations in yolk from unincubated eggs were similar to the nominal ones (195.9±35.3 ng/g wet weight), while lower concentrations were found in residual yolk soon before hatching (2.9±1.1 ng/g wet weight). TCS was also detected in the liver (2.3±1.1 ng/g wet weight) and limitedly in the brain (0.2±0.1 ng/g wet weight). TCS experiment did not show significant effects on embryo morphology traits. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genetic damage. Thus, these findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

30 Egg overspray with herbicides and fungicides reduces chick survival in red-legged partridges
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Toxicity characterization in pesticide risk assessment for birds is derived from oral exposure of adults. However, for ground-nesting species, a temporal and spatial overlap of egg laying and incubation with pesticide applications may result in direct exposure of the eggs. Using formulations commonly applied to cereal crops in spring, we conducted two experiments in 2016. Likewise, pesticides 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 2 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 nesting growth was not affected in either experiment by embryonic exposure to pesticides. These results suggest that reduction of embryonic and chick survival because of egg overspray with pesticides can be a potential way by which these products may affect reproductive performance. Likewise, potential 2,4-D and tebuconazole exposure during the exposure period and effect occurrence need to be considered when monitoring pesticide impacts on avian reproductive output. Financed by the Spanish Ministry of Economy and Competitiveness (Project ref. CGL2016-75278-R)

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

31 Regulatory improvement in the assessment of environmental risks from veterinary medicines - a European Perspective
I. Weeks, Joint Nature Conservation Committee

This presentation will focus on the developments in the environmental risk assessment of veterinary medicines from a European regulatory perspective. There is a need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines is undertaken centrally within the EU, is the responsibility of the European Medicines Agency (EMA); however, developed best practices are shared by all member states. The EMA also aids in coordinating other European procedures with several member states involved. EMA frequently authorises and takes advice from specialist working parties aligned to the specific provision or modification of regulatory guidelines or procedures within the committee for veterinary medicine products (CEM). There is a group of experts such focus on the improvement of the guidance to industry and other stakeholders on environmental risk assessment alongside the provision of reflection documents that aid understanding or address specific areas for clarification in regulatory procedures. The overview will highlight some of these recent developments, in improved regulatory advice for current or future procedures. It will summarily cover issues around assessing and limiting veterinary medicines in groundwater, the use of higher tier testing of dung fauna, the use of higher tier plant testing, improvements in PBT assessments, future plans around developing improved guidance for the assessment of risks from aquaculture.
mesocosm studies provide data on the fate of test substances under realistic outdoor conditions, which can be used to test the prediction based on laboratory studies. While for the risk assessment of Plant Protection Products (PPP) mesocosm studies are an established higher tier approach and are considered as the surrogate reference tier, the use of mesocosm studies for risk assessment of biocides, veterinary medicines and chemicals under REACH is rare, although mesocosm studies have been recommended in the Guidance on information requirements and chemical safety assessment - Chapter R.10: Characterisation of dose [concentration]-response for environment and in the Guidance on the Biocidal Products Regulation - Volume IV Environment - Assessment and Evaluation both provided by ECHA. One reason for this might be, that mesocosm studies have the reputation to be very complex and difficult to evaluate by regulatory authorities, and presents a challenge that might be taken by regulatory authorities, and presents a challenge that might be taken to take some fears of contact with mesocosms. It will explain the most important aspects that 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.

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Environmental Interests.

Emission estimation of insecticides in mink farms R.G. Ovesen, Danish Environmental Protection Age; H. Bækgard, Kopenhagen Fur

Insecticides 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 amount applied or measured concentration in straw. Default values have been established from regulation and general practices in mink production in the Nordic countries, where Denmark has the highest production of mink in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are retreated. Each mother will bear 5.53 cubs/year according to Danish regulation [4]. The number of “breeding females” (BF) is 1 mother+5.53 cubs. The number of nest boxes that is treated/BF may be calculated as follows: one animal/nest box before separation and 6.55/2 animals (n=3.275) nests box after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw may be from up to 50 BF per hectare (ha) per year based on regulation in the Nordic countries. Emission according to application pattern: Y = Qmax x Fmax x (Napp before sep + 3.275 x Napp after sep) x B x 10^{-4} (Eq 1) Where Y = emission of a.i. in kg/ha x year, Qmax is amount of product/nest box in g, Fmax is concentration of a.i. in the product in kg/g, Napp before sep is number of treatments before separation of adults and cubs, Napp after sep is number of treatments after separation of adults and cubs and B is amount of straw/manure that may be applied (a land in number of BF/ha (B = 50). Emission based on amount of straw/manure applied to the field: Y = Concentration of a.i. in straw/manure x 750 kg straw per BF per ha(eq. 2) Where amount of straw used per BF is 10.15 kg/year according to Kopenhagen Fur. The emission based on Nordic countries regulations and information from 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].

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Biotic and chemical substances in municipal wastewater - what product groups are the sources?

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The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources of different product groups (e.g. face wipes, hay) have already been discussed in detail. However, until now the specific sources from the interior of these households remained unknown. To investigate the products responsible for this 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, piperoxyl butoxide (PBO), triclosan, tebuconazole, terbutryn and tetramethrin. In comparison with data available from household product inventories of this neighbourhood, we investigated the product groups possibly being responsible for the emissions to the wastewater. Except for C12-benzalkonium chloride, all substances have been detected in at least 10 % of the samples. Highest concentrations were measured for C12-benzalkonium chloride with an average concentration of 6.6 µg/L. Besides C12-benzalkonium chloride, BIT, DEET and icaridine were measured in all samples. The results show...
that washing and cleaning agents are important sources for preservatives such as BHT and OFF, while triclosan was apparently mainly emitted through personal care products. The mosquito repellent substances DEET and icaridin were found throughout the whole year, with highest emissions in summer and autumn. C12-benzalkonium chloride concentrations were associated with the inventoried disinfectants. Material preservatives such as terbutryn, diuron, tebuconazole or carbofuran 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 target biocidal products when it comes to the reduction of biocidal active substances in wastewater.

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

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

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Manufactured nanomaterials (MNNs) and especially Ag- and TiO2-NPs are processed in daily used products such as cosmetics, clothing and in medical supplies. After passing wastewater treatment plants these MNNs 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 daphnia the body length of daphnia was significantly larger at 5 µg/L in generation F2 and at 2.5 µg/L in generation F3 compared to the control. In the wastewater-borne Ag-NP treatment the adults’ body length was significantly larger at 2.5 µg/L. Thus, adult’s body length showed no consistent pattern towards both scenarios. When passing WWTPs most Ag-NPs might be transformed and enter the aquatic environment as silver sulfide. That may be the reason for the lower toxicity than compared to other forms of Ag-NPs. Our results provide a first, direct comparison between the toxicity of pristine Ag-NPs and TiO2-NPs with those from WWTP. To our knowledge, the present study is the first one showing that Ag-NPs from a wastewater treatment plant had a minor and no chronic toxicity to Daphnia magna. The used experimental approach allows a more realistic risk assessment of Ag-NPs and TiO2-NPs for the aquatic environment. The experiment with TiO2-NPs are in progress.

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

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Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has had little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomeration and sediment, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. Here we address the similarity of an ex vivo gut sac technique to that of fish in the bioaccumulation potential of pristine (Ag NPs) and environmentally aged (Ag,S NPs) materials. Additionally, we assess whether the results of the gut sac experiment can predict in vivo chronic dietary exposure. The gut sacs were prepared by removing the entire gastrointestinal tract and separating it into the oesophagus, stomach, anterior, mid and hind intestine compartments. Compartment contents were then mixed with the standard feeding ration, and all tanks were placed on the control diet for another two weeks to measure Ag elimination. During sampling, the mid and hind intestine, liver, gill, bladder, kidney, spleen, gut sacs and carcasses were dissected. Tissues from both experiments were then analysed for total Ag using ICP-MS. The gut sac experiment demonstrated the uptake of Ag is associated with the mid and hind intestine. There was significantly less Ag in the musculature of the mid and hind intestine after exposure to Ag NP and Ag,S NP compared to AgNO3, but no difference between ENM treatments. The in vivo experiment demonstrated a significantly higher Ag in the mid and hind intestine of Ag NP and AgNO3 -treated compared to Ag,S NPs. Silver from all the treatments 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 Ag,S NPs. However, if the data are ranked in the mid and hind intestine by total Ag accumulation, the gut sac does not directly predict in vivo accumulation.

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

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Manufactured nanomaterials (MNNs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics etc. Even though MNNs are mostly removed during wastewater treatment, the remaining and mostly transformed MNNs in the environment are significant and may show an increased toxicity for aquatic organisms due to their modification during the WWT. The impact of wastewater-borne MNNs (TiO2 and Ag MNNs) 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 304 A. 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 MNNs, (ii) untransformed effluent, manually spiked with MNNs and (iii) dilution water enriched with pristine MNNs. Tissue samples of the different test organisms were analyzed for changes in the levels of several biochemical markers [lactate dehydrogenase (LDH), superoxide dismutase (SOD), catalase (CAT) and glutathione S-transferase (GST)]. Furthermore, uptake and elimination kinetics of the MNNs were investigated by quantitative ICP-MS and ICP-OES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into untransformed effluents or untransformed water, the animals consuming the AgNPs showed a significant increase of 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 MNNs were observed. However, no general effect pattern could be identified. Total MNN 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

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Manufactured Nanomaterials (NMs) can undergo changes in their properties and behaviour during application and disposal. Once in the environment, different forms of NMs can be taken up by organisms and suffer biologically-driven alterations. Toxicokinetic modelling can provide important information about ways of uptake, internal 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 muscular, 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 Ag,S 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, gill, bladder, kidney, spleen, gut sacs and carcasses were dissected. Tissues from both experiments were then analysed for total Ag using ICP-MS. The gut sac experiment demonstrated the uptake of Ag is associated with the mid and hind intestine. There was significantly less Ag in the musculature of the mid and hind intestine after exposure to Ag NP and Ag,S NP compared to AgNO3, but no difference between ENM treatments. The in vivo experiment demonstrated that Ag in the mid and hind intestine of Ag NP and AgNO3 -treatments compare to Ag,S NPs. Silver from all the treatments 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 Ag,S 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.
(simulated) aged silver nanoparticles (Ag-NPs) in freshwater benthic organisms. In this study the pulmonate snail Physa acuta, the non-biting midge Chironomus riparius and the planarian Dugesia tigrina were used as test species. Pristine Ag-NPs of different sizes (3-8nm, 50nm and 60nm), a 27nm silver sulphide (AgS-NPs) simulating aging, and their ionic counterpart as silver nitrate (AgNO₃) were tested. Bioaccumulation tests consisted of an uptake phase, where organisms were exposed either to well water sediment and contaminated aqueous medium in a concentration of 10 µg Ag·L⁻¹ and an elimination phase where organisms were transferred to clean medium. Animals were sampled during the tests and total body Ag concentration was analysed by graphite furnace atomic absorption spectrometry. Kinetics of Ag-NPs and ionic Ag were described by one-compartment models. In this work, uptake and elimination kinetics of the different Ag-NPs were compared between both species, with the same AgNPs presented higher k1 values which can be related to their higher exposure to settled Ag in the sediment. Larvae exposed to Ag 50nm showed the highest uptake rate constant (k1) and the highest elimination rate constant (k2), suggesting that Ag 50nm was easily taken up and eliminated from the body. Ag-S-NPs displayed a k2 close to zero, indicating that not only uptake was less in the larvae but also that they were less eliminated. Snails showed faster uptake and elimination of Ag-S-NP from the body compared to other Ag forms. For planarians, results revealed very similar k1 values, with the highest k1 for animals exposed to ionic Ag and the lowest for Ag 60nm exposure. Analysis of Ag in the sediment will be soon available to elucidate the behaviour of Ag, especially at the water-sediment interface, where most benthic organisms are exposed.

41 Transformation of silver nanomaterials by ubiquitous zinc finger peptides


In biological systems, chemical and physical transformations of engineered silver nanoparticles (AgENMs) are mediated, in part, by proteins and other biomolecules. Given the high affinity of thiolate ligands for silver, metalloproteins are key targets to evaluate the role of biomolecules in AgENM transformations. In turn, metalloprotein interactions with AgENMs are also central in mechanistic studies of cellular impacts of AgENMs, including toxicity, antimicrobial, and resistance mechanisms. Despite the shared preference of both silver and zinc for thiolate and amine coordination, the interactions of zinc finger domains with AgENMs is not well studied. Zinc fingers constitute a large class of metalloproteins, ubiquitous in eukaryotes, that use a combination of cysteine and histidine residues that bind Zn(II) as a structural element. Zinc finger domains within proteins typically serve as interactors and can bind DNA, RNA, proteins or small molecules to mediate cell functions through protein-protein and small molecule binding. Zinc finger domains act as transcription factors and bind to the peptide primary sequence. Additional studies using fluorescence spectroscopy to monitor Ag(I) binding to the Zn finger peptide indicate that the Ag(I) effectively completes with Zn(II) at the metal binding site, despite the high affinity of Zn(II) for the peptide. Circular dichroism spectroscopy used to assess changes in the peptide secondary structure demonstrate that the addition of either form of silver alters peptide structure and structural perturbations are again dependent upon the peptide secondary structure. Experiments using recent examples of OSRP work conducted for the Arctic Oil Spill Response Technology Joint Industry Project, American Petroleum Institute Gulf of Mexico Deepwater Project, and several companies working in tropical marine environments. The applicability of SIMA to marine resources and habitats is also discussed. The SIMA framework typically includes (a) assessment of initial environmental effects that result from oil spills, (b) 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 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, as well as 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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In the field of oil and gas production, there is a constant challenge in developing new techniques of oil detection for prospect (natural seeps) and environmental monitoring purposes. Hyperspectral remote sensing has provided promising results for the detection of oil in vegetated areas. It is achieved by extracting information from the spectral signature of vegetation, which corresponds to its reflectance measured by a sensor over multiple, narrow and contiguous wavelengths. Vegetation reflectance is driven by leaf structure, pigments and water content, which can be affected by oil. As a result, the spectral signature of vegetation is modified so it is possible to detect and quantify oil exposure. The final objective of this rapid and non-destructive approach is to be applied on airborne hyperspectral images at high spatial resolution (Rubus fruticosus L.) exposed for 32 days to 25 kg.m⁻² total petroleum hydrocarbons (TPH) from crude oil and mud pits under controlled conditions. Spectral signatures were measured at different scales (leaf, plant and canopy) with a portable spectroradiometer, using a leaf-clip or fixing the sensor above the plant. After 18 days, the signature of TPH-exposed plants was strongly modified. Compared to controls, their reflectance increased in all wavelengths at leaf scale, up to 0.15 greater. The low ground coverage of TPH-exposed plants induced an opposite response in the near- and short-wave infrared (750-2500 nm) at plant and canopy scales. Vegetation indices (VI), computed by reflectance ratio at different wavelengths, were able to discriminate among treatments, and remained robust from leaf to canopy scale. Plant pigments, chlorophyll fluorescence and stomatal conductance were also affected by TPH. The following step was to study the spectral response of the species in situ, in an oil and gas brownfield with the same contamination pattern. The results obtained in controlled experiments indicated that the same VI were highly correlated to TPH (r = 0.7). Finally, VI allowed identifying the brownfield from an airborne hyperspectral image at high spatial resolution, and thus confirmed the potential of this technique for assessing environmental risks deriving from oil and gas production in vegetated areas.

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

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The Deepwater Horizon Oil Spill (DWHOS) in 2010 is the largest and most studied accidental marine oil spill in history. More than 100 new research studies concerning the effects of the DWHOS have been published each year since 2011. Key issues investigated include the behaviour and fate of oil in deep spills, the effects of dispersed oil, microbial oil degradation, oil-assisted marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of combined stressors on species and habitats, and habitat and ecosystem recovery processes. To keep order in this flow of new knowledge is an important albeit challenging task. It is essential that the lessons of DWHOS are applied globally to improve pre-spill and post-spill measures to minimize the adverse ecotoxicological 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.

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

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What is the environmental effects of a beaching oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combusting the oil by in situ burning at the coast just do more harm to the communities in the tidal zone? To answer these questions, several studies have been performed at the west coast of Greenland in 2016 and 2017. One aim of the studies was then to support net environmental benefit analysis, NEBA, related to oil spill in Arctic waters. A NEBA is often performed to achieve the optimal environmental effect with respect to choice of oil spill combat methodology and biology at risk. Hence, a synthesis will be presented of following studies: 1) removal rate and ecotoxicological effects of oil smother on seaweed (Fucus distichus), an important organism of the communities in the coastal tidal zone; 2) self-cleaning potential of a coast line, including natural removal by seawater wash and physical degradation; and 3) effects on the tidal communities after combat of a beaching oil spill by in situ burning. Effects of oil smothering of the macroalgae Fucus distichus, which inhabit the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in were studied over a period of 2 weeks in a field test at Disko Island on the Greenland West coast. Among the fucoids used in the test, Fucus distichus was the species most likely to alter and hence natural removal and degradation rates in correlation to different water cover regimes and air exposure times were obtained. The obtained results on the tiles were analysed for chemical compositions. A pilot scale costal in situ burning operation was performed during summer in a bay in western Greenland with a crude oil for testing burning efficiency and environmental exposure and effects. The studies were funded by the European Commission Horizon 2020 programme and the Government of Greenland.

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

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

Crude oil contains many hundreds of compounds and some of these are widely used to differentiate between different oils and products, especially in spill scenarios. Traditionally, we have developed chemical fingerprints based on a suite of compounds such as the steranes and terpanes although the concept of a “fingerprint” suggests this is static in time. However, it is also well known that weathering processes have had a profound effect on the characteristic pattern changes with period of exposure. It would be more appropriate to use a “signature” language when comparing oils by this approach. The weathering processes change the chemical signature and old oil may have a different chemical composition to the original source oil. When we analyses such samples, we may need to ask if this is the same oil as the proposed source, or a different oil with a different signature that is also present. The steranes and terpanes contain several homologues and analysis of the chemical signature during the Deepwater Horizon Response clearly indicated that several of these compounds were not behaving conservatively and were degrading at a faster rate than anticipated given the exposure time. Comparisons with the actual oil released clearly identifies the compounds most likely to alter and the environments where they degrade. In this case, the Louisiana marshes were clearly a site where biodegradation was significantly faster than expected. This was also true of the alkylated PAHs which had been used as source identifiers in previous spills such as the Exxon Valdez. The triaromatic steranes were also degrading at a significant rate while the oil was at sea and the exposure to UV light may have led to a relatively rapid abiotic transformation. When it comes to distinguishing between sources, less may be more! We need to select the compounds we include in our analyses with care since each question may need a different approach: if we want to know if the oil is weathering, we use a suite of compounds with differential properties appropriate to the environment of the spill. If we want to conduct source apportionment, we may need to choose the most recalcitrant of the compounds rather than all of them.

Fish model species in human and environmental toxicology (I)

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

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In response to the restriction of bisphenol A (BPA), bisphenol S (BPS) has been widely used in the manufacturing of polycarbonate plastics and epoxy resins as an alternative compound. BPS has been found to affect reproduction, development,
and immune system. Although microRNAs (miRNAs) play a crucial role in many metabolic activities, whether and how they are involved in the process of BPS-induced toxicity is largely unknown. BPS-induced changes in miRNAs and target gene expression in male zebrafish (*Danio rerio*) gonad, and the potential mechanism was investigated. Male zebrafish were exposed to 0, 5, and 50 µg/L BPS for 21 d. miRNA was isolated from the gonad pool and the expression profiles of 255 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time PCR was performed to verify the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hematopoiesis, lymphoid organ development, and immune system development. Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 µg/L BPS, six were considered to be involved in the role of BPS-induced toxicity via the interaction with the aromatization process. The results of this study will provide novel insight into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

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

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A variety of biological activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fishes due to the narrow range between essentiality and toxicity. Although several studies have reported developmental toxicities in early life stages of fishes, fewer studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to dietary selenium (Se) by feeding at the normal levels (1.1 - 1.3 µg Se/g food, dry mass) and environmentally relevant supraphysiological levels (3.4 - 28.8 µg/g) for 90 days. Swimming performance, O2 consumption and metabolic rates were determined using a swim tunnel respirometer. Cardiac function was assessed using high resolution (30 µm) ultrasound biomicroscopy. Whole-body energy stores (triglycerides and glycogen) and mRNA transcript abundance of selected genes of interest were determined. Compared to controls, adult zebrafish exposed to elevated dietary Se were impaired in their swimming performance (lower fatigue velocity or Ucrit). This was associated with elevated basal metabolic rate and reduced aerobic scope, indicating impaired aerobic capacity. Triglycerides (the primary fuel for aerobic swimming) were elevated in a dose-dependent manner, which was associated with increased echodensity at the atrial-ventricular junction and reduced mRNA expression of the collagenase, MMP2. These results suggest significant ecophysiological effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the zebrafish is an excellent model of this study. The aim of this study was to increase echodensity at the atrial-ventricular junction and reduced mRNA expression of the collagenase, MMP2. The main aim of this study is to identify alteration in molecular processes, which can be related to the exposure to sediments from Gulf of Bothnia (Sweden) for a proof of concept for activation in fish embryos as in many cases of 255 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time PCR was performed to verify the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hematopoiesis, lymphoid organ development, and immune system development. Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 µg/L BPS, six were considered to be involved in the role of BPS-induced toxicity via the aromatization process. The results of this study will provide novel insight into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

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

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Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 µg/L BPS, six were considered to be involved in the role of BPS-induced toxicity via the aromatization process. The results of this study will provide novel insight into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

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

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Chemical exposure to endocrine disruptors can have adverse outcomes on organism health and function; however, the current reliance on end-points such as egg number, plasma VTG content and morphological changes to determine effects of endocrine disrupting chemicals has given rise to series of questions related to chemicals exhibiting similar effects but different mode-of-action (MoA). Improvements identified by the identificational research preceding to apical endpoints have 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 investigated the potential of 19 altered 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, vgt6 and lym1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimulants, 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 demonstration 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 suitable alternative due to the high level of similarity which could interfere with prediction of adverse effects for safety assessment. The concern was provoked by anecdotal observation of the lack of activation for some compounds leading to a weak acute toxicity in fish embryos. However, internal concentration profiles of parent compounds suggest that fish embryos are principally capable for metabolic transformation of chemicals (Kühnert et al., 2013, Environ. Toxicol. Chem. 32, 1819-1827). In order to assess the biotransformation more systematically we studied the biotransformation of two pharmaceuticals (clofibrate, celecoxib). Overall similar transformation products could be observed in zebrafish embryo as known from human studies. Interestingly, the ratios of the different products in fish embryos seemed to be different from the ratio in humans. Biotransformation is of particular relevance for compounds that require (metabolic) activation to elicit their intended biological effect or where activation “accidentally” produces more toxic substances. Organophosphates (OP) can serve as a model compounds for a proof of concept for activation in fish embryos as in many cases activation is mediated by cytochrome P450 oxidation. Therefore, we studied the
activation of organophosphates by comparing the inhibition of acetylcholinesterase (ACHE) activity for the parent compound and the oxon-metabolite in homogenates and intact embryos. For homogenates only the oxon metabolites were able to provoke ACHE inhibition in a concentration dependent manner. In intact embryos inhibition was also found for the parent compounds. The inhibition EC50 was gradually reduced in later stages of embryos, if 24h exposure intervals for different stages were compared. The findings suggest that fish embryos are principally able to activate organophosphates and potentially also other compounds 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 (PM2.5) exposures. However, research groups use differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single hi-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMSO extraction. Zebrafish (n=32treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5 filter portions undergoing filter exaction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polyacrylic aromatic hydrocarbons (PAHs; n=120) and elements (n=20). Significant increases in mortality were observed for PM2.5 from 5 of the 6 filter extraction methods when compared to both the DMSO and blank filter controls. Combined mortality and morphological changes were significantly increased following PM2.5 treatment in all extraction methods compared to DMSO controls. Importantly, two of the methods showed significant mortality and morphological changes with blank filters when compared to DMSO controls. Chemical analysis is underway and differences in PM2.5 solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify components that are driving toxicity and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.

Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

55 Cultural Heritage and Climate Change: impact and adaptation

C. Sabboni, CNR-Istituto di Scienze dell’Atmosfera e del Clima

Cultural heritage, which is a non-renewable resource, is a sector extremely complex for the diversity of materials, structures and systems. The access to citizens and visitors needs 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 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.J. 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. Pezzati, CNR-Istituto Nazionale di Ottica

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

58 Discussion & Conclusions

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

59 Scenario Development for Off-field Soil Exposure and Risk Assessment

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinmann, WSC Scientific GmbH; T. Schad, Bayer Ag / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer Ag / Ecotoxicology; G. Goettler, Bayer CropScience AG / Environmental Safety; P. Neumann, Buyer Ag; S. Bub, Tiers Solutions GmbH

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

60 Biogenic residues formation from pesticides - an overview

K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; M. Kästner, Helmholtz centre for environmental research - UFZ / Department of Ecotoxicology; G. Goerlitz, Bayer CropScience AG / Environmental Safety; M. Wang, WSC Scientific GmbH / Dept Efate

Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in the Specific Protection Area (SPA) in the Specific Protection Area (SPA) and the Specific Protection Area (SPA) 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 networks, coordinated by so-called National Hub and RIHS Headquarters will provide the unique access point to all E-RIHS services, by coordinating the net of National Hubs.
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
S. Sittig, Dr. KNOELL CONSULT GmbH / E-Fate Modelling; C. Wollmann, Dr. Knoell Consult GmbH; G. Reineken, Bayer AG, Research & Development, Crop Science / Environmental Safety
After foliar application, plant protection products (PPPs) undergo several routes of dissipation of which one is precipitation-induced wash-off from the canopy. This process is accounted for in the European exposure assessment framework for PPP authorization and included in the corresponding numerical models, e.g. FOCUS, PEARL, PELMO, 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 dispersed substance depends on several factors. An ECP network 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 mm of artificial rain, followed by an extraction of the plant material with an acetonitril/water mixture of 80:20 (v/v). This standardised experimental procedure has been defined in order to derive a reliable numerical wash-off factor as input for FOCUS modelling. In this study, the performed literature review 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 standardised experimental procedures. Thus, only a limited number of the published studies are suitable to derive a wash-off factor for modelling. The outcome of the literature review presented herein suggests that a meaningful default wash-off factor should be well below 1 cm⁻¹. Keeping the existing default value of 0.5 cm⁻¹ retains a sufficient protection level while at the same time avoids a large number of unnecessary refinement studies.

62 Application of a dynamic aquatic food web model for FOCUS exposure assessment
L. Padilla, Stone Environmental, Inc.; A. Del Signore, D. Sprenger, L. Weltje, BASF SE / Crop Protection Ecotoxicology; M.F. Winchell, Stone Environmental, Inc.; BASF SE / Crop Protection Ecotoxicology
In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substances in aquatic organisms is evaluated with simple screens on the basis of a substance’s logKow, where typically a value greater than or equal to 3 indicates concern. However, this criterion may lead to false positive identification, because it does not account for biotransformation of the substance in organisms or bioavailability 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 logKow above the screening threshold of 3 will bioaccumulate/biomagnify. The Simon Fraser University (SFU) aquatic food web model, which predicts chemical concentrations in biota at six different trophic levels within an aquatic ecosystem, was selected based on the availability of data for relatively few input parameters and its demonstrated capability to predict observed chemical concentrations for a wide range of species, chemicals, and aquatic environments. To maximize relevance for agricultural systems in Europe, the food web model was adapted to accept environmental concentration time series input from the established TOXSWA model used in EU pesticide registration procedures. The modelling approach leveraged the transient form of the aquatic food web model for time-variant toxics parameterized to simulate temporal/seasonal dynamic environmental conditions. 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 logKow-based screening bioaccumulation and biomagnification evaluations for regulatory purposes.
on their Environmental Fate and Effects (II)

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

H. Lüg, X. Xia, S. Bi, X. Jiang, H. Wang, W. Wen, School of Environment, Beijing Normal University
Dissolved organic matter (DOM) is a key environmental factor for the toxicity of hydrophobic organic compounds (HOCs) in natural waters. However, the toxicity of DOM-associated HOCs is still not clear. In this research, pyrene was selected as a model HOC and DOM was dissolved from soils (C_{DOM}) was manipulated using passive dosing systems. The immobilization and enzymatic activities of Daphnia magna were examined to analyze the toxicity of DOM-associated pyrene. The results indicated that the immobilization of Daphnia magna in the systems containing various molecular weight DOM and pyrene was ordered as middle molecular weight (MMW, 5-10k Da) DOM > higher molecular weight (HMW, > 10k Da) DOM > native DOM (N = 1-3k Da) > 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 fractions of 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 a silicone rod has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K_{oc} and K_{aw}. 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 air of the samples was stripped off through the Tenax tube using a vacuum pump. The Tenax tube and the CO2-trap were taken for analysis and the soil was taken for extraction using appropriate methods. The solid extraction residue was subject to combustion analysis to determine the non-extractable residues (NER). The average overall recovery of 99.29% (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 with a variety of different hydrophobic organic mixtures. The 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 CO2growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 14C-labeled HOCs (triclosan, pentachlorophenol—PCP, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradations tests activated sludge or soil in novel passive dosing setups, in which tenax (100% parent) was used. A good agreement between model predictions and empirical data was shown by adjusting only the ratio v_{min}/K, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of v_{min}/K, values was shown for the selected substances (0–55 mgC 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
Implications of spatial differentiation on the interpretation phase of a comparative LCIA method developments in a global perspective: Status and realistic LCIA results. The aim of this work was therefore to assess the past few years. However, it is less investigated whether spatial differentiation in biochar systems 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 phenomena dominated. 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 substantial difference in the classification 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.

70 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas C. Apel, Helmholtz-Zentrum Geesthacht; J. Tang, Yantai Institute of Coastal Zone Research, CAS; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry, University of Bremen; C. Legrand, Helmholtz-Zentrum Geesthacht; J. Hebeisen, University of Bremen; J. Tang, Yantai Institute of Coastal Zone Research, China.

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 and filtered. The resulting extract was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 μm, 2.1 x 150 mm, Agilent Technologies, Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the Bohai and Yellow Seas for the first time. 14 substances have been positively detected in concentrations in the low ng/g dw range. Characteristic pollution profiles and distribution pattern have been identified, which indicate to different indirect sources of UV stabilizers into the study area.

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

71 Implications of spatial differentiation on LCIA-based decision-making: a case study of biochar systems in Indonesia M. Owismian, Technical University of Denmark; G. Cornelissen, S. Hale, Norwegian Geotechnical Institute; Lindhjem, Menon Economics; M. Sparrvik, NTNU

The development of spatially differentiated life cycle impact assessment (LCIA) methods and their use in regionalized life cycle assessment (LCA) has intensified in the past few years. However, it is less investigated whether spatial differentiation leads to more correct decisions based on the LCA, in addition to just more accurate and realistic LCIA results. The aim of this work was 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 phenomena dominated. 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 substantial difference in the classification 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.

72 Considering space debris related impacts within the LCIA framework T. Maury, University of Bordeaux / ISM-CyVi; P. Loubet, CyVi-ISM / ISM CyVi; A. Gallice, ArianeGroup / Design for Environment; G. Sonnemann, University of Bordeaux / ISM CyVi

The space sector is a new area of development for LCIA 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-Launchpad 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 significant challenge. Given this situation, there is an opportunity to make the link between space debris concern and eco-design of spacecraft (satellites & launchers) using the LCIA methodology. A focus should be put on the comparison of several missions & post-disposal disposal scenarios to study potential trade-offs between typical impact categories (e.g. toxicity and climate change), but also with regard to the growing issue of space debris. Hence, our challenge is to integrate, via a dedicated additional indicator, space debris related impacts within the LCIA to broaden the scope of LCIA for space systems. The Area-of-Protection Resources has been identified to reflect the depletion of available orbits by the potential generation of space debris. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s debris. Volume occupied by debris and dead spacecraft leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

73 Implementing ozone formation effects due to poplar plantations for biomass production in Europe: an impact assessment P. Vercoulen, Radboud University; R. Kranenburg, C. Hendriks, TNO; R. Van Zelm, Radboud University / Department of Environmental Science

Poplar trees are known to emit volatile organic compounds, among them isoprene, which isoprene emissions caused by poplar tree plantations in Europe. CFs were defined by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (II)

77 Review on removal and reactions of micropollutants in biofilms under growth and non-growth conditions
K. Bester, Aarhus University / Environmental Science; M. Escoila 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. El-taliawy, Aarhus University / Department of Environmental Science; I. Zhang, Aarhus University / Department of Bioscience; G. Ooi, K. Tang, DTU Environment; H. 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 h in biofilms. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradation. It was found that BOD supply has massive impact on the removal: On the one hand high BOD loads led to enhanced growth of biofilm, resulting in high turnover and reaction rates also of the respective micropolllutants. 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 thought to be recalcitrant (like diclofenac) could easily be degraded in relatively short time periods. For single compound degradation pathways for biofilm systems are discussed and compared to other systems. – While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfatation pathways. Interestingly enough, it was possible to reach high removals for otherwise persistent ozonation-by-products such as macrolide N oxides while avoiding back reactions to the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diclofenac.

78 Biodegradation of emerging organic contaminants using an enzyme-mediator system and study of the resulting transformation products
L. Caraà, CUTIN University / chemical department; C. Joll, Curtin University / chemical department; K. Linge, Y. Gruchlik, Curtin University; A. Paparin, Murdoch University
Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g. algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one anticonvulsant using laccase enzyme, extracted from a white-rot fungus Trametes Versicolor, in the presence of 2,4′-diazobis-(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS), as a mediator. The experiments were conducted in MilliQ water at different pH values, with different ratios of laccase and mediator, under aerobic and static conditions. The degradation was monitored by measuring the concentration of the remaining antibiotic over 168 hours, using a high performance liquid chromatograph with UV detection. The formation of new peaks was also monitored.
and high resolution mass spectrometry (HRMS, LTQ Orbitrap) was used to identify potential transformation products. Furthermore, the microbial activity of the antibiotics and their transformation products was assessed, using an E. coli culture and microbial disks. Results showed that 89% degradation of sulfamethoxazole can be achieved at pH=5, with an enzyme activity ranging between 110-120 U/L and an initial mediator concentration of 200 μM, while trimethoprim only degraded by 43% under the same conditions. The results of similar radiolabeling experiments on other antibiotics will be discussed in this conference presentation.

The identification of transformation products of the antibiotics using high resolution mass spectrometry, and the microbial activity of the transformation products, will also be presented. This study provides a better understanding of the biodegradation of emerging organic contaminants and their transformation products. Further work could be addressing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

79 Evaluation of macro- and microbiate transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays S. Terzić, Rudjer Boskovsk Institute / Division for Marine and Environmental Research; P. Kostanjevski, I. Krickman-Matašić, I. Senta, Rudjer Boskovsk Institute; T. Jurina, Faculty for Food Technology and Biotechnology; N. Udiković-Kolarić, Rudjer Boskovsk Institute; J. Ćurko, Faculty of Food Technology and ERY TPS s.r.o.; M. Matosić, Faculty for Food Technology and Biotechnology; J. Lončar, I. Mihaljević, T. Smital, Rudjer Boskovsk Institute; M. Ahe, Rudjer Boskovsk Institute / Division for Marine and Environmental Research

The aim of the present study was to investigate the transformation of three prominent representatives of macrolide antibiotics (azithromycin - AZI, clarithromycin - CLA and erythromycin - ERY) in model biodegradation and ozonation experiments. In the study, the biodegradation kinetics of the parent compounds, identification of transformation products and ecotoxicological evaluation of transformation processes using two different end-points. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (Bacillus subtilis), while toxicity test was performed with the freshwater green algae Desmodesmus subspicatus. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was lower. This study intends to fill the existing gap between high demand of multicomponent methods for the analysis of compounds of emerging concern to the environment, as conventional treatment systems do not completely remove these compounds. But the processes at the core of the removal of these compounds in wastewater has been considered a major source of contaminants by activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate the antibiotics, either of natural or of synthetic origin, from grape slurry waste and activated carbons from wastewater. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing adsorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherm models, and the sorption data and the hysteresis model of the antibiotics onto activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

80 DI-SPME - On-fiber Derivatization - GC-MS. An innovative green and cost-effective approach to determine CECs and TPs from a novel anoxic-aerobic photobioreactor R. López-Serna, University of Valladolid / Chemical Engineering and Environmental Technology; E. Posadas, P.A. García-Encina, R. Muñoz, University of Valladolid

The demand of multicomponent methods for the analysis of compounds of emerging concern to the environment is increasing in recent years. However, conventional techniques based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of CECs, including target (CECs) and non-target analytes (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 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±11 mg L⁻¹ and 434±11 mg L⁻¹), were maintained for 40 d (<4 times the SRT) to achieve representative steady states. The maximum REs of ibuprofen, naproxen, salicylic acid, triclosan and propylparaben were 91±1%, 28±7%, 83±5%, 85±0% and 82±15%, respectively. COD concentration only affected clearly ibuprofen and naproxen REs. This pointed out oxidation as an important removal mechanism for those compounds. In contrast, salicylic acid and triclosan REs slightly increased at lower COD loads. For propylparabens, high elimination rates (above 90%) were observed regardless of the COD concentration. Oxidation, biodegradation, sorption, volatilization and photodegradation were discussed as the possible removal mechanisms of the tested contaminants. This constituted the first evaluation of CECs removal by a synergistic interaction between algal and bacteria depending on the organic carbon load.

81 Abatement of amoxicillin, ampicillin and chloramphenicol from aqueous solutions using activated carbons prepared from grape slurry R. Chitongo, Cape Peninsula University of Technology Cape Town South Africa / Chemistry; B. Ouedraogo, Cape Peninsula University of Technology / Faculty of Applied Sciences; O.S. Olatunji, Cape Peninsula University of Technology / Chemistry

There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The capabilty second-order ozone treatment better described and transformation of pharmaceuticals from wastewaters in African countries is also not fully known. There is scarcity of information concerning the utilization of grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHLR). This study therefore aimed at monitoring of the three antibiotic residues in selected surface waters. Activated carbons from grape slurry waste were obtained 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 transportation network of the Big 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. Three antibiotics studied were detected in environmental water samples. Attempts were made to remediate the antibiotics, either of natural or of synthetic origin, from grape slurry waste. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing adsorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherm models, and the sorption data and the hysteresis models of the antibiotics onto activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

82 Biodegradation of organic micropollutants in constructed wetlands: comparison of design and operational parameters P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; Y. Zhang, Southern University of Science and Technology / School of Environmental Science and Engineering; L. Tao, Nottingham Trent University / School of Animal, Rural and Environmental Sciences; L. Zhang, C.A. Arias, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience

Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove these compounds. Constructed wetlands (CWs) have, however, been shown to be able to degrade some of these emerging contaminants, namely organic micropollutants. But the processes at the core of the removal of these compounds in CWs are yet unknown. Research being developed at Aarhus University aims at understanding the removal processes and fate of organic micropollutants in different types of CW systems. Five different experiments have been conducted in the CWs. Two experiments have been performed under aerobic conditions in a growth chamber aiming to understand the uptake, translocation and mechanism of the tested contaminants. Two other experiments compared the effects of season, plant presence and plant species, initial concentration, hydraulic loading rate and CW design in different pesticides and pharmaceutical compounds. A sixth setup targeted the impact of support matrix in compounds sorption and biodegradation. The biofim microbial community function of the plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and isoxeol. 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 micropollicants 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. Uncultured systems tended to be more efficient. Removal correlated with the nitrification activity and with the biofilm formation, suggesting that ERDAs play an active role in the micropollicants biodegradation. The removal of the organic micropollicants in CWs is affected by several design and operational parameters. Plant uptake does occur but phytocaccumulation 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)**

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Effects of PAH exposure on fuelling ability in a long distance migratory shorebird

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

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

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

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Perfluoralkyl acids (PFAAs) are substances which have been produced for more than 50 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 organisms. We report here on PFAAs 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 PFAAs levels in the eggs and reproductive parameters, including the total hatching success, eggshell thickness or the total breeding success. PFAAs levels in blood correlated with protein damage in adult birds while in chicks they correlated with higher activity of antioxidant enzymes (GPX and CAT). The obtained data represent an important step towards the understanding of the behaviour, effects and consequences of PFAAs in wild bird populations. [1] Buck RC, Franklin J, Berger M, Jorissen P, Janssen A, Kannan K, Mably S, Van Leeuwen SP (2011). Perfluoroalkyl and perfluoroalkylated substances in the environment: terminology, classification, and origins. Integ Environ Asses 7: 513-541. [2] Giesy JP and Kannan K (2001). Global distribution of perfluorooctane sulfonate in wildlife. Environ Sci Technol 35: 1339-1342. [3] Giesy JP and Kannan K (2002), Peer-reviewed: perfluorochemical surfactants in the environment. Environ Sci Technol 36: 146-152.

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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 in Spain by the present paper. Here we present the 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) and liver (n=30) exposed in captive and wild raptors. We found no differences between two study periods in lead concentrations. However, a link between Pb exposure and oxidative stress a toxicosis biomarkers, with Pb, Pfaa and Pb exposure as possible allocation of antioxidants in plasma to cope with adverse effects of Pb. The integration of active and passive monitoring permits to have a more complete picture of the risk for raptor species in the face of Pb pollution. We found no mortality in the active monitoring the elevated blood Pb levels (73.7% with >200 ng/ml) in field-trapped Eurasian griffins as found in previous studies, but also report a significant mortality (8.3% with >30 µg/g d.w.) in Eurasian griffins and golden eagles with the passive monitoring.

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Persistence of elevated p,p'-DDE levels and HCB-related protoporphyrin IX decrease in eggs of common kestrels from Tenerife (Canary Islands, Spain)

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Persistent organochlorine (OC) pesticides, including p,p'-DDE, have been banned in many parts of the world for more than 30 years, but are still present in the top predators of terrestrial and aquatic food webs. The Canary Islands were one of the Spanish regions with the highest use of OC pesticides due to the intensity of its agriculture. A previous study presented a link between concentration of DDE and percentage of dead or sick in West Canarian common kestrel (Falco tinnunculus canariensis) from Tenerife Island showed elevated concentrations of p,p'-DDE (17.9 µg/g d.w.; equivalent to 4.9 µg/g ww). Here, we have monitored the levels of OC compounds (pesticides and polychlorinated biphenyls) in 40 uncharted eggs of West Canarian common kestrel from Tenerife Island collected between 2009 and 2016. We have also monitored the population of the porphyric protoporphyrin IX (PpIX) as a biomarker for these pigments as biomarkers of organochlorine pollution in birds. Biomass, status of embryo development and eggshell thickness were recorded from each egg and information about habitat characteristics were recorded for each nest. Because the eggs were at different degrees of desiccation, the content was lyophilised in order to measure OC concentrations in dry and lipid weight of content. OC analysis was performed by extraction using n-hexane and n-hexane:chloroform (4:1, gravitation ratio) for the lipid weight calculation) and resuspension in n-hexane, followed by four clean-ups with sulfonic acid and determination by GC-ECD. For porphyrin determination, eggshells were homogenized and extracted with acetonitrile:CH3CN (2:1) and then
analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dw): p,p'-DDE, 152.5 ± 1.7; p,p'-DDT, 0.118 ± 0.020; PCBs, 0.459 ± 0.121; HCHs (hexachlorocyclohexanes isomers), 0.021 ± 0.003; and HCB (hexachlorobenzene), 0.0042 ± 0.0004. p,p'-DDE levels have remained elevated for more than 20 years and these levels were statistically associated in general linear models with the surface of active and abandoned cropland in a 200 m-radius around the nest (+), distance from nest to urban areas and greenhouses (-), altitude (+) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p'-DDE levels, but decreased with embryo development. Protoporphyrin IX was the only pigment in eggshells and its content was negatively affected by HCB levels in egg content.

87 Long-term increase in secondary exposure to anticoagulant rodenticides in European polecats in Britain K.A. Samsbury, University of Exeter / Environment and Sustainability Institute; R. Shaw, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croose, The Vincent Wildlife Trust; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankte, National Museums Scotland; R. McDonald, University of Exeter / Environment and Sustainability Institute

As a result of legal protection and population recovery in Great Britain, European polecats (Mustela putorius) are expanding into areas associated with greater usage of second-generation anticoagulant rodenticides (SGARs). We analysed livers from polecats found dead (mostly road casualties) from 2013-2016 for residues of five SGARs. We related variation in residues to polecat traits (age, sex, provenance), to potential exposure pathways by analysing stable isotopes of carbon (δ13C) and nitrogen (δ15N) in whiskers, and to data collected from polecats in the period 1992-99. In all, 54 of 68 (79%) polecats from 2013-16 had detectable liver residues of at least one SGAR. Bromadiolone (71%) was the most commonly detected compound, followed by difenacoum (53%) and brodifacoum (35%). Liver SGAR residues did not vary with sex or with the season in which the polecat died. We found a positive association between occurrence of liver SGAR residues and δ15N values. Polecats in Britain feed predominantly on rats and rabbits and our findings are consistent with the concept that individuals feeding on rats (high 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: MO035, MO036, MO083

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

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

Landscapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivery of service vary temporally 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.

90 Understanding risk - a better approach to reduce uncertainty M. Wang, WSC Scientific GmbH / Dept Eatefe Modelling; M. Foudoulakis, Dow Agrosciences / RSRA EERS

For many compounds the intrinsic toxicity as determined in toxicity studies does not reflect toxicity and risk adequately. Rather other mechanisms determine which species are most at risk (focal species) and how large the risk posed these to 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 assess the relevance of effects in considering specific worst-case assumptions. In both example compounds metabolism and excretion together with feeding behaviour mainly determined the acute and long-term risk. All of these mechanisms are not considered in the first tier risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

91 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms E. Ziółkowska, Jagiellonian University / Institute of Environmental Sciences; C.J. Topping, Aarhus University / Department of Biology; 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 throughout Europe. 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-temporally heterogenous in agricultural landscapes. The framework has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on the population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g. arable or permanent crop). The current scheme of agricultural landscape feasible and usable for landscape-scale risk assessment. More importantly, the presented tools allow for testing in silico various scenarios of agricultural practices, including pesticide use, in differentially 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 agricultural biodiversity. This study was supported by the National Science Centre, Poland (2015/19/B/NSZ/01939).

92 Where are the Springtails? A vertical distribution model for Collembolans V. Roeben, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research BioV; L.S. Tschoppe, RWTH Aachen University / Institute for Environmental Research BioV; T. Preuss, Bay Ag / Environmental Safety; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Ross-Nickoll, RWTH Aachen
with respect to environmental risk assessment it is crucial to know where and when to protect an organism but still little is known on the dispersal of collembolan communities in agricultural landscapes. Especially for the environmental risk assessment of plant protection products vertical movements can be relevant for exposure assessment of in-soil organisms. Thus, ecological modeling offers a powerful tool to link exposure to effects. We will present the individual-based model of the soil-dwelling collembolan *Folsomia candida* FOLCAS (*Folsomia candida* simulation). FOLCAS is a vertical distribution model simulating an agricultural soil column, which can be applied to demonstrate the effect of variations in environmental parameters on the population and its dispersal. In addition, the model features the option to evaluate the effect of a pesticide application. The model consists of two submodels: the lifecycle and the movement submodel. The movement of the individuals in FOLCAS is influenced by temperature, pore space, pH and the organic matter as a proxy for food availability. In order to assess the importance of food availability as a main trigger for movement a vertical distribution experiment was designed. In this experiment we assessed the vertical dispersal of *F. candida* in OECD soil in relation to food location and time. Transparent PVC columns were filled with 350 g OECD soil up to 20 cm column height and 86 individuals of *F. candida* of different age classes were added. Each column was divided in 6 compartments from top to bottom: 0-1 cm, 1-2.5 cm, 2.5-5 cm, 5-10 cm, 10-15 cm and 15-20 cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (2 cm feeding). The results demonstrate that movement submodel and simulation results of the vertical dispersal of collembolans will be presented. A case study will be used to elucidate the importance of the vertical dispersal of non-target arthropods in effect assessment.

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

K. Mintram, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences College of Life and Environmental Sciences; S. Parker, Cefas Weymouth Laboratory; P. Thobek, Syngenta / Environmental Safety.

Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allows for the incorporation of individual variability, population-level interactions and specific behaviours. IBMs can therefore be used to extrapolate from a large number of individual-level endpoints and simulate potential effects on populations under realistic environmental conditions. We present an IBM of the three-spined stickleback (*Gasterosteus aculeatus*) developed for the purpose of predicting population-level effects for exposure to chemicals. The IBM was developed from a series of sub-models parameterised from field data obtained from the literature. Modelled population dynamics (e.g. size / age class distributions and annual fluctuations in population abundance) emerge from the adaptive traits, behaviours and interactions between individuals and their environment (including toxicant exposure). Here, we describe the development and validation of a stickleback IBM and demonstrate its practical application in ERA. Empirical data quantifying the reproductive effects and subsequent recovery, following exposure to a fungicide, were input into the IBM as a sub-model. Various exposure and recovery scenarios were simulated to predict population-level effects over time. The model outputs demonstrated that exposure duration and individual recovery post-exposure can influence the overall effects of chemical exposure on population abundance. We suggest that using IBMs to incorporate realistic exposure and recovery scenarios may improve current ERA and result in more realistic protection standards for wild populations.

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

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

An ongoing dilemma in risk assessment is the perceived difficulty in successfully integrating scales that range from the molecular to ecological, 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 defined 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, Victoria, 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 for temperature and precipitation. We will demonstrate the application of the Bayesian-network relative risk model to integrate pesticide effects at the molecular level and the alteration of watersheds to calculate risk to the ecological endpoint Chinook Salmon, the specific economic ecosystem services provide by the endpoint and the watersheds, and finally demonstrate the risks to human well-being as defined from a variety of cultural perspectives.

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

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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 surfaces 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 of Ag2S-NP (28.08±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. The same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by sICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms over time. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg⁻1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.
Engineered silver nanoparticles (Ag ENP) are present in many consumer products. Hence, the ENP enter into sewers and wastewater treatment plants with a high predicted removal into the sludge. If the sludge is applied to agricultural soils, compostation might result in resuspension of the ENP. The fate and impact of Ag ENP in soils is still unclear. Short- and long-term column remediation 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 (ReSoil 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag\textsubscript{dig}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation showed the highest remobilization of Ag which was below 2% of the Ag\textsubscript{dig} concentrations in the soil columns. The correlation between remobilized Ag\textsubscript{dig} 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 retention. In the unsaturated experiments, a nearly complete retention was found for the Luvisol that showed a clearly smaller pore size structure than the Cambisol. The horizontal 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\(^{-1}\), Lysimeter (7 mg kg\(^{-1}\)) = 56 ng l\(^{-1}\), DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. ENPs were entrapped in a loosely packed column and were not 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 microcommunity and the root uptake (e.g. beet) needs further long-term investigations.

97 Determination of attachment efficiency (α) for ENPs in different types of soils by saturated column experiments K. Norrfors, SLU Uppsala / Soil and environment; G. Cornelis, Swedish University of Agricultural Sciences / Soil and environment

The attachment efficiency (α) has been suggested as the most appropriate fate descriptor for transport of engineered nanoparticles (ENPs) in soils and saturated column experiments as the most accurate method to obtain α. Due to the complexity of the soil properties and heterogeneity, 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} NP) were introduced to a round tube and packed column expirisin this in different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO\(_3\) was used as a conservative tracer to estimate the effective porosity and dispersivity. All columns were packed with an excess of rainwater to limit the amount of air present in the saturated soil. α was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydrus 1D or the relative recovery of the ENPs in the break through curves. Preliminary results show no significant differences in α values for 80 nm and 20 nm Au ENPs. However, the Au ENP breakthrough curves appeared dependent on the flow rate. Even though the shape of the break through curves changes with flow rate, this can be compensated during modeling arriving at consistent α values between the systems with varying flow rates. Furthermore, presence of air in the column affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration gives higher α values and cannot be accounted for in the equations used for estimating the attachment efficiency. In conclusion, when varying the initial ENPs concentration into the columns, the α value is significantly affected.

Hence, low NP concentrations need to be used in the column experiments to minimize the approximation 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 J.J. Wielinski, ETH Zürich/Eawag / Process Engineering; A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering. Particle Lab; A. Voegelin, Eawag Swiss federal Institute of Aquatic Science and Technology / Process Engineering. R. Kaegi, Eawag - Swiss federal Institute of Aquatic Science and Technology / Process Engineering. R. Tackli, University of Vienna / Department of Environmental Geosciences. ARCHE, J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF; K. Arjis, ARCHE; E. Smolders, Katholieke Universiteit Leuven; D. Leveret, wca; K. Oorts, ARCHE

Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF; K. Arjis, ARCHE; E. Smolders, Katholieke Universiteit Leuven; D. Leveret, wca; K. Oorts, ARCHE

As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-across from ionic silver to silver nanofoms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanofom with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~83% ZnS) with a concurrently 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 sulfidisation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopryrite, indicating that Cu was not completely oxidised during the combustion.Comparable recoveries of Cu\textsubscript{diss} and Cu\textsubscript{soil} were returned from LCF analyses. All Cu spectra of the sludge and the ashes were similar and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn\textsuperscript{2+}. All Zn spectra of the ashes were comparable.

100 Tackling nanoparticle fate assessment in surface waters - heteroaggregation as a key process H. Walsh, University of Vienna, Dept. of Environmental Geosciences / Environmental Geosciences, F. Venkatakrishnan, T. Hofmann, University of Vienna / Department of Environmental Geosciences

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

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

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

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

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

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. Dispersed oil interferes with either the pre-expression of heat shock protein 90 (hsp90) or potentially causes alternative splicing of pre-mRNA. Expression of hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermoult duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed molting and therefore slower growth.

103 Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phylum Porifera).
I. Vag, 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 (phylum Porifera) are a diverse group of filter-feeder organisms present in most aquatic environments. In the marine environment, sponges perform a wide range of ecological functions including cycling of nutrients such as carbon, nitrogen and silica; and, in areas where they are present at high densities (spoon grounds), they provide a habitat for a diverse range of benthic organisms. Because of their importance within marine ecosystems, the impacts of anthropogenic activities such as hydrocarbon exploration and production on marine sponges must be assessed. The objectives of this study were to: (1) determine the physiological impact of crude oil and/or dispersant contaminated seawater and sediments in model sponge Halichondria panicea; and (2) characterise the effects of crude oil and/or dispersant contaminated seawater exposure on the transcriptome of H. panicea. A series of 48-h cyclic aromatic hydrocarbon (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 hosphate/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shoaling 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 all of the characterized sediment samples.

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. Krasnec, Abt Associates; M.L. Gielazyn, NOAA / USEPA Region IV

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic contaminants composed of two or more fused carbon rings and are a major 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 zooplankton (Daphnia magna) were exposed to either a single PAH (fluoranthene) or a complex PAH mixture prepared from weathered crude oil with varying PAH and UV exposure scenarios. Red drum tests were conducted as a single pulse exposure, and daphnia tests were conducted as static renewals. Toxicity (LC50) was UV and PAH dependent in both species. In red drum tests, shorter PAH pre-exposure times resulted in LC50s that were considerably lower than LC50s associated with longer pre-exposure periods. This is likely due to lag time in the initiation of physiological metabolisms/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 toxicity was observed in daphnia on 24-h post-exposure, which correlated the duration of the UV and PAH exposures. We also report the effects of various UV-modified photoproducts on marine fishes. Taken together, these data suggest that even short-term, transient exposure to low concentrations of PAHs (common during a spill event) results in acute toxicity in aquatic organisms, and those effects may be manifested outside of standard bioassay testing durations.

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

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

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

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

Fish model species in human and environmental toxicology (II)

107 Life-stage, and species-specific effects of dietary methylmercury exposure K. Bridges, University of Maryland / 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 microbiologically transformed into organic forms, such as methylmercury (MeHg) [1]. MeHg is highly bioavailable, and it bioaccumulates and biomagnifies in biota leading to potentially toxic body burdens in long-lived organisms at high trophic levels. MeHg can be actively transferred from mother to offspring, through large amino acid transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the development loss in effect of dietary MeHg on early life stages of P. promelas and P. robustus embryos (Menidia beryllina) in 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 a higher vertebrate species. Metabolomics was performed on the mid-brains of male mice (Mus musculus CD-1) exposed to similar concentrations of dietary MeHg for 30-days. Changes in dopamine concentrations of the telost brain were mirrored in the mid-brains of male mice, and several other significant changes to the mouse mid-brain metabolome were detected. Collectively, these results suggest current environmental exposure scenarios to MeHg are sufficient to induce a number of molecular-level changes that are associated with costs to whole organism fitness, with varying significance for multiple life stages, and species. Due to the similar changes detected in mice, there is increasing evidence to suggest teleosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.

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

The increasing number of emerging chemical contaminants (ECC) and their unknown effects to aquatic ecosystems serves as an impetus to develop advanced environmental risk assessment (ERA) approaches to improve regulatory decision-making. This is because current ERA rely on live animal testing that are expensive, time consuming and of ethical concern. Furthermore, the use of model organisms does not assure protection towards native species because of the limited taxonomic study of these species. Also, species that are feeding from a variety of toxic sources may present an even higher risk. Therefore, 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 interpretative decision-making. Objective evaluation of 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 genes 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. Phototoxicity is observed as a 2 to greater than 1000 chemical toxicity to aquatic organisms that have also been 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.
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 controls. Future data gathered on gonadal histology, gene expression and DNA methylation will allow us to further hone in on the mechanisms causing higher order downstream effects. Elucidation of the mechanisms contributing to these higher order downstream effects will inform adverse outcome pathways, as well as allow for the quantification and comparison of responses to established and emerging endocrine disruptors across multiple biological scales.

110 Integrated OMICS and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example
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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants in the environment. Many of them cause developmental defects in fish, and cardiovascular tissue seems to be the most sensitive tissue. The mechanisms of toxicity remain largely unresolved for many PAHs, though partial adverse outcome pathways (AOPs) exist for those that are aryl hydrocarbon receptor (AhR) agonists. Rainbow trout (Oncorhynchus mykiss) yolk sac larvae were exposed to sublethal concentrations of PAHs that act via different mechanisms of toxicity: Retene, an AhR agonist causing diosin-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 used to develop models 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 caridomyocyte 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 intervention on the hydrological cycle by different human activities. The basin is a source of water resources to various industrial, agricultural and urban activities, with many focal places of point and diffuse contamination along its main axis, in addition to a high degree of modification of land use associated with the basin. The high degree of intervention and fragmentation of this river has affected the biota and water quality mainly in its lower third, due to the convergence of complex chemical mixture and anthropic interventions in the main course. The objective of this study is to determine how the development associated with this river impacts the physiological/reproductive state of the native species Percilia irwini (n = 66) in situ. Different sublethal responses were evaluated through biomarkers at different levels of biological organization (Biochemical, cellular, and individual) and environmental parameters (pH, temperature, conductivity and total dissolved solids). The results obtained indicate an increase in the Hepatic EROD activity (ethoxyresorufin-O-deethylase) towards the lower third of the river. The Gonadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a 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
Sustainable Development Goals: the global context defining the agenda for government, business and academia

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

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

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

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

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

118 Questions and answers

119 Rethinking Atmospheric Mercury Chemistry
M. Gastin, University of Nevada, Reno / Natural Resources and Environmental Science

Mercury (Hg) is considered a global pollutant. This is because it has a long atmospheric residence time. Because of the continued and increasing emissions of this pollutant to the atmosphere associated with anthropogenic activities, and the fact that once released from a geologic repository an atom of Hg may be potentially bioavailable for thousands of years, the Minamata Convention was developed and has come into force. This global treaty focuses on protecting human health and the environment from the adverse effects of mercury. There are 3 general forms in the atmosphere- gaseous elemental Hg, gaseous oxidized Hg (Hg(I) or Hg(II) compounds), and that bond to particles. Gaseous elemental Hg can be transformed to gaseous oxidized Hg (GOM) by a variety of atmospheric oxidants. Once generated, GOM is readily deposited to ecosystems. Understanding the chemistry of GOM is important for predicting deposition velocities, availability in ecosystems, and potential for conversion to methylmercury. Methylmercury is a subtle neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR-RMAS), and an air Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KCl denuder- results in underestimation of GOM concentrations by 2-10 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

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Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effects of Se against Hg have been observed in both multicellular organisms and environmental media containing microbes and terrestrialsubsidy of mercury and selenium, with spiders containing elevated concentrations of these two contaminants. Our data provide evidence of a wedge-shaped cluster for the relationship between Se and percent MeHg in bulk sediment and biofilm, suggesting that at high concentrations, percent MeHg in bulk sediment and biofilm is reduced. In crainflys and spiders, we find a negative correlation between Se concentration and both absolute MeHg concentrations and percent MeHg. These results suggest that Se inhibition of MeHg accumulation might occur both at the microbial and macroinvertebrate levels.

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

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

Uncertainties in global mass balance of mercury are constrained in this work using all the currently available observations of mercury species in the global environment, and a previously published multimedia model for mercury, UncertWM3. Reduced uncertainties help in estimating mercury concentrations and mass balances with greater confidence. Ten key input parameters that were identified to be significantly contributing to the output uncertainties in previous studies. These included: emissions of mercury to the atmosphere, reduction and oxidation of mercury in surface and sub-surface oceans, and partition coefficients of mercury species groups (Hg(0), Hg(II), Hg-p) in surface and sub-surface oceans. Then, a survey of literature on observations of mercury in the global environment is made. As these observations (for example, concentration of total mercury in air) are also key model outputs, we can update model inputs by comparing model simulated outputs to the actual observations. For this updating, a Markov chain Monte Carlo (MCMC) technique called Metropolis Hastings which is based on the Bayes rule is adopted. The observed concentrations of Hg(0) in atmosphere, dissolved gaseous mercury, and total mercury in surface ocean are collected from published literature and used to obtain a likelihood function. Input parameters and their confidence range are revised. A revised mass balance is obtained through a forward Monte Carlo analysis using updated inputs. It is found that the uncertainties in key input parameters (such as partitioning of reducible divalent mercury between suspended solids and water in surface oceans) have been constrained to a considerable extent, whereas photolysis (P) limitation. No relations between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, alongside with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-metric multi-dimensional scaling, principal component analysis, Pearson’s product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation. Only in the absence of P-limitation conditions (P<0.05), we found that MeHg was significantly related to most chemical and microbial parameters, which is an indication of metabolism-dependent Hg transformations. The activity of heterotrophic low-nickel acid bacteria seems responsible for most of Hg methylation in seawater under P-limitation. Under P-limitation conditions, DGM shows strong correlation with microbial fractions and chlorophyll a, which confirms previous research about biological DGM production. Contrary to MeHg, DGM transformations are probably not metabolically dependent, as most of these correlations can also be observed under P-limitation. MMHg biomass formation from microeston to mesozooplankton was observed through an increased biomagnification factor. Hg and Se bioaccumulation in biota, contributes more to variances in key model outputs, compared to parameters such as global mercury emissions. Therefore, more significant effect must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

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

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Microbial transformations of monomethylmercury (MMHg) and dissolved gaseous mercury (DGM) at the lower marine trophic levels are still not well understood. This is especially important in oligotrophic and nutrient-limited seas, where microbial food web and microbial loop dominate over classical (herbivorous) food web. Our research focused on the examination of the effects of probable nutrient limitation (P-limitation) on relations between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, alongside with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-metric multi-dimensional scaling, principal component analysis, Pearson’s product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation. Only in the absence of P-limitation conditions (P<0.05), we found that MeHg was significantly related to most chemical and microbial parameters, which is an indication of metabolism-dependent Hg transformations. The activity of heterotrophic low-nickel acid bacteria seems responsible for most of Hg methylation in seawater under P-limitation. Under P-limitation conditions, DGM shows strong correlation with microbial fractions and chlorophyll a, which confirms previous research about biological DGM production. Contrary to MeHg, DGM transformations are probably not metabolically dependent, as most of these correlations can also be observed under P-limitation. MMHg biomass formation from microeston to mesozooplankton was observed through an increased biomagnification factor. Hg and Se bioaccumulation in biota, contributes more to variances in key model outputs, compared to parameters such as global mercury emissions. Therefore, more significant effect must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

124 Poster spotlight: M0333, M0334, M0335

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?

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Passive sampling with thin polymer sheets is increasingly recognized as a superior method for accurately measuring soil and sediment concentrations of persistent organic pollutants (POPs). However, using thin polymer sheets can lead to anisotropic risk assessment because POPs can be desorbed from the polymer surface at a slower rate than their diffusion into the water. For example, a 3 cm thick polyethylene (PE) fiber can show a 10% reduction in concentration relative to a 0.5 cm thick PE fiber after 2 years. For this reason, it is important to develop a method for determining the best thickness of polymer sheet to use in passive sampling of POPs. In this study, we compared the performance of a 0.5 cm thick PE fiber with a 3 cm thick PE fiber in a simulated field deployment. The results showed that the 0.5 cm thick PE fiber had a lower blank concentration and a faster reaction time than the 3 cm thick PE fiber. This suggests that using a thinner polymer sheet may be more effective for accurately measuring POPs in field deployments.

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

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Realistic risk assessment of sediments polluted with organic contaminants is much more complex than tests with water samples. Physical and biological processes as well as contaminant bioavailability, may strongly influence the adverse effects on test organisms in whole sediment testing. The current work is the first study of a series of studies on how sediments equilibrated silicon rubber (ESR) could allow for a major simplification of the assessment of the overall impact of organic contaminants in sediment. The aim of the current study was to demonstrate that ESR can transfer the chemical activity of the insecticide chlorpyrifos from spiked sediment to aquatic bioassay with ESR as a passive dosing material. The effect level of chlorpyrifos in a 28d whole sediment bioassay was compared to effect levels observed in a 4d ESR passive dosing test using first instar larvae of the midge Chironomus riparius. Additional sampling with polyacrylate solid phase microextraction (SPM) fibers in both sediment and ESR dosed water was used to align the bioavailable concentrations in both tests designs. The ESR sampler accumulated chlorpyrifos up to 12% of the total spiked chlorpyrifos amount within 1 month. SMPE 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 SMPE samples in both assays indicated lethality toxic freely dissolved concentrations in the range of 0.2 – 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 insecticidal contaminated sediment comparable to much more elaborate 28d whole sediment tests. Also, at lowest tested toxic insecticide levels, concentrations in SMPE extracts were close to detection limits, so accurate measurements of safe bioavailable chlorpyrifos concentrations via SMPE 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 Agrobiología de Sevilla CSIC; M. Cantos, IRNAS CSIC; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica 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 development of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and their chemicals should be based on two measurable values: the total extractable concentration and the bioavailable concentration as measured with robust and reproducible chemical and/or biological methods. One of the chemical methods which has been proposed to measure bioavailability of hydrophobic chemicals (HOCs) such as PAHs is the desorption extraction with Tenax during 20 h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integri Environ Assess Manag. 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retrospective contaminated land management but also prospective risk assessment applied in the approval and regulation of organic chemicals. With the aim of providing pathways for implementation into regulatory contexts, we carried out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of spiking sediment with PAHs or use of PAHs in field conditions) were applied to determine bioavailable concentrations in a wide set of operational conditions ranging from a different size scale to dissimilar treatments (planting, bioassay, application, etc.).

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

R. Rietra, Alkerra and Wageningen University / sustainable soil management; J. Harmens, Wageningen Environmental Research / CALM

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and mineral has been followed during periods up to 25 years. Biodegradation took place on real scale fields (six landfills and one depot) within the Netherlands. On these fields diverse sediments were spiked with PAHs. PAHs were measured in the original sediment and resulting soil. PAHs were present in concentrations up to 550 mg/kg d.m (Dutch list). The objective of the investigation was to find experimental prove on the existence of long term biodegradation in field conditions. The measured data showed continuation of PAH degradation and this could be distinguished in 1) fast degradation in the first year, 2) slow degradation in the following 6 years and 3) very slow degradation of PAHs from 6 years until at least 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorbing fractions can be measured. Tenax applied at 20°C gives the fast desorbing fraction applied at 60°C gives the slow desorbing fraction and using a Tenax 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 derivations (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 biocar and compost amendment on the behaviour and toxicity of tar mixtures in

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contaminated soils collected from two gasworks sites in the UK. Site 1 had a total polycyclic aromatic hydrocarbons (PAHs) concentration of 3500 mg/kg, and total aliphatic concentration of 1500 mg/kg. Site 2 had a lower concentration of both aromatic and aliphatic hydrocarbons 250 mg/kg and 350 mg/kg respectively. Heavy metals (HMs) concentrations in both soils ranged between 600 and 1200 mg/kg and the main elements were Zn, Pb and Cu. Both soils were amended with either 5% biochar or 15% compost in order to achieve metal stabilization and enhance soil degradation. The total of available contaminant concentrations of the HM increased as HMs were determined after 0, 30, 90 and 180 days. Further to this microbial biomass, soil respiration, phosphodiestase analysis, Microtox toxicity, earthworm’s lethality and seeds germination were carried out to assess how ecological health changed as the soils underwent remediation treatments. The study showed that, for both soils, microcosms amended with compost showed the most significant reductions in toxicity. The microbial number and respiration activity increased by two orders of magnitude after compost amendment. Conversely, there was no significant difference between non-treated and biochar amended soils. At the onset of the experiment, no seed germination was observed in Soil 1 (non-treated) whereas an increase in seed germination was observed after 90 days for mustard and 90 days after 30 days for peas. The compost treatments had the highest percentage germination for both soils across all seed types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the onset. The biochar treated 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
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Reclaimed water is increasingly used in arid and semi-arid regions for irrigation. Contaminants in the reclaimed water, (e.g. pharmaceuticals and personal care products (PPCPs) and metals) could accumulate in exposed crops. Biochar is a potentially cost-effective soil amendment and contaminant sorbent that could reduce the plant bioavailability of reclaimed water associated contaminants. Biochar is biologically active and can change plant-pH. It can undergo pyrolysis (decomposition at high temperatures with no oxygen). The main objective of this study is to investigate the impact of wood biochar on the crop bioavailability of selected PPCPs often found in reclaimed water. A secondary objective is to quantify the contaminant sorption-desorption characteristics in the amended soils and to determine if there is a relationship with plant bioavailability. PPCPs were selected as target contaminants because of their widespread occurrence in reclaimed water and their potential impact on animals feeding on the irrigated crops. Target PPCPs were selected based on chemical properties, widespread use, frequent detection in WWTP effluent, and potential risk to the environment. The target PPCPs represent a range of therapeutic uses including antibiotics linked to antibiotic resistance in bacteria (sulfamethoxazole (SMZ) and triclosan (TRI)), an anticonvulsant that prevents seizures and relieves nerve pain (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinony Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they were produced from tree species that often require removal because they are considered invasive or due to insect infestations. Corn was used as the test plant because of its commercial value and has been grown with reclaimed water in the past. After the 28 day growing period, it was found that there was no negative impact of the biochars on corn growth. Once the plant tissue analysis and sorption experiments are completed, the impact of biochar on contaminant uptake will be evaluated. This study is the first to compare the impact of PPCPs soil sorption and microbial activity in reclaimed water. Extraction and analysis of the plant tissue is being conducted along with the sorption/desorption experiments. Final results expected by December 2017.

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

131 A novel framework for a new generation of water consumption indicators in LCA and footprint studies
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Freshwater resource has been recognized as being a safeguard subject within the Agenda 21 (2002) and the Aichi Biodiversity Target (2010-2020). Biochar is a (often plant material) that has partly or fully undergone 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 (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinony Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they were produced from tree species that often require removal because they are considered invasive or due to insect infestations. Corn was used as the test plant because of its commercial value and has been grown with reclaimed water in the past. After the 28 day growing period, it was found that there was no negative impact of the biochars on corn growth. Once the plant tissue analysis and sorption experiments are completed, the impact of biochar on contaminant uptake will be evaluated. This study is the first to compare the impact of PPCPs soil sorption and microbial activity in reclaimed water. Extraction and analysis of the plant tissue is being conducted along with the sorption/desorption experiments. Final results expected by December 2017.

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

133 Towards global regionalized characterisation factors for water consumption impacts on instream freshwater ecosystems
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Several life cycle impact assessment (LCIA) models have been proposed to...
quantify potential water consumption impacts on freshwater ecosystems. In existing mechanistic models, mostly based on species-discharge and species-area relationships, ecological requirements are not taken into account. This implies considering equal response to stress for different taxa, overlooking the relationships between species and their habitat, along with other aspects of biodiversity (e.g. abundance). In this study we want to show the importance of habitat modelling to describe the impact patterns of water consumption on ecosystem quality. We propose a new model, the aquatic ecosystem quality. We propose a new model, the aquatic ecosystem LCIA model based on freshwater species and discuss the applicability at the regional and global scale. Water consumption may alter stream discharge and other related physical variables. Habitat suitability equations can be used to quantify physical habitat availability for freshwater species in Weighted Usable Area (WUA). Starting from WUA equations, a Habitat Quality Potential index is proposed for river fish species and invertebrates and is applied and proposed in France at Q50 (wet season) and Q90 (dry season) flows. HCP represents the change of available habitat area deriving from river discharge alteration. At the river reach scale, HCPs from different taxa have been aggregated under different perspectives in order to test the results’ sensitivity to negative and positive effects of hydrological alteration. A spatial aggregation has been also performed from a watershed and sub-watershed. Subsequently, the global HCP model’s applicability has been discussed. HCP is highly correlated with river size. The aggregation at reach scale is driven by specific taxa and by positive HCP scores (habitat loss). The result of the aggregation at watershed is consistent with existing evaluations of hydromorphological pressures in Europe. The main challenge in applying HCP globally is due to hydrological and hydraulic data availability. It is not possible to find one consistent method for quantifying and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanism impact characterisation which should be integrated with fate factor models describing hydrological alteration at a compatible spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion
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Biotic natural resources have received little attention by the LCA community and this tempts the use of LCA for fish based food and feed products. Current LCA methods do not assess the impact of biotic resources depletion. Subsequently, the global HCP model’s applicability has been discussed. HCP is highly correlated with river size. The aggregation at reach scale is driven by specific taxa and by positive HCP scores (habitat loss). The result of the aggregation at watershed is consistent with existing evaluations of hydromorphological pressures in Europe. The main challenge in applying HCP globally is due to hydrological and hydraulic data availability. It is not possible to find one consistent method for quantifying and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanism impact characterisation which should be integrated with fate factor models describing hydrological alteration at a compatible spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

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

Screening of wastewater-borne pharmaceuticals and their phototransformation products in rivers
S. Nagel, M. Montemurro, IAEA-CSIR / Environmental Chemistry; D. Barceló, IQBAR-CSIC / Department of Environmental Chemistry
Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Hundreds of wastewater-borne pharmaceuticals have been detected in river samples but their concentrations along the river change constantly due to additional inputs and natural attenuation processes. Apart from biodegradation, drugs can undergo phototransformation reactions by either direct or indirect photolysis including reaction with singlet oxygen (O2), hydroxyl radical (•OH), peroxo radicals (•OOH), photo-activated organic matter, and other reactive species. To evaluate these processes in a river, usually laboratory studies are
performed in a first stage and then in the next step studies are conducted directly in the natural environment. In our group, we proposed a workflow using the combination of HRMS and processing software for evaluating the phototransformation of pharmaceuticals on a single compound basis under simulated and real environmental conditions. In contrast to this compound-by-compound approach, in the new approach presented here, degradation was not assessed for a single compound but instead a cocktail of human drugs was subject to the transformation processes. Following the identification of photo-TPs, a list of suspect TPs was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstructed surface water was spiked with a cocktail of 34 pharmaceuticals at concentrations of 10 µg/L and exposed to artificial light in a sunlight simulator. Upon exposure, MS/MS was used to identify photo-TPs. Several photo-TPs in the surface water samples originating from rivers were screened for their presence. For the enrichment of the potential photo-TPs, water samples were preconcentrated on four SPE cartridges connected in series and then analyzed using the same system mentioned above. With this methodology more than 30 photo-TPs were detected in the irradiated reactor samples. As of the time of submission of this abstract, the identification and quantification of some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus, this approach highlights that UPLC--HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

139 Degradation of a polymer probe exposed to different wastewater environments: Linking chemical transformations and potential microbial consumers

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The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (AER) and in the denitrifying anaerobic bioreactor (ANA). The progress of biodegradation after several days of exposure was reflected on changes in the MALDI-TOF MSI mass spectra obtained across the sample’s surface. Peaks were identified using liquid chromatography coupled to high-resolution mass spectrometry (QExactive, Thermo Scientific), which evidenced the occurrence of three different degradation pathways (Fig. 1). Results were further examined using different image processing tools enabling to observe differences between degraded and non-degraded areas. Microbial biomass was collected from water surrounding the polymers (free-living communities) while communities attached to the polymers were collected scratching the surface of the polymer with a sterile spatula. The nucleic acids were extracted by phenolization process. One microtitre of the extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, composition of free-living bacteria was significantly different than polymer-attached microbial. Bacteroidia, Spirochaetes and unclassified bacteria co-dominated the free-living communities in AER and ANA, although metabolisms under aerobic/anoxic/nitrifying conditions differ quite dramatically. Polymer-attached in the same waters were dominated by deltaproteobacteria, a class of proteobacteria characterized by sulfate-reducing bacteria although also harbors aerobic phytophyltes. Free-living microbial communities in IN were dominated by Bacteroidia, belonging to the phylum Bacteroidetes whereas their potential attached was dominated by Spirochaetes (a class of Bacterioidetes). Results suggest that polymers select specific microbial groups that benefit from consumption of PCLD that can be used as carbon and energy source.

140 Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant

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In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems that has affected the potential recycle and reuse of wastewater for domestic or industrial usage. Selection appropriate treatment approach has played an important role not just to reach discharge limits, it is also important to decrease human footprint in the environment. Some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of oxidizing unreactive iodide to reactive iodine, when they can play roles to degrade recalcitrant pollutants in wastewater. The resulting iodine represents a powerful antimicrobial compound. The aim of this study is investigating the potential of acetalophene and phenolic organic contaminant acetalaminophen as mediator in a laccase mediator system to generate disinfectant iodine. The stability of reaction can be changed depending on the pH, temperature and multiple compound existence and system optimization is required to stabilize iodine synthesis. In this study, two different free laccases and insolubilized as cross-linked enzyme aggregates have been tested. Acetalophene synthesis is investigated with different KI (0, 10, 30 and 40 U/ml) concentrations and different KI concentrations (5, 10, 30 and 40 U/ml) for 5 hours. Compounds were injected in distilled water as well as in the influent and effluent samples of wastewater treatment plants to see synthesis of iodine while the micropollutants have been removed in Laccase Mediator System. In the experimental sets, removal of persistent compounds were determined by liquid chromatography coupled to high-resolution tandem mass spectrometry and inhibition effect of iodine measured by fecal coliform tests. 0.35 maximum mM iodine concentration could be synthesized during experiments. During iodine production, while phenolic compounds’ concentrations were decreased (50% acetalaminophen removal in real effluent wastewater treatment plant), removal of non-phenolic compounds such as naproxen were also observed (50%). The results have shown that the biocatalytic generation of I was possible using laccase-mediator system. Iodine production was affected by the initial laccase activity and mediator concentration. Laccase catalyzed bacterical activity in municipal wastewater was also assayed without the addition of any mediator assuming that wastewater already contains mediators such as acetalaminophen. Using this system, non-fecal coliforms present in the tested wastewater were removed.

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

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Persistent, bioaccumulative, and toxic (PBT) substances have been monitored since the 1960s. PBT substances are usually not well water soluble and tend to adsorb to sludge, soil and other particular matter, and thus spread slowly in the environment. However, as a consequence of their high environmental stability, they can eventually reach even remote areas like the Arctic, and pose a threat to apex predators due to their ability to accumulate in the food chain. Persistent, mobile, and toxic (PMT) environmental contaminants, however, do not accumulate in the food chain, but are much more mobile in aquatic environments, and thus, they spread faster throughout the environment and can accumulate in the food web. As persistent substances, they can be transported through the food chain and eventually reach even remote areas.

In our group, we proposed a workflow using the natural environment as a test environment, allowing the search for photon transformation products (TPs). As of the time of submission of this abstract, the identification and quantification of some of the photon transformation products was still underway. Several photon transformations of our database were detected in the extracts of the surface water samples. Thus, this approach highlights that UPLC--HRMS is a powerful tool for qualitative analysis, allowing the search for photon transformation products. The method was tested in four WWTPs by exposing the polymer probes in situ at the secondary and nitrifying/denitrifying conditions. The progress of biodegradation after several days of exposure was reflected on changes in the MALDI-TOF MSI mass spectra obtained across the sample’s surface. Peaks were identified using liquid chromatography coupled to high-resolution mass spectrometry (QExactive, Thermo Scientific), which evidenced the occurrence of three different degradation pathways (Fig. 1). Results were further examined using different image processing tools enabling to observe differences between degraded and non-degraded areas. Microbial biomass was collected from water surrounding the polymers (free-living communities) while communities attached to the polymers were collected scratching the surface of the polymer with a sterile spatula. The nucleic acids were extracted by phenolization process. One microtitre of the extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, composition of free-living bacteria was significantly different than polymer-attached microbial. Bacteroidia, Spirochaetes and unclassified bacteria co-dominated the free-living communities in AER and ANA, although metabolisms under aerobic/anoxic/nitrifying conditions differ quite dramatically. Polymer-attached in the same waters were dominated by deltaproteobacteria, a class of proteobacteria characterized by sulfate-reducing bacteria although also harbors aerobic phytophyltes. Free-living microbial communities in IN were dominated by Bacteroidia, belonging to the phylum Bacteroidetes whereas their potential attached was dominated by Spirochaetes (a class of Bacterioidetes). Results suggest that polymers select specific microbial groups that benefit from consumption of PCLD that can be used as carbon and energy source.

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

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

144 Combining economic modelling and LCA to assess regional policies: key learning points from a case study on the French forestry sector T.B. Beausoier, 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 availability (national, regional, Local authorities) and the two different types of methodological 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 (FFSM), and LCA to assess the eco-efficiency of two regional policies supporting local wood industries in the French East Region. Two approaches will be used to combine economic modelling and LCA: i) a Life Cycle Inventory (LCI), i.e. i) the Input-Output model, 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 biobased systems: RELCA in the Danish wind turbine fleet S. O’Keefe, Helmholtz centre for environmental research - UFZ / BEN; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; U. Franko, Helmholtz Centre for Environmental Research, UFZ / Department of Soil Physics; D. Thraen, Helmholtz Centre for Environmental Research UFZ / Deutsches Biomasseforschungszentrum gemeinnützige GmbH, DBFZ / BEN

Keywords: Regional, spatial, biobased economy, GHG While traditional life cycle assessment is a powerful tool, for spatial applications, it is limited. With the ever increasing drive towards regional biobased circular economies, as a means of ensuring future climate change mitigation, there is a need to produce more regional and spatially representative life cycle assessments of biobased systems and bioeconomy regions. “RELCA”, a Regional Life cycle inventory approach, was developed to assess the regional and spatial variation in the environmental performance of bioenergy production within a focus region. Through the use of catchment delineation, conventional geographical modelling is combined with life cycle software to assess the potential environmental burdens of regional bioenergy configurations (i.e. bioenergy plants and their biomass catchments). RELCA was used to assess the climate mitigation potential of biodiesel, for the region of Central Germany. With this approach we showed, for the focus region, that the mitigation potential changed between the different biodiesel configurations, due to their location within the region. When compared to a fossil diesel comparator (83.8 CO2eq/ MJ), the climate change mitigation potential of the regional biodiesel varied 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 biodiesel production phase. The results indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14–5.71 g CO2eq/MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territorial and geographical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.


The environmental performance of a wind turbine is usually calculated as the ratio of the life cycle impacts of the turbine to the electricity it produces 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 turbines a daunting task. To this end, LCA_WIND_DK combines 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 model for Scotland A. Froemelt, ETH Zurich; R. Buffat, ETH Zurich / Institute of Cartography and Geoinformation; N. Heeren, S. Hellweg, ETH Zurich / Institute of Environmental Engineering

Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur throughout the whole life cycle of products and services, installation and operation. 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
Mechanistic effect modelling for risk assessment: applications, use in a regulatory context and future directions

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

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

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

The toxicokinetic-toxicodynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD effects. In an attempt to include temperature dependency in the TKTD framework, we performed a case study with Chaoborus crystallinus larvae. We hypothesised that the temperature dependency of the TKTD model may be able to explain certain observed differences in toxicity. In our study, we observed that the value of the "α" parameter will depend on the exposure concentration. The preliminary results indicated that the temperature dependency of the TKTD model can be used to perform Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS 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, diet, regions and different consumption areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all these sub-models permits testing of policies and in-depth analyses of scenarios, ranging from local climate change mitigation and adaptation strategies to future mobility solutions such as autonomous vehicle systems.

148 Poster spotlight: MO109, MO110, MO113

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

The Chaoborus model was used with and without the implemented temperature dependency. The approach to perform Bayesian statistics in ecotoxicology is rather unrealistic, especially in outdoor scenarios with 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, the Bayesian R software to stochastic death mechanistic models over the widespread statistical language R (JAGS and Stan). Then, we embedded those algorithms within two R packages with the core idea to be user friendly (e.g., using experiment design to define priors). A side result is to propose a step-by-step approach to perform Bayesian statistics in ecotoxicology.

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

The azole fungicides propiconazole and prochloraz are known to enhance the toxicity of pyrethroid insecticides like α-cypermethrin during co-exposure. The development of these synergistic actions in the waterfly Daphnia magna have recently been modelled using toxicokinetic (TK) and toxicodynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to test the same as a TKTD-framework for synergistic interactions in D. magna can be applied to the midge larvae Chironomus riparius to describe development in survival rates and the underlying mechanisms over time when co-exposed to azole fungicides and pyrethroid insecticides. Toxicity of the individual compounds was tested using a pulsed concentration response design with an initial 24 hour exposure period followed by six days of recovery in clean water. To assess the combined effects 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 including the internal temperature. We hypothesised that the synergistic interactions can be described and modelled by adding a synergy parameter "s" to the biotransformation rate constant for α-cypermethrin and that the value of this "s" parameter will depend on the azole exposure concentration. The preliminary results indicated time-dependent synergistic interactions in C. riparius as previously observed in D. magna, but also a higher sensitivity of C. riparius towards the fungicides with 168 h EC₅₀-values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µg L⁻¹ for propiconazole and prochloraz, respectively. This is surprising as previous non-published data indicated that C. riparius has an approximately 10 fold faster initial elimination rate of the azoles compared to D. magna. We expect that our TKTD models will be able to explain these kinetic differences and how they relate to the observed toxicity. We further hope that model predictions will be able to perform Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models with environmental background data allowed for computing an environmental profile for each household in Switzerland reveals interesting differences between individual households, diet, regions and different consumption areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from local climate change mitigation and adaptation strategies to future mobility solutions such as autonomous vehicle systems.
Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.

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

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynus mykiss) using TK-7D modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stage tests (ELS): a standard Tier 1 study with constant exposure and a Tier 2c study under time variable exposure. Observed effects differed in these two studies. Under constant exposure, severe mortality and significant growth effects were observed while under peak exposure, no effects on survival were observed, and only negligible effects on growth were found. The model was successfully calibrated using the constant exposure experiment, and then accurately predicted the effects observed in the peak-exposure assay. The modelling supports the internal feedback from the fish does not pass the threshold for an effect on survival. This helps to explain why no mortality is observed in the peak exposure experiment. The no effect threshold for sublethal effects is passed in the modelling under constant exposure, which is consistent with the observations. In the peak experiment, the duration of the effect on the feeding behaviour is insufficient to induce large effects on growth in weight or lengths, because beta-cyfluthrin is removed from the fish organics and the fry have difficulty to cope with reduced feeding over a short period. The modelling supports the experimental finding that under realistic exposure conditions, short term effects on the feeding behaviour do not lead to growth or survival effects, and gives a mechanistic explanation for this observation. We were able to derive a mechanistic explanation for the results from laboratory experiments conducted with three different early life-stages of the trout, and for different exposure profiles to beta-cyfluthrin. The model shows that results from both laboratory studies are consistent. This validated model has the potential to be used to make accurate in silico predictions of effects on fish early life stages from time-variable exposure profiles.

154 Prediction of effects on chemicals on three-spined stickleback populations in mesocosms V. Dávid, INERIS; B. Gouss, University of York / Environment; J. Porcher, INERIS / INERIS UMRI SEBIO ECOT; R. Beaudoin, INERIS / Models for Ecotoxicology and the Internal ME TO

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 points for the population which make their development difficult to build. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teletost 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 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 endpoints of stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male, female and juvenile frequencies, lengths and coefficient of variation) 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.

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

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

V. David, INERIS; M. Fournier, University of York / Environment and Environmental Protection Area. Fisiology and Uptake, egestion and accumulation of microplastic in mussels. Marine or coastal waters usually consist of chemical, glass, wood and plastic, being the 80% of these plastic wastes. One of the main issues is the extreme stability of plastic wastes. Under environmental conditions, the erosion of these materials generates smaller fragments some of them in the nano- and microscopic scale, which are known as nanoplastics (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic wastes is particularly difficult because of their physicochemical properties (low solubility, a wide range of molecular weights, etc.) and potential contaminations sources in the laboratory. For these reasons, different approaches should be considered to find a standardised protocol for the determination of MPLs and NPLs in the environment. In this context, this study was focused on the investigation and practical comparison and combination of different analytical tools for the quantitative analysis of MPLs/NPLs using: (1) techniques to assess the physicochemical properties such as Thermogravimetric Analysis or TGA, Differential Scanning Calorimetry or DSC, and Fourier-Transformed Infrared Spectroscopy or FT-IR; (2) quantitative and qualitative information by techniques based on direct mass spectrometric as high resolution mass spectrometry with Electrospray ionization (ESI), Atmospheric Pressure Chemical Ionization (APCI), Atmospheric Pressure Photoionization (APPI), Matrix-assisted Laser Desorption Ionization (MALDI), Desorption Electrospray Ionization (DESI) and Direct Analysis Real-Time (DART). These studies have been carried out using as a representative polymer the polystyrene (PS), which is one of the most frequently used for plastics production. Finally, LC-APPI-HRMS complemented by other techniques such as TGA, DSC and FT-IR allows obtaining quantitative information about the whole spectrum of polymers, which may be present in the environment.

156 Analysis of polystyrene based microplastics in the environment G.F. Schirinzi, IDAEA-CSIC / IDAEA; M. Farre, IDAEA-CSIC / Environmental Chemistry; m. farré-urrégel, IDAEA-CSIC; D. Barcelo, I+QAB-CSIC / Department of Environmental Chemistry

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

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

Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingestion. Field and laboratory studies have reported that MP are ingested by mussel. Once ingested, MP may be excreted through defecation,
158 Analysis of tire wear particles in environmental samples using TED-GC-MS

P. Eisenbraut, Bundesanstalt für Materialforschung und -prüfung; E. Dürenich, Bundesanstalt für Materialforschung und -prüfung / 5.3 Mechanics of Polymers
A.S. Ruhl, TU Berlin / Department of Water Quality Control; M. Jekel, TU Berlin; M. Benz, TU Chancellor; U. Braun, BAM: Federal Institute Material Research and Testing / 5.3 Mechanics of Polymers

Tire and road wear particles (TRWP) as environmental contaminants have received increased interest since the 1960s[1]. TRWP have adverse effects on human health[2]. Multiple cities in the EU are violating legal threshold values for atmospheric pollution to which TRWP contribute. Therefore, financial penalties as well as consequences like vehicle bans in metropolitan regions are discussed. TRWP can be regarded as microplastics, because the rubber component of TRWP is mainly polymer (natural and synthetic). With regional differences, the contribution of TRWP to the microplastics emissions to the environment can reach up to 60%[3]. Analysis of TRWP is challenging because of the high variance in compositions of these particles. Established analytical methods suffer from unspecific marker compounds, sample size or low sensitivity[4-6]. The topic of this presentation is the analysis of TRWP using the recently developed method TED-GC-MS (thermal extraction desorption gas chromatography mass spectrometry)[7]: Sample materials are heated in a thermogravimetric analyzer. The decomposition products are purged with nitrogen through a heated coupling device to a solid phase adsorber. After the adsorber is loaded with an excerpt of the decomposition products, an auto-sampling robot transports the adsorber to a thermal desorption-GC-MS for further analysis. Rubber materials were provided by TUC, Sigma Aldrich and Avcol. The tire samples included used and unused materials provided by TUC, Umweltforschungszentrum Leipzig (UFZ) and former BAM projects. A bitumen and an asphalt material, provided by BAM were analyzed. As tire-free matrix, materials were provided by BAM and recycled by Umweltbundesamt (UBA) were chosen. Environmental samples with expected TRWP pollution were provided by TUB and consisted of lake sediment from Berlin / Germany and various stages of a filter system receiving street runoff. Various potential marker compounds for tires were identified. They include characteristic decomposition products of elastomers, antioxidants and vulcanization agents. Advantages and drawbacks of these marker substances will be evaluated. 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) Tram妻子 assisted acid digestion and elemental detection of sulphur and carbon. A stepwise method development including analytical and method 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 varied between 2500 mg/kg (± 1700 SD) and 4500 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 BBMF for funding the MiWA project (reference number 02WRS1378H) and BBW 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 / DTU Environment; A. Verschoor, RIVM / Centre for Safety of Substances and Products; T. Hüffer, University of Vienna / Department of Environmental Geosciences; M. Hassellöv, 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 categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain categorizing and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea 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 (11)

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

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In fishes, olfactory cues provide information about predators, prey, and conspecífics that is crucial to survival; however, olfactory sensory neurons are too sensitive and can lead to overlearning. 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 categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain categorizing and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea 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.
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolour damselfish (Stegastes partitus). To date, within the marine teleost group, nothing is known about how crude oil exposure affects the detection of olfactory cues or how crude oil can be detected and avoided. To address these questions, the time that control and oil-exposed bicolour damselfish spent in a chemical alarm cue and the time that control and oil-exposed mahi-mahi spent in diluted crude oil was examined using a two-channel flame detector system. Results showed that mahi-mahi avoided the olfactory chemical alarm cue whereas the 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. Stiegitz, 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. Schiedek, RST, CA State Fish & Wildlife. Such reductions in cardiac contractility 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. Altin, 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 aerobic 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 cardiac myocytes show that sarcocere 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 contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

164 Impacts of Oil Exposure on Mahi Embryos

C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L.E. Sweet, Environmental Protection Agency USA; E.M. Magaer, University of North Texas / Department of Biological Sciences; J.D. Stiegitz, 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 impacted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The maintenance of embryo/biota populations 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. Furthermore, predation of negative buoyancy was coupled with significantly faster sinking rates and increased energy depletion, likely resulting in detrimental consequences for these developing fish. The mechanisms behind untimely buoyancy change are unknown, but our findings suggest a behavioral avoidance response as well as an inability to maintain buoyancy due to diminished energy reserves. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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

R.M. Heuer, University of Miami / Marine Biology and Ecology; H.A. Shiel, G.L. Galli, University of Manchester / Faculty of Biology, Medicine and Health Sciences; G.K. Cox, J.D. Stiegitz, 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, studies have revealed a ~40% reduction in cardiac output following oil exposure in mahi. Although cardiovascular effects have been widely reported, the mechanisms underlying cardiac dysfunction remain poorly understood. In the present study, we examined the impacts of crude oil on isolated mahi heart cells to better understand these mechanisms. Contractility of mahi ventricular heart cells was measured via sarcomere shortening using an IonOptix cell recording system. The first objective was to examine cardiac myocyte contractility over a range of crude oil concentrations. 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 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, 2.0, 3.0 Hz; 3.6 μg 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, Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).
microRNA and messenger RNA networks in early life stages of pelagic and nearshore fish species exposed to Deepwater Horizon oil

D. Schlenk, University of California-Riverside / Department of Environmental Science and Engineering; G. Xu, UC Riverside / Department of Environmental Sciences - Developmental cardiotoxicity is a commonly observed phenotype in a number of fish species following exposure Polyaromatic hydrocarbon (PAH) or oil. While many PAHs elicit cardiotoxicity through activation of the aryl hydrocarbon receptor (AhR). Additional pathways of toxicity have been observed downregulating 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 diverse number of 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 expression and identified with standard pathways. Gene ontology (GO) analysis on the target miRNAs was consistent with predictions 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 KCH2 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 associations 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 ecotoxicology 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 flatnape shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic contamination, including in marine environment. Organic compounds, such as pesticides and personal care products have been increasingly used and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. Besides, human activities have been increasingly 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 4-MBC, Carbendazin, Linuron and Triclosan, which have potential endocrine disrupting activity. Early life stage development, growth, behaviour and biochemical markers were evaluated through endpoints in two periods of exposure to stressors: a first initial period between egg stage and 96 hpf and a second period during the nearly 15-day full metamorphosis progression of S. senegalensis. Exposure to UV radiation and to the four organic compounds (compounds 4MBC, Carbendazin, Linuron and Triclosan) was performed. Our results suggest that the effects of S. senegalensis are highly dependent on the test design and the evaluation of effects at different development stages. Initial egg stages globally display a higher sensitivity to stressors, presenting lower LC₅₀ and EC₅₀ values. Besides, biochemical markers (cholinesterases and oxidative stress) were differentially affected, depending on S. senegalensis life stage. Significant alterations of normal behavioural pattern were observed in response to stressors exposure, confirming behaviour as a sensitive and relevant tool in ecotoxicology studies. The increasing environmental levels of the contaminants tested may lead to adverse effects on highly sensitive life stages of marine vertebrate species.

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

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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 in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Onchorhyncus mykiss, RTgill-w1) exposed to a given chemical can be used as a bioensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that gill cell line has the potential to replace zebrafish embryo in toxicity testing.

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

K. Schirmer, Eawag / Environmental Toxicology; H. Mottaz, R. Schonenener, 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. In this project, we propose that the chemical effects on cell population growth, measured over few days, can be used as a proxy for chemical impact on fish growth, which needs weeks to occur. In particular, we linked information on the proliferation and survival of a fish gill cell line (in vitro) to the effect of chemicals on fish growth (in vivo). Research was divided into two phases. In the first phase, we have tested in vitro several chemical concentrations that correspond to those used in vivo to experiments. The second phase upgraded an in vitro approach so that no prior knowledge about chemical concentrations tested in vivo was required: in vivo data were needed only to validate the model but not to decide which chemical concentrations should be tested in vitro. More than ten organic chemicals (including fungicides, herbicides, insecticides, industrial compounds and pharmaceuticals) were tested for different fish species (rainbow trout, fathead minnow and zebrafish). The results indicate a very good agreement between measurements and predictions determined for different species of fish, being exposed in vivo from 7 to 62 days, depending on the species and test design. Results moreover confirm that it is possible to predict chemical impact on fish growth without prior knowledge on concentrations that are used in in vivo studies for chemicals that do cause an effect on fish weight as well as for those that do not. Therefore, in spite of semi-quantitative and simplifications, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish. In addition, considering the simplicity, rapidity and low costs of this approach, we believe that it can be an encouraging step toward alternatives to long-term whole organism toxicity testing.

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

M.R. Embry, ILI Health and Environmental Sciences Institute (HESI); M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; S.E. Belanger, The Procter & Gamble Company / Sustainable 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 / Sustainable Stewardship and Sustainability Organization; D. De Zwart, DdZ Ecological Centre for Sustainability Research / ILI 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 EVCAM; 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

SETAC Europe 28th Annual Meeting Abstract Book
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 QSRs, guiding product development discussions, and assisting read across or categorization judgements. An ecotoxicological database of approximately 120,000 records was developed based on recent assessments of published data and international chemical management programs. This ecotoxicity data is associated with physical chemistry data and curated taxonomic information for the organisms tested, including a process to conclude acute and chronic effects as well as identify the PNEC for exposed ecosystems based on depth and breadth of data. Several modes of action schemes are also included to facilitate development of a best approach for grouping compounds. To make these data accessible and useful to stakeholders, the dataset was transitioned from Microsoft Excel and Access into a modern MySQL format, allowing for a format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. The dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecoTTC concept. An international workshop was held to discuss and evaluate the feasibility of the eco-TTC approach, which included evaluation of several case-studies based on particular decision-contexts (e.g., prioritization of precautionary chemical risk). Integrate 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.

**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 center for environmental research - UFZ / Department of Cell Toxicology; _D. Kerkhof_, Helmholtz center for environmental research - UFZ / Department Bioanalytical Ecotoxicology; _M. Leonard_, IOREAL SA; _T. Kielhöf, Scientific Software Solutions; R. Altenburger_, UBC 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 QSRs, the identification of non-baseline toxicants requires assessment of endpoints that can be related to the MoA of a chemical and ultimately assign an adverse outcome pathway. Such a MoA analysis could be possible using the zebrafish embryo test (ZPET) extended by various endpoints, chemical and risk. In this 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.

**Poster spotlight: MO158, MO159, MO190**

_Migratory bird species at risk - the role of pesticides and other chemicals_

**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

**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

**Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions**

_P. Berny_, VETAGRO-SUP / Toxicology

**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. Cremnic_, Wildfowl & Wetlands Trust

**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

**Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions**

_M. Odino_, Independent Environmental Services Professional

**Questions and discussion**

**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

**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**

**Towards a more holistic environmental risk assessment approach of crop protection products as tools in agriculture**

_P. Oehmen_, 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 other ecosystems, how field data on migratory species might feed into regulatory.
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 retaining the species and sufficient local food production with an environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and measurable concepts allowing an (eco)political assessment of impacts 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.
F.M. Bakker, R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; D. Phillips, Fera Science Ltd / Environmental Sciences; P. Gilbertson, Fera Science Ltd; D. Clenn, 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 effective Protection Goals (SPGs) that are harmonized with existing regulatory options. The EFSA’s Scientific Opinion addressing the state of the science on the risk assessment of plant protection products for non-target terrestrial plants (NTPPs) was published in 2014. The Opinion defines non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. It also states that non-crop plants growing in in-field areas provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, The Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds but will not be growing in the crop or landscape 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.

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

Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents i.e. Effects of pesticides on Non Target Terrestrial Plants, Non Target Arthropods and Soil Organisms. Whilst each of these Scientific Opinions makes proposals for SPGs, the European Commission and Member States should agree on the on SPGs before they can be taken forward to be used in the Guidance Document development phase. The purpose of this paper is to provide industry input for consideration and discussion during this process. In an earlier EFSA Scientific Opinion it was recommended by EFSA that Specific Protection Goals (SPGs) should be based on the principle of Ecosystem Services utilising 6 dimensions: ie biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (< 7%) without robust scientific justification. The use of 7% suggested there was data to support it but in fact it was still a judgement, i.e. it is a hidden ‘judgement’. The suggestion that there was an arithmetic relationship between large (>35%), medium (15-35%) small (7-15%) and negligible (3.5-7.5%) is in itself surprising for a biological system particularly one with complex feedback loops such as in honeybee colonies. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientist and stakeholders is is required it is recommended that 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 kingdom 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 (NTPPs) was published in 2014. The Opinion defines non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. It also states that non-crop plants growing in in-field areas provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, The Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds but will not be growing in the crop or landscape level. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientist and stakeholders is is required it is recommended that 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 kingdom species) of species potentially affected, and the frequency of occurrence.

186 Specific Protection Goals and the Assessment of Key Drivers in the Aquatic Environment: Are we doing the right thing?
E.M. Bakker, Eurofins-ITC

Does prior knowledge influence preferences?; how preferences are assessed (e.g. what they know (how does knowledge influence preferences?)); how preferences are assessed (e.g. stated v revealed preferences). We demonstrate that all three factors can have an impact on what freshwater ecosystem services are preferred by the general public and therefore should be prioritized for protection.

187 Is “biodiversity” a measurable study endpoint?
F. Phillips, Fera Science Ltd / Environmental Sciences; P. Gilbertson, Fera Science Ltd; D. Clenn, Centre for Crop Health and Protection (CHAP)

In the last decade there has been significant development of ‘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 retaining the species and sufficient local food production with an environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and measurable concepts allowing an (eco)political assessment of impacts on ecosystems beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.
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 setups. With this contribution we explore different approaches to quantifying effects on structure and functioning of soil microbial communities using fluorescence in situ hybridization (FISH) and reducing the number of species 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 biositiation of soil microbiota for the setup of a site-tailored rhizomeration 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. Ulhík, University of Chemistry and Technology, Prague; E. Zamboni, 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 (SN) Brescia-Caffaro is a highly polluted area in Northern Italy presenting mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). In order to evaluate the biodegradability of the site plant species were cultivated in conditions of redox cycle showed to stimulate the highest metabolic activity of biphenyl and possibly the degradation of HMW PCBs from the cultivation medium accord-

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. Carbone, P. Goria, J. Bütschnigg, Regenesi Ltd; S. Rossetti, B. Matturro, Water Research Institute Italian National Research Council IRSA; M. Daghio, A. Franzetti, University of Milano / IRSA; M. Bacchi, P. Foglietto, University of Insubria / Chemistry; A. Palma, E. Palma, CNR-IRSA; M. Daghio, A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences; M.P. Papini, Università La Sapienza / Chemistry; F. Aulenta. National Research Council / Water Research Institute (IRSA)

A major share of world energy production, deriving from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of transportation accidents. Groundwater contamination by petroleum hydrocarbons is a serious problem, with nearly 50% of groundwater contamination being due to petroleum-derived products such as mineral oil, chlorinated hydrocarbons, monomers (e.g., BTEX) and poly cyclic aromatic hydrocarbons (i.e., PAH).

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

The bioelectric well: a novel approach for in situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons

A major share of world energy production, deriving from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of transportation accidents. Groundwater contamination by petroleum hydrocarbons is a serious problem, with nearly 50% of groundwater contamination being due to petroleum-derived products such as mineral oil, chlorinated hydrocarbons, monomers (e.g., BTEX) and poly cyclic aromatic hydrocarbons (i.e., PAH).

The bioelectric well: a novel approach for in situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons

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Gram-positive bacteria, associated to *Mycobacterium*, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-HMA-PAH removal identified members of the recently described order *Immundisolibacterales* and members of *Sphingobium* as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of *Sphingobium* were major phylotypes that were most strongly enriched in the incubations, whereas members of *Immundisolibacterales* clearly predominated in incubations with 13C-pyrene and 13C-benz[a]anthracene. Interestingly, members of *Mycobacterium*, traditionally associated to HMW-PAH degradation were not detected in either of the incubations. Our results indicate the minor contribution of mycobacteria to the degradation of the more labile fraction of HMW-PAHs. Their increased activity during the late incubation phase, when degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

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

**194**

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

M. Vieira, PRe Sustainability; K. Cenian, PRe Consultants; A. de Schryver, European Commission; A. Genest, ifu Hamburg; L. Zampori, European Commission / Joint Research Centre; C. Wolf, Tier3 Solutions GmbH; M. Dupriez, RDC Environment; S. Horlacher, thinkstep; E. Mieras, PRe Sustainability

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

**195**

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

A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation (ERIN); D. Torregrossa, Luxembourg Institute of Science and Technology (LIST); E. Benetto, Luxembourg Institute of Science and Technology (LIST)

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

196 Enhancing Land Use Change modelling with IO data
J. Schmidt, Aalborg University / Department of Planning; M. De Rosa, BONSAI / Agroecology

Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (iLUC) modelling in LCA since 2011 as part of a crowdfunding 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. Recent advancements in IO-ITAP are consistent with 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, NOx, NO2, NH3 and resource inputs of accelerated denaturation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCIA) model. Overall, the results show that for agricultural crops, iLUC increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 50-300% and for primary plastics 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countries in the world. It has already been applied to more than 50 LCA studies and on several product categories.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA
S. Bartsch, UMR ITAP ELSA; P. Roux, Istea / ITAP ELSA-FACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istea; G. Junqua, École des Mines d'Alès / LGEI; A. Sferratore, Société du Canal de Provence; Y. Pennu, SUEZ groupe / CIRSE; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istea / UMR ITAP

Fishing water comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water quality standards provided by local (surface, groundwater, rain), external (inter-basin transfers) and alternative sources (e.g. sea water). Water from these sources are withdrawn and processed via water technologies using the local electricity mix. The combination of water sources and technologies results in a regional water supply mix (WSmix) for each specific use. Current LCI databases do not include these mixes when modelling processes leading to a poor representation of water supply systems and related environmental impacts in LCA. Furthermore, changes in water sources, caused by changes of climate and socio-economic factors, will occur in the future. These changes should be considered in LCA of products or infrastructure with long lifespans. This work aims to develop a WSmix framework for modelling current and future water supply (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. An initial WSmix database (WSmix 1.0) 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
D. Durlinger, L. Kuling, Blank 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 product, processes/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 Blank 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

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

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alänärä, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science

Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and irbesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L), for temazepam and irbesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (scototaxis assay 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 temazepam showed high and low doses of temazepam dispersed faster downstream when compared to control fish. Irbesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the model tissue of fish in the laboratory, and how results can be used to 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.

201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish
M.G. Bertram, Monash University / Biological Sciences; M. Saaristo, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.B. Wong, Monash University / School of Biological Sciences

Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alänärä, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science

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Hormonal growth promotores are designed to have biological effects at low doses, often act on physiological pathways that are evolutionarily conserved across species, and have repeatedly been detected in ecosystems worldwide. However, despite being shown to cause altered development, reproduction and morphology in various non-target species, relatively little is known about the potential of HGP's to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24h) or long-term (3 months) fetal exposure to field-detected levels (mean measure ± standard deviation: 16 ng/L) of 17β-trenbolone—a potent growth-promoting veterinary pharmaceutical repeatedly detected in freshwater systems—on a suite of ecologically important behaviours in female eastern mosquitofish (Gambusia holbrooki).

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

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

J.N. Henry-Osman, Irstea / EABX-CARMA; C.N. Doose, INRS - Centre Eau Terre Environnement; B. CHAUMET, Irstea; N. Mazella, Irstea Bordeaux / UR EABX; N. Majdi, Ecolab / UMR 3245 CNRS; J. Vedrenne, S. Morin, Irstea Bordeaux / UR EABX; W. Traunspurger, Bielefeld University / Animal Ecology

The herbicide diuron and the insecticide imidacloprid are amongst the most frequently detected pesticides in French rivers, and each is known to affect many aquatic organisms. However, it is less examined whether and how both pesticides together might affect behaviour. Further, whether treated conditions for sociability, exposed fish were effects such as modification of biological interactions within freshwater microbial communities. This study was undertaken to determine the effect of diuron and imidaclopid alone and in combination on the feeding behaviour of chironomid larvae. A first experiment measured the impact of the different contamination conditions at environmental concentrations (5µg L\(^{-1}\) for each pesticide) on the grazing rate of chironomids on three microalgal species, independently. Therefore, two diatom species, Gomphomena gracile (two different morphotypes: normal (GG) and tetarogen (GT)) and Planolodium lanceolatum (PL), and one green algae Pseudokirchneriella subcapitata (PS) were offered as food, during 24h. Protein and lipid contents in microalgae were analysed subsequently. Each pesticide condition elicited a different grazing rate in chironomids with regards to algal species and their nutritional quality, with a general preference for Gomphomena gracile with tetarogen shape and Pseudokirchneriella subcapitata. In a second experiment (cafeteria), food selectivity of chironomids was determined under similar contamination conditions during 4h: Under diuron, larvae switched equally among microalgae, then were as mobile as in the control without pesticide. However, imidacloprid and the pesticide mixture condition altered chironomids’ movements and grazing behaviour. In these experiments, we highlighted that chironomids feeding behaviour and food preferences are impacted by pesticides. Herbicide and insecticide exposure, alone or in combination, had contrasting effects on grazing, both directly on the larvae or indirectly (food selectivity according to its quality). Our study illustrates the value of considering the impacts of toxicants on target and non-target organisms across trophic levels to improve ecotoxicological risk assessment in an ecosystem perspective.
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 Environmental 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 9% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC in consecutive years as well as from various substances. The monitoring programs considered in this study often include only a subset of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is rather the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analyzed two data sets on macro invertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires further action. The assessment of long-term changes of fish health and environmental quality. The results showed that the fish length trends and fish length trends and hence hint at long-term changes in environmental quality. We show examples for current trends of these indicators in German river systems. Our results confirm the high value of consistent long-term chemical and wildlife monitoring.

207 Threshold trends in wildlife taxa: challenging and evaluating our chemical- and environmental-risk assessments of chemicals and their mixtures
L. Postuma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiDZ Ecotox / Centre for Sustainability Environment and Health; J. Postma, Ecofide; 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 epidemiology. This presentation is a recent gold-digging trial, with surprising results. We collated biomonitoring and mixture exposure data from the Dutch Waterboards, as collected due to obligations of regulatory frameworks (such as the Water Framework Directive). We qua...

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 determinants. Whilst there was no change in overall flows, winter water temperatures downstream of Swindon rose over the course of the 30 year monitoring period. We could not identify trends between the macroinvertebrate community from the application of tertiary granular activated charcoal treatment (GAC) lasting from 2008 to 2014. No new macroinvertebrate families appeared during this period. The steady improvement in macroinvertebrate diversity in an effluent dominated river implies that current chemicals in domestic wastewater are not noticeably harmful to these organisms. This implied that provided we can achieve a 90% percentile BOD below 5 mg/L and below 0.6 mg/L for NH4, long-term changes in status and quality of macroinvertebrate diversity will steadily improve (within the limits of habitat suitability). The small river has a population of stickleback and other fish but their changes in abundance are not known. The recovery of macroinvertebrate diversity is slow and has not yet returned to the expected range for such a river, however, it was noted that the habitat is not ideal. This project has demonstrated the immense power and value of consistent long-term parallel chemical and wildlife monitoring.

209 Biometric parameters of the bream (Abramis brama) as indicators for long-term changes in environmental quality - results from the German ESB
D. Teubner, Trier University / Biogeography; M. Paulus, M. Veith, Trier University; R. Klein, Trier University / Biogeography

Fish health depends upon the macroinvertebrate community from the application of freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology
S. Happi, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; N. Poulet, Agence Française pour la Biodiversité / Pôle Ecoludynamique, AFB-IMFT; A. BESNARD, Centre d’Ecologie Fonctionnelle et Evolutive / Biogéographie et Ecologie des Vertébrés Population dynamics of aquatic species and ultimately their population growth rate (λ), must be known to properly define species conservation status and plan appropriate conservation actions. It also essentially involves the quantification of 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 analyzes. The present work demonstrates that during the last decades, 10 species
exhibited significant decline in abundance, 2 species were in expansion and fish abundance remained stable for 6 species. The correlation between biomass and abundance growth rates was also very high (R²=0.93). The intra-specific trends in fish length over the studied period also showed a severe decrease among the largest individuals (quantile 0.75 and 0.90) and was correlated to severe biomass decline in several species. This result reflect progressive alterations in the population size / age structure suggesting that a decrease in growth and survival might be responsible of the pattern here 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 pressure, which could explain body growth decrease, juvenile and adult survival alterations due to micropollutant exposures. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor periodic species recovery.

211 The use of natural historical reconstructions 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. Hippsley, White-bellied eagle dataset (CSR), Swedish Environment Monitoring; G. Malarvannan, University of Antwerp / Toxicological Center; J. Søndergaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Tottrup, Natural History Museum of Denmark; M. Eens, University of Antwerp / Department of Biology; I. Eulaers, Aarhus University / Department of Bioscience Understanding temporal trends of persistent contaminants in wildlife is critical for the assessment of the pattern associated past, present and future health risks. We have established a retrospective examination of Mercury (Hg) and several organohalogen contaminants (OHCs) in Swedish, Norwegian and Greenlandic white-tailed eagle (Haliaeetus albicilla) using body feathers obtained from natural history and ornithologist collections. We analyzed feathers for Hg, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), as well as stable carbon and nitrogen 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 Swedish feathers. For the most part IET analysis was performed for a sea urchin (S. purpuratus) and a Baltic cod (Gadus morhua) to determine the effect of ligand complexation on the Ni toxicity and to which they are protective of aquatic life. Develop technical information regarding the type and quantity of data necessary to develop and apply bioavailability-based aquatic toxicity models. Develop recommendations for approaches to validate bioavailability-based models, and Provide recommendations for suggested measures of acceptability for bioavailability-based aquatic effects models.

213 Mitigating factors for nickel speciation and toxicity in seawater

W. Chen, Wilfrid Laurier University; S. Sherman, Wilfrid Laurier University / Biology; J. McGeer, Wilfrid Laurier University / Department of Biology; R.C. Santore, Windward Environmental, LLC; T. Blewett, University of Alberta; G. Merrington, WCA Environment Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining and processing activities. Determining Ni speciation is vital to understanding and predicting Ni toxicity and ultimately for bioavailability-based nickel risk assessment. Application of existing freshwater bioavailability based approaches for nickel in salt water predicts negligible binding of Ni to dissolved organic matter, but there are several examples of toxicity tests in natural seawater that are protective compared to artificial seawater control samples. Determining 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(II) to determine Ni speciation. 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 ([Ni₃]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Yale 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. Stubfield, 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 aquatic life effects. The ability to utilize a risk assessment framework of deriving bioavailability-based models and the ability to accurately predict the toxicity of metals in the environment to aquatic organisms has increased rapidly in recent years. Workshop participants reviewed the current state-of-the-science on aquatic bioavailability information for metals and on methods to model bioavailability under a range of environmental conditions. Participants also discussed the technical challenges associated with applying bioavailability-based approaches, especially in a regulatory context. The outcome of the workshop will support expanded incorporation of metal bioavailability information into global regulatory frameworks. Approximately 40 invited scientists representing industry, governments, 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/or other alternative approaches) offer a means to model bioavailability under a range of environmental conditions and to which they are protective of aquatic life. Develop technical information regarding the type and quantity of data necessary to develop and apply bioavailability-based aquatic toxicity models. Develop recommendations for approaches to validate bioavailability-based models, and Provide recommendations for suggested measures of acceptability for bioavailability-based aquatic effects models. Workshop findings will be presented and will later be published in the form of a SETAC “Summary document” and a series of manuscripts to be submitted to a SETAC journal.
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 model parameters for 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 predicted 94% of the 47 individual acute Ni toxicity data points within a 3-fold error, and 90% within a 2-fold error. 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

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Environmental regulations are becoming more and more ecosystems-oriented. In this respect, the habitat’s faunal biodiversity is targeted, meaning the contaminant’s bioavailability is taken into account. The latter depends on the environmental conditions of the aquatic system, which define the chemical speciation. For several elements, Environmental Quality Standards (EQS) and Sediment Quality Standards (SQS) have been proposed. For non-priority elements such as Uranium, EQS and SQS should be supplemented with national standards. As the bioavailable fraction in sediments is dependent on geochemical factors and sediment mineralogy, it is important to investigate the role of sediment composition on the bioaccumulation of uranium in benthic organisms. In the present study, laboratory experiments were performed on the bioaccumulation of uranium in the larvae of the non-biting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz, 10% Kaolin/90% Q, 10% Sphagnum/90% Q, 10% Ferrihydrite (FOH)/90% Q and a mixture of the 4 mineral phases (3.3% Kaolin/3.3% Sphagnum/3.3% (FOH) and 90% Q) spiked with uranium at two different concentration levels. During a ten days’ exposure experiment, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomid larvae Sediment to porewater partition coefficients (Kd) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Accumulation Factor (BSAF) is found for quartz (11), followed by Ferrihydrite (9) and Sphagnum (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 a computer simulation of a geochemical speciation code (EQ3/6) 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 Experimental Investigations into the Toxicity and Bioavailability of Aluminium to Aquatic Species

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Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: 1) the generation of large amounts of empirical toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and toxicity. An important requirement for the provision of data describing the chronic toxicity of regulated chemicals to a variety of aquatic organisms. To address possible data gaps in the Al database, a series of chronic toxicity tests were conducted with freshwater organisms. Aluminium toxicity is a function of its speciation and this is a function of water pH. Previous chronic toxicity tests with Al were typically conducted under acidic test conditions and few studies have been conducted at pHs more typical of natural surface waters. The studies reported here investigated the chronic toxicity of Al at pH 6.0 to 8.0 freshwater species. The species tested were the great pond snail (Lymnaea stagnalis), a rotifer (Brachionus calyciflorus), an aquatic oligochaete (Aerolosoma sp.), 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 µL/g total Al) based on growth effects. The least sensitive species was Lemna minor, with an EC10 of 2175 µg/L total Al as total weight. A series of chronic and acute tests conducted with chemical speciation data (Ceriodaphnia dubia, fathead minnows, and the algae (Pseudokirchneriella subcapitata) suggest that modifying factors such as pH, dissolved organic carbon (DOC), hardness, and temperature have a large impact on the bioavailability and toxicity of Al to aquatic organisms.

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


The irreversible effects that the environment has suffered due to anthropogenic activity has reduced the availability of water for living beings, both in terms of quantity and quality. Industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystems. The impacts of mining activity on aquatic ecosystems have been widely documented, reporting the deterioration of water quality, the impact of biodiversity, as well as the release of heavy metals of potential accumulation in organisms and subsequent biomagnification through the food chain. Although it is known that non-technical mining activity affects the environment, it is necessary to identify and prioritize those factors related to mining activity that have a greater impact on the ecosystem (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 predictors of the 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 predictors of the 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 predictors of the models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams in the study area.

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

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

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Detecting microplastics and determining actual concentrations and sizes of plastic particles present in the environment is essential to assess the risks that are posed by plastic particles. Microplastics have been detected globally in various aqueous ecosystems. The determination of microplastics is hampered due to the high methodological challenges. But yet, its formation was proven experimentally and, for the first time, its presence in marine surface water samples confirmed. Building on those results, we further propose a framework that is able to consistently determine a broad size spectrum of plastic particles in an aqueous environmental sample. The results from initial tests confirm the general applicability of individual techniques to, firstly, sample and, secondly, detect plastic sizes and polymer types. To obtain representative results, a sampling strategy is needed to concentrate plastic particles. Crossflow ultrafiltration is applied to concentrate nanoparticles from 100 into 0.5 L and yields in a reproducible particle recovery of 54±2 %. Microplastics are detected 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 sizes, and pyrolysis GC-MS, that is used to identify the polymer types, are
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoplastics. The pre-concentration by crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 µg L\(^{-1}\) in aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microparticle decomposition products, used for quantification of the polymers, were adjusted sampling dates and within different sieve fractions. Much higher amounts of PS were find in the raw waste water of the sewage treatment plant in Ruhleben, water influent and effluent of a Berlin waste water treatment plant for the most using GC-MS. The developed fractional filtration for sampling and the analytical tool, the so-called TED-MS, has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. 

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, Telernark University College; L. Nizzetto, NIVA

The very little existed on microplastics in organic-rich substrates such as soil or sewage sludge. The organic components, as well as the complexity of the solid matrix, complicates the extraction process. No standardised methodology has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. The methods testing procedure was split into three phases: 1. Effect of reagents on test polymers; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extraordiary surveying the incorporation of samples including density separation. 7 reference polymers were used: HDPE, LDPE, PP, PS, PET, PC and PA-66, which account for >70% of global plastic demand. Degradation was observed for several of the reagents and selected polymers. NaOH treatments caused the most significant changes, including degradation of PET and PC. Small degradative changes occurred as a result of peroxide oxidation and KOH treatments. Fenton’s reagent was the most 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 work provides a time- and cost-effective approach suitable for application in routine monitoring of complex environmental substrates whilst facilitating the collection of important particle information.

222 Mapping microplastics in sludge during a country-wide investigation of wastewater treatment plants

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Incorporation of anthropogenic particles into sludge has been highlighted as a major route for the transport of pollutants into the environment. Here we present the results of a countrywide survey investigating the incorporation of microplastics into sludge from domestic wastewater treatment plants which operate different waste 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 – 8 317) or 1 176 889 particles m\(^{-3}\) (470 270 – 3 394 274). Particles from sludge consisted of beads (37.6%), fragments (31.8%) fibres (28.9 %) and glitter (1.7%). Most of the particles were clear in colour (41%). Ten percent of the overall particles extracted were tested using FT-IR. All particles (n= 60) were confirmed to be plastics. Polyethylene particles were the most common (30.5%) followed by polyethylene terephthalate (26.7%) and polypropylene (20.3%). 62% of plastics were extracted during the low density (1 g cm\(^{-3}\)) separation steps and 38% were extracted at high density (1.8 g cm\(^{-3}\)). Results between WWTPs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment technologies. Based on this study and details on the application of sewage sludge in Norway, it can be estimated that approximately 446 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 microplastic particles that are released into the environment per year.
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 from linking experimental work on microplastic, covering different shapes (spheres, fibrillar, irregular), microplastic mixtures influenced by water properties, considering a range of ambient conditions (temperature, salinity and turbulence). The microplastic were compared before and after exposure to weathering processes in the lab and outdoors. The results obtained in this sinking experiment were compared to theoretical expectations, based on literature equations that describe the relationship between the drag coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastic.

**Air Pollution, Biomonitoring and Human Health (I)**

**224 Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor**

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We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM<sub>2.5</sub> and PM<sub>1.0</sub>) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and week-ends during a 6-week winter period and a 4-week summer period (Special Observation Periods - SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-Term Sampling) consists in twelve 1-month PM<sub>2.5</sub> 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 organics and cations (by ion chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). The bioaerosol sampling was carried out by using long-term (>24h) sampling, from the beginning of December until the end of April, which represent the period of the Long-Term Sampling. The composition of PM in the indoor environments was dominated by the organic fraction, with a relevant contribution of the bioaerosol, mainly in the coarse fraction. The infiltration of particles from outside constituted a significant source of inorganic species. A vertical gradient was observed for soil components. A relationship of the concentration and composition of indoor PM with the volume of the classroom, height from the ground, presence/absence of the students and distance from the street has been highlighted.

**225 Source apportionment of major species and metals in PM<sub>2.5</sub> in urban sites under industrial influences in northern France**

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PM<sub>2.5</sub> have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The health risk is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of Europe means that this area is subject to major transportation activities by road and also by sea. In this context, the objective of this work was to acquire a better knowledge on the exposure level to major species and metals in PM<sub>2.5</sub> and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using Dionex® 12000 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 (StO, inland urban and industrial site). PM<sub>2.5</sub> composition was analyzed for major elements, trace elements and water-soluble organic compounds, respectively. Species concentrations were examined according to different ways including temporal evolution, concentration and pollution roses. The impact of such sources on major species and metal concentrations in PM<sub>2.5</sub> was then quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF), NO<sub>x</sub>, SO<sub>4</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup> and TC were found as the major contributors of PM<sub>2.5</sub> (between 95% and 99%). Similar results were obtained for organic compounds. 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 save deposition reference values**

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Partitioning of PAHs between the particulate and the gaseous phases strongly influences their fate and transport in the atmosphere and human exposure. Dry and wet deposition processes are major sources for PAHs in soil and crops. Our aim was to determine the proportion of the overall burden of environmental and dietary exposure to PAHs that is attributable to deposition in order to derive save deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Expo, a software tool that allows to model lifetime exposure, integrating exposure through multiple pathways. Model simulations were based on recent yearly average concentrations in air and particulate matter (PM<sub>10</sub>) and (PM<sub>2.5</sub>) in Belgium. The conceptual model implemented, included inhalation, soil and dust ingestion as well as dietary exposure via the consumption of vegetables, meat and dairy products. Toddlers were chosen as the receptor as they are considered a vulnerable group. Dietary exposure to PAHs via crops was modelled using an adapted plant uptake model representing leafy vegetables fruits, 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. Safe deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). In case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were ran for 16 different regions, for 4 different weather periods including baseline, winter, summer and spring. The results obtained in this study are important for the risk assessment of PAHs to human health, especially in coastal regions and urban areas where they are exposed high concentrations of PAHs.

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


Air quality is currently assessed by monitoring a few pollutants involved in the production of human health consequences. The identification of new pollutants that may cause hormonal disruptions observed in humans is therefore necessary. The goal of this study is to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposure 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 EDCs led to the same conclusions, except in cold season during which the indoor gaseous phase concentrated fewer target EDCs than in summer along with presenting a higher endocrine-disrupting effect, especially estrogenic. In order to identify the bioactive compound families responsible for this endocrine-disrupting potential, a bioassay-directed analysis was developed and may represent an advanced biomonitoring tool for air quality. The gaseous phase was collected in a Parisian day-care center during cold season (winter 2014) and in sufficient quantities (6 consecutive samplings of 15 days) to implement the entire fractionation process by semi-preparative liquid chromatography: split-off the initial organic extract into three fractions, each fractionated into three subfractions. All these samples and the multiple controls were submitted to the chemical analysis (68 target EDCs) and the biological analysis (estrogenicity measured by transactivation cellular assay). After applying a glass transition procedure for the target EDCs in each subfraction (concentration level, intrinsic estrogenicity, lipophilicity), major families found indoors (phthalates, synthetic musks, alkylphenols, parabens) stood out as playing a role in the estrogenicity of the gaseous phase, especially the lead compounds butylbenzylphthalate, galaxolide, butyl-paraben and nonylphenol. The data suggest however the involvement of non-studied EDCs in this biological effect. Our data confirm that bioassays represent suitable biomonitoring tools to assess air quality, whether they are associated with the chemical analysis or not.

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The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health
H. Rickenbacker, H. Rickenbacker
The ventilation system of buildings is a major source of indoor air pollution. The concentrations of pollutants indoors are strongly influenced by the concentration of outdoor pollutants. The concentration of outdoor pollutants is influenced by the degree of outdoor air exchange. If the ventilation system of buildings is not operating properly, indoor air quality can be significantly worse than outdoor air quality. In this study, the ventilation system of buildings was monitored and the results were compared with the results of the outdoor air quality monitoring. The results showed that the ventilation system of buildings was not operating properly in most cases. The concentrations of pollutants indoors were significantly higher than the concentrations of outdoor pollutants. The results of the study indicate that the ventilation system of buildings needs to be improved in order to ensure good indoor air quality.

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Transgenerational effects of a parental exposure in the sentinel species Gammarus fossarum
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Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that univocally link biomarker responses to fitness impacts and finally to population level are scarce (1). This is mainly due to the discordance in time scales between toxicological and ecological responses. In previous laboratory studies exploring the effects of high contamination levels of single molecules, a relationship has been established between genotoxic impacts in 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 revealed in adult gammarids exposed to a chemical stress could be predictive at the fitness of their progeny (i.e. transgenerational effects). For this, the consequences of an exposure in the lab of genitors to environmentally relevant concentrations of cadmium were evaluated in F1 and F2 individuals reared in uncontaminated conditions. In complement, a field exposure experiment through in situ caging of the adult F0 followed by the assessment of the subsequent effects in F1 and F2 progeny, is currently in progress. References (1) Forbes VE, Calow P, Shibly 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

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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 are strobilurin and azole fungicides. This study aimed to investigate the species’ sensitivity to both fungicide classes and to gain mechanistic insights on potential synergistic effects of azoles on strobilurin fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strobilurin fungicide azoxystrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyalella azteca. Furthermore, we explored median lethal concentrations (LC50) of azoxystrobin in the presence and absence of prochloraz, the inhibition strength (IC50) of prochloraz, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxystrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg-1, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg-1 in G. pulex and H. azteca, respectively. Many biotransformation products were found for both species in both species, in a compounds of which arylamine and arylazole conjugates were specifically identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-methoxycarbamate group of azoxystrobin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxystrobin in both species, leading to higher internal azoxystrobin concentrations and suggesting synergistic effects. The half maximal inhibition concentration of prochloraz IC50 (mg L-1) was 0.1 and 0.02 µM in G. pulex.
and H. azteca, respectively. The LC50 of azoxystrobin alone were 157 and 200 μg L⁻¹ in G. pulex and H. azteca, respectively. Prochloraz significantly decreased the LC50 of azoxystrobin in both species. Video-tracking of the locomotory behavior suggested that prochloraz induced hyperactivity in G. pulex, but not in H. azteca. Overall, results suggests H. azteca comprise more diverse biotransformation reactions and G. pulex tended to be more sensitive than H. azteca toward prochloraz effects.

232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb, H. Aramburoiu, Irieste Lyon / Freshwater system, Ecology and Pollution Research Unit, Irieste / UR MALY Laboratory Ecotoxicology; N. Delorme, K. Abbaci, Irieste Lyon / UR MALY Laboratory Ecotoxicology; P. NOURY, Irieste Lyon / Ecotoxicology; R. Tutundjian, Irieste Lyon / E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSC / Environmental Chemistry; I. Fuertes, Institute of Environmental Assessment and Water Research IDAEA; V. Debat, MNHN / Institute of Systematics, Evolution and Biodiversity.

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

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

Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the efficacy of pesticides. However, it is now 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 reclamation from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below the readily achievable acute effects showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC50 = 218 μg L⁻¹) compared with non-exposed populations (mean EC50 = 81 μg L⁻¹). This tolerance of exposed populations increased from 2- to 4-fold with increasing distance to the next recovery site (0 to 10 km). We conclude that the development of tolerance for non-target species may occur at very low concentrations, much below those affecting sensitive test organisms and also lower than those predicted to be safe by governmental risk assessment frameworks.

234 The use of antifouling biocides in a changing world: combined impact of non-engineering biofouling 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, Smallmate - 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 CICECO; 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 glaucum, a coral that is also a model of the cidarian-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 monocular coral fragments (n=5) for seven days, at two different temperatures (present day conditions—26°C—and forecasted scenario for 2100—30.5 °C), to 50 μg DCOIT L⁻¹ for free-DCOIT or SiNC@DCOIT and 196 μg SiNC L⁻¹ (nanocounter control). A negative control was added for each temperature. Photosynthetic parameter (Fv/Fm) was measured using a Pulse Amplitude Modulated Fluorometer (PAM), with the behavioural endpoint (% polyps open) being scored and the biochemical parameters (both in animal and microalgae fractions) being determined by means of main enzyme activity of catalase (CAT), glutathione-S-transferase (GST) and lipid peroxidation (LPO). 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 increase 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; N. Manton, Centre for Ecology & Hydrology; S. Short, E. Lahive, P. Kille, D. Spurgeon.

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

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. They also support a vast array of biodiversity. In the past decades Greenpeace did several investigations on persistent chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic-chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on bees and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the
context of Greenpeace’s detox campaign have found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polychlorinated 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 carried out an expected number of streams, snow and lake water samples were taken at 10 remote high altitude sites showing that these persistent chemicals are present everywhere on the planet. In 2017 Greenpeace Italy carried out PFAS analysis in wastewaters, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and regulations are required. The use of pollution prevention control or wastewater treatment does not deal effectively with all hazardous substances, and only postpones the need for more effective measures. The problem has to be tackled at its source. The Detox campaign challenges top textile brands to work with their suppliers and eliminate PFAS and 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 uses goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public. [1] https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Vienna_EU_27_10-28-2011.pdf [11] http://www.greenpeace.org/international/GLOBAL/international/publications/toxics/Water%202011/dirty-laundry-12 pages.pdf [11] https://www.greenpeace.de/sites/www.greenpeace.de/files/20121203-Toxic-Threats-China-engl.pdf [9]/<sup>n</sup>/sup> Greenpeace (2015), Footprints in the Snow; http://detox-project.org/assets/uploads/Report%20n%20A%20RAE_report_08_2015_en gh.pdf [9]/<sup>n</sup>/sup> Greenpeace Italy (2017) FAS in Veneto; inquinamento sotto controllo? (in italian) http://www.greenpeace.org/Italy/Italy/italy/report/2017/Inquinamento/PFAS-in-Veneto.pdf [9]/<sup>n</sup>/sup> Greenpeace Italy (2017) Non ce la beviamo. Presenza di PFAS nell’acqua delle scuole venete (in italian) http://www.greenpeace.org/Italy/Italy/italy/report/2017/Inquinamento/Report_N on_ce_la_beviamo.pdf

237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework A. Schymanski, John Snow, Recherche, Etude et Politique Environnementale / Environment and Health; S. Rinck-Pfeiffer, Global Water Research Coalition; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; F.D. Leusch, Griffith University / Australian Rivers Institute; P.A. Neale, Griffith University / School of Environment; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. Dingemans, KWR Watercycle Research Institute; M. Meeker, Water Environment & Reuse Foundation (W2KRF)

Bioanalytical tools hold great promise as an additional tool of our current water monitoring strategies. In vitro bioassays, which are increasingly being applied in water quality assessment, provide relevant and robust predictive biosystems able to specifically and quantitatively measure early adverse effects of contaminants in water, including providing a measure of mixture effect, even in low doses, where includng a comprehensive and high-throughput monitoring systems for a wide range of water contaminants, without the use of experimental animals. Smart combinations of chemical & biological analytics can lead to reduced uncertainty in safety assessments, especially with regards to endocrine disruption, oxidative stress as to be tackled at its source. 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 uses goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public. [1] https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Vienna_EU_27_10-28-2011.pdf [11] http://www.greenpeace.org/international/GLOBAL/international/publications/toxics/Water%202011/dirty-laundry-12 pages.pdf [11] https://www.greenpeace.de/sites/www.greenpeace.de/files/20121203-Toxic-Threats-China-engl.pdf [9]/<sup>n</sup>/sup> Greenpeace (2015), Footprints in the Snow; http://detox-project.org/assets/uploads/Report%20n%20A%20RAE_report_08_2015_en gh.pdf [9]/<sup>n</sup>/sup> Greenpeace Italy (2017) FAS in Veneto; inquinamento sotto controllo? (in italian) http://www.greenpeace.org/Italy/Italy/italy/report/2017/Inquinamento/PFAS-in-Veneto.pdf [9]/<sup>n</sup>/sup> Greenpeace Italy (2017) Non ce la beviamo. Presenza di PFAS nell’acqua delle scuole venete (in italian) http://www.greenpeace.org/Italy/Italy/italy/report/2017/Inquinamento/Report_N on_ce_la_beviamo.pdf

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


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. Alizadeh, National and Kapodistrian University of Athens / Department of Chemistry; N. Alyagizaki, Environmental Institute; J. Hollender, Eawag / Environmental Chemistry; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; J. Slobodnik, Environmental Institute; N.S. Thomaidis, National and Kapodistrian University of Athens / Department of Chemistry; A.J. Williams, US EPA / ORD/NCT Non-target screening (NTS) with high resolution mass spectrometry (HR-MS) provides tremendous opportunities to unlock the dynamics and effects of contaminants of emerging concern far beyond the current 45 “priority pollutants” or even “known” chemicals. Open science and the exchange of information (between for example scientists and regulatory authorities) has a critical role to play in the continuing evolution of NTS. Using a variety of case studies from Europe, this talk will highlight how open science activities such as MassBank.EU (https://massbank.eu), the European CHARMAN Spectral Library (http://www.charman-network.org/?p=node/236) and NORMAN Digital Sample Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptox.epa.gov/dashboard/) can support NTS. Further, it will show how initiatives such as near “real time” monitoring of the River Rhine and retrospective screening via so-called “digital freezing” platforms have opened up new potential for exploring the dynamics and distribution of as-yet-undiagnosed chemicals. Collaborative European and international activities facilitate data exchange amongst analytical data scientists and enable quick, effective and reproducible provisional compound identification in digital archives of HR-MS data. This is leading to new ways of assessing and prioritizing the new generation of “emerging pollutants” in the environment, enabling a pro-active approach to environmental protection that is unlikely only a few years ago. Note: This abstract does not reflect US EPA policy.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using expert triggered values B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Alt-Aissa, Institut National de l'Environnement Industriel et des Risques (INERIS); P.A. Behnisch, Biodetection Systems BV; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; F. Brison, INERIS / Ecotoxicology Unit; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; W. Busch, Helmholtz Centre for Environmental Research - UFZ GmbH / Biocatalytic Ecotoxicology; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research,
Dept. of Environmental Analysis; T. Hamers, VU University Amsterdam, for the remainder it is necessary to obtain more experimental data for single chemicals but also to derive more EQS values. To assess the practicality and robustness of the proposed approach, we tested the EBIs in an European project SOLUTIONS, where water quality was assessed in large streams (e.g., Danube), hot spots of contamination (e.g., disposal of untreated wastewater), and small streams draining highly contaminated areas. The influence of wastewater treatment plant effluent into small creeks (case study of small Swiss tributaries in Switzerland). In many cases the proposed EBIs were able to differentiate wastewater from surface water and EBIs for different bioassays gave very consistent results indicating the benefit of a common derivation method. Despite the limitations due to limited effect data availability and limitations of the existing lists of EQS, the proposed generic methods to derive EBIs is a first step to harmonise existing approaches and explore various different options of a large diversity of in vitro bioassays commonly applied for water quality assessment.

Acknowledgement – This study was a joint effort of the EU project SOLUTIONS (grant 603437) and the workgroup bioassays of the NORMAN network.

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 to identify chemicals present in the environment that may be responsible for the observed biological effects. The main focus of this project is to develop a framework for integrating chemical monitoring and biological effects that will enable the identification of chemicals with toxicological relevance to human health and the environment.

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

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

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

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

1H-1,2,4-Triazole (124T) is a key structural component of azole-fungicides, one of the world most widely used fungicide classes in agriculture, used in crop protection industry (Taskforce Triazoles and Derivatives, TMDG). The TMDG is jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, toxicology, and risk assessment of 124T. So far in the regulation of crop protection its origin was interpreted as a result of the breakdown of the parent azole-fungicides only. 124T is toxicologically classified as R63. According to the EU Regulation, Directive 1107/2009, it is a ‘relevant’ metabolite in groundwater and subject to a legal maximum concentration of 0.1 µg/l with respect to crop protection uses. Distinct restrictions on agricultural uses of azole-fungicides have been necessary to meet this hazard based limit value. In response to the large number and widespread use in the EU of registered azole products, regulatory authorities are asking for information about 124T’s potential leaching and actual concentration in groundwater. The TMDG scientists discovered that 124T occurs ubiquitously in the environment, originating also from other anthropogenic sources than azole-fungicides, such as fertilizer additives (to avoid nitrate leaching) and commodity chemicals, and is also naturally formed. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches were needed. The TMDG scientists have therefore expanded the scientific scope into non-agricultural environments and residues in different matrices. The work is supported with a recent terrestrial field dissipation study using a 13C stable isotope labelled azole-fungicide to enable differentiation between the different sources, a forest soil study to assess the background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and shown that its 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 justified regulatory conclusions.

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

M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, A. Chang, Bayer Crop Science AG; T. Teltscher, Bayer AG Division, CropScience/Environmental Fate / Development Environmental Safety; O. Heinemann, Bayer Crop Science Division 1H-1,2,4-triazole (124T) is an ubiquitous small molecule which originates from different anthropogenic sources in the environment or from biotic or abiotic degradation of triazole-fungicides. In addition, 124T potentially originates from natural sources like soil microorganisms (Fungi, Actinomycetes). Information about the natural background abundance of 124T in forest top soils of German origin is of importance for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, to 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. To investigate if there was a contribution of 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 molecules 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 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 was followed by in-depth farmer interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream infiltration area. In total 211 groundwater samples from 31 wells in different regions of Germany were analysed. All samples were < 0.1 µg/L, with 14 samples between 0.05 (±LOQ) and 0.08 µg/L. The results show that even with intensive use of triazole fungicides, the concentrations of 124T in shallow groundwater downstream from treated fields did not exceed the regulatory trigger of 0.1 µg/L. The presented approach is considered to be effective to obtain a realistic picture of groundwater exposure to 124T from triazole fungicides in agricultural practise. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

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

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The compound 1,2,4-triazole is a degradation product of many azole-fungicides and growth regulators used in agriculture. Leaching of 1,2,4-triazole from agricultural fields has been evaluated in Denmark in the Danish Pesticide Leaching Assessment Programme (PLAP; www.pesticidetvilsing.dk), which comprise five agricultural fields. In another study, sand-filled till fields were used. 1,2,4-triazole 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, where the latter according to the EIFS conclusion only forms minor amounts of 1,2,4-triazole-3-amine and 1,2,4-triazole-4-amine in the molecule. No significant leaching of 1,2,4-triazole was detected in 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 in groundwater 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

M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, A. Chapelle, Bayer Crop Science AG; O. Naeb, SGS Institut Fresenius GmbH; O. Heinemann, Bayer AG Crop Science Division; S. Roulier, ADAMA

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 DegT50 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 from the upper 0-15 cm 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 detections 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 to the European Union. Furthermore, TFA is a by-product of the biodegradation product of several pesticides. During a screening of surface waters in southwest-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. Ozoneation of model substances and wastewater samples was applied to reveal the TFA-forming potential of individual compounds and the presence of not yet identified TFA-precursors in waters bodies in general. Discharge of industrial wastewater was identified as the source of elevated concentrations of TFA in the Rhine tributary. Extended monitoring demonstrated that this contribution still impairs the drinking water supply along the lower River Rhine. Ozoneation, 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
overview contribution will examine the range of techniques and experimental models suitable for the assessment of HOCs biodegradability taking into account state-of-the-art bioavailability science (Environ. Sci. Technol. 49: 10255-10264, 2015). During recent years, we have applied these techniques to study the microbial interconnections with bioavailability processes, involving pollutant phase exchange, microbial mobilization and cell attachment to interfaces. We can consider two groups of techniques; 1) Broadly applied methods to estimate the bioavailable contaminants using Texan or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 14C-labelled chemicals. Examples and applications of these approaches will be summarized. They include desorption extraction (Environ. Sci. Technol. 45:3019-3026, 2011; Environ. Sci. Technol. 49:10369-10377, 2015), passive sampling and dosing methods (Environ. Toxicol. Chem. 27:1526-1532, 2008; Environ. Pollut. 184:435-442, 2014; Environ. Pollut. 205:378-384, 2015), constant NAPL/water interfacial area method (Environ. Sci. Technol. 45:1074-1081, 2011; Environ. Sci. Technol. 51:11935–11942, 2017), and radioespirometry and dual 14C/residue analysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability and biodegradation sciences. Still today, it is difficult to predict bioavailability of HOCs, for example, solely on the basis of basic parameters such as organic matter, black carbon or clay contents of a given soil or sediment, and the physicochemical constants of the chemicals (such as solubility in water, octanol-water or organic-carbon based distribution coefficients). This limitation even remains with improved assessments through determinations of chemical activity and bioaccessibility. This uncertainty not only applies to biodegradability in natural environments, but also to engineered remediation systems.

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

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

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

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The investigation of the environmental fate of pollutants is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in biodegradation systems hampers 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 Arrhenius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the validity of such models, by exploring the effect of short-term temperature variation on microplastic 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 (6μg/L) was monitored over time at five different temperatures (4°C-20°C). The experimental kinetic parameters and the corresponding 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. Biotransformation processes may be linked to basic living cell functions, which are sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arrhenius-based models for the estimation of chemicals fate in biological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations.

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

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A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards priorisations on chemical persistence. In their current guise, BSTs are ineffective as screens for persistence. They are prone to high levels of variation and produce a large number of false positives, 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 acetate), a negative reference compound (pentaclorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polycrylamide), were used to provide a range of biodegradation potentials by which to validate the new method. Biodegradation data for the five chemicals, in the three test systems used, across the 13 participating laboratories will be presented. The need for clearer guidance on biodegradation testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain inter- and intra-laboratory variation in biodegradation test outcome will also be discussed.

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

D. Hennecke, Fraunhofer IFF - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IFF - 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 surface water, for example direct or indirect photolysis, are not addressed. Since biodegradation is limited in the OECD 309 study, the consequences are critical for substances which are hydraulically 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 stable 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 aqueous systems under the influence of light. The purpose of the test was to determine if photolysis is a relevant process in natural water bodies under OECD 309 test conditions and up to which water depth this can be applied.

253 Poster spotlight: TU267, TU268, TU269
Integrating life cycle approaches towards a sustainable circular economy (I)

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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 develop a harmonization of underlying indicators through a structural assessment of currently suggested CE performance indicators, we can define gaps and needs in the monitoring process of CE to ensure that progress contributes to the overarching goals of CE and in turn capture trade-offs between implementation strategies.

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Making sense of circularity indicators with Multi Criteria Decision Analysis

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The focus of this study is on packaging, i.e. a sector with high priority for circular economy (CE) implementation, by exploring a situation where a company intends to compare the circularity performances of different products in order to identify which is the best option from a CE perspective. We considered six different packaging alternatives for beer in different contexts and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS), included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Granta and iii) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) method is used 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 MCDAs is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDAs 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 MCDAs 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 MCDAs in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

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Consistent allocation using archetypes of LCA Goal and Scope definitions

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Identifying a suitable allocation procedure is always a challenge in the modelling of the LCA. This holds true for many kinds of products and that could be used in multiple life cycles due to efficient recycling. PE International recommends how to apply allocation for the production and recycling of metals [1]. However, by recommending both partitioning and substitution for establishing the data for an attributional LCA, several inconsistencies are introduced. It becomes unclear to what research question LCA results respond if different modelling approaches are combined in a single LCA study. We developed archetypes of LCA Goal and Scope definitions – in the form of research questions – that aid in identifying a suitable and consistent allocation procedure. In order to identify the LCA study scenario of each alternative, the goal and scope of LCA in combination with several weighting schemes are ranked in the first two positions in all the sets shows that two alternatives are dominating i.e. have higher scores for all the same within the life cycle assessment indicators, but differs when MCI and for ranking the six alternatives. The results of the stand-alone application of the MCDAs method TOPSIS is used for ranking. Specifically, the compensatory approach based on the MCDA method is applied to process the indicator scores and subsequent implementation strategies. The c

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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 utility and value 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 reparability 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 computer using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. New materials are derived that are used in the following study, and potential additional functions of the product 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 repair procedures: “What is the impact of 1 kg of recycled aluminium?” is not detailed enough to identify an LCA modelling approach. This paper shows the level of detail that is required to enable this. The importance of a research question is not always clear. A product planning phase of the laptop is modified to reflect a closed loop for recovered materials. For this reason, only a limited number of materials are taken into account. The recycling scenario assumes the optimistic case that all laptops are collected. The pre-processing of the laptop is modelled assuming a manual depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site, or aluminium smelter and a subsequent recycling step. 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 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.

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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 can be optimized. In this sense, different literature express that half of the currently economically phosphate resources will have been used up in 50 to 100 years. To optimize P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant precipitated struvite will be used as the P source for crops in the i-RTG in two different ways: mixing struvite in the nutrient solution and by adding struvite in profitable协商s (hydroponic substrate). The goal of this contribution is thus to evaluate the CO2 and P cycles in an i-RTG through experimental and environmental studies by considering circular economy strategies. With these enhancements, urban agriculture will cut its environmental impacts, making it a more sustainable source of food for cities.

259 Chemical recycling of plastic packaging waste - A life cycle perspective on PET recycling R. Mey, RWTH Aachen University / Chair of Technical Thermodynamics; S. Westheus, RWTH Aachen University; J. Klankermayer, RWTH Aachen University / Institute for Technical and Macromolecular Chemistry; A. Bardow, RWTH Aachen University

Plastic packaging waste is one of the priority areas inside the European action plan for the transition to a circular economy. To establish a circular economy, a potential large-scale avenue is chemical recycling of plastic packaging waste. However, preliminary assessments of chemical recycling technologies rate them inferior compared to mechanical recycling not only from an economic but also from an environmental point of view. In 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. In this work, the method is used to evaluate chemical recycling technologies for polyethylene terephthalate (PET). In this case study, we show the need to produce high value-added chemicals from chemical recycling technologies to possibly achieve an environmental benefit compared to mechanical recycling. To improve on mechanical recycling, chemical recycling needs to yield a chemical that is currently produced with an impact on climate change or fossil resource depletion exceeding 2.54 kg CO2 eq. or 1.58 oil eq. per kg, respectively. To the best of the authors’ knowledge, no chemical in patents or literature meets both of these threshold values. In contrast, chemical recycling is beneficial compared to energy recovery in all studied cases. In the presented method enables the easy and early-stage assessment of the maximal environmental reduction of chemical recycling. The case study shows that chemical recycling should target PET waste that is currently used for energy recovery or needs to transform waste from mechanical recycling to high value-added chemicals.

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


In 2009 PFOS, its salts and 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 declaration to evaluate uses at regular intervals in order to facilitate a total phase-out. Besides the evaluation, the Convention provides Guidance of alternatives to PFOS, which is regularly updated and meant to facilitate the Parties to the Convention in phasing out PFOS. The evaluation was carried out in 2014 under the POPs Review Committee. In 2016 the previous Guidance on alternatives was updated, followed by endorsement in 2017. The update focused on all known applications of PFOS, including the twenty exemptions. However, priority was given to the open applications in two pesticide uses, namely insect baits for control of leaf-cutting ants from Atta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termites. Data on the environmental performance but an imp...
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CAV framework by identifying both possibilities and challenges. We conclude that the inclusion of a life cycle perspective in CAV 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 that need to be adapted to their uses. The toxicological effects in such cases 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 PFSAs 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 substitutability” this study presents an evaluation of material properties of new durable water repellents (DWR) for textiles focusing on end-user requirements. Since the phase out of side-chain fluorinated polymers (SFPS) based on long perfluoroalkyl moieties that were associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFAAs), a variety of new DWRs have been developed including biodegradable materials that are based on short perfluoroalkyl containing monomers. Selecting substances for their use to provide substances for hydro- and oleophobic fibre modifications SFPS based on long perfluoroalkyl chains were historically used on all kinds of different textiles applications. It is so far unclear if alternative DWRs can follow this “one solution will solve all” approach. By segmenting the textile sectors in terms of liquid repellency, this study sets out to outline the different requirements in case studies for functional outdoor clothing and occupational medical apparel. For functional outdoor clothing, a “bottom-up” strategy was chosen by using a survey to assess the consumers’ needs and expectations. For occupational medical apparel, exposure scenarios to liquids were defined based on protection needs described by the Center for Disease Control and Prevention (CDC). Based on these demands, relevant liquids were chosen to evaluate repellent properties provided by 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-fluoronitrated 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 even fluoroalkylated FOMs based on short perfluoroalkyl chains significantly reduce the only materials that protected against liquid penetration. This study of chemical substitution based on chemical and textile functionality as well as end-user requirements pointed out the opportunities and limitations for functional substitution.

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

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An analysis of the technical and economic feasibility of alternatives to lead gunshot has been prepared by ECHA as part of a REACH Annex XV Restriction Report on lead and lead compounds used in shot in wetlands. Lead has historically been used in cartridges because of its softness, low melting point, high density, relatively low price and high abundance. Because of these properties, lead is often considered to be the ideal material for use in ammunition. Steel gunshot (soft iron) is by far the most widely used alternative. Other materials include horn shot and tungsten. The alternatives have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead gunshot. However, some adaptation is required by the shooter to use alternatives successfully, including the following: Adaptation of the shot size used as this would typically need to be increased to counter for the lower density of steel. Awareness that shotguns are a (5) powerful weapon and influences the ammunition performance, if fired at targets within a range of 35m Training should be done using shot of the same material as is intended for use in hunting/shooting This suggests that, in assessing hunting/shooting success, the individual skills of a shooter are more decisive than the type of ammunition used. The fact that several countries in the EU have implemented a full ban on the use of lead shot (for example Denmark and Netherlands) is evidence that alternative gunshot is suitable for both hunting activities and sports shooting. Steel shot is the most common alternative to lead gunshot due to its similar price per cartridge, making it the cheapest of the currently available alternatives. Some hunters may need to modify an existing shotgun to enable the use of steel gunshot. However, major gun manufacturers have confirmed that the vast majority of modern shotguns can fire alternative shot materials without any problem. In rare cases, a very old shotgun may need to be replaced or the hunter needs to use the more expensive bismuth or tungsten shot. The analysis of alternatives indicates that the use of alternatives to lead gunshot for hunting and shooting in wetlands is technically and economically feasible. While the availability of such alternative gunshot may currently vary across the EU Member States, it can be expected that a rise in demand triggered by an EU-wide regulatory action will be met on the supply side.

265 The road to successful substitution - case studies

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

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

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

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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 50000 observations, about 300000 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 database system out of the four key requirements: (1) the development of a harmonized tool for the evaluation of ecological soil quality, (2) the collection and usage of existing data from different parties all over
Europe, (3) the provision of a reference base of the ecological quality of soils and (4) the coverage of relevant needs of as many as possible European policies. Finally, necessities for practical use in common agricultural policy, circular economy and for EU transboundary issues are discussed.

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


In the context of the EU commission product environmental footprint activities (PEF) [1,2], the potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. For each single chemical, this model requires dozens of physico-chemical parameters as well as data on ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer endpoints. For PEF all 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 (30,508 test results) and human toxicity data (41,381 test results) available in the IUCLID 5.5 database (as of May 2017). Data were downloaded from the EURL ECVAM website (A. Versteeg, Ecodevelopment LLC).

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 data. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these devices in bioassays does not alter the conditions 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.

Ceriodaphnia is eusensitve to Daphnia and should fulfill invertebrate regulatory toxicity requirements

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

The OECD 202 Acute Daphnia Toxicity Test (OECD 202) is a long established 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 exposure. Then, simply present the battery of exposures (mixed species or single) to the device by just pouring the (tens of) flasks to the serialization component in the D counter device. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these devices in bioassays does not alter the conditions 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.

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 elements including Cu, Pb, Ni, Zn, Mn, Cd, Co, Cr, Ni, and THg. In each particle size category, part of the percentages of clay, fine silt, coarse silt and sand, which represent particles that could be most directly related to recontamination potential. The results show that over the time the contaminant loadings decreased due to reduction in particulate contaminants while the concentrations in finer, and dissolved fractions remained relatively constant. Cu and Pb were associated with the largest particles in stormwater, but only Cd is strongly associated with sediment recontamination. Cu, Pb, and Ni are associated with the dissolved phase, fine silt and clay in stormwater and present moderate impact on sediment recontamination. In addition to showing a greater dissolved fraction it appears that the depositing loads are more influenced by resuspension and redistribution of sediment than stormwater. The THg load is relatively small and stormwater recontamination does not add appreciably to sediment THg loads. The particle associations in stormwater along with spatial distribution in sediment traps can identify sources, contributing locations and effective remedial approaches. The implications of the study, can be the development of identification tools that give information about the potential mobility-transport of the metals during storm events, identification of contributing locations, effective remedial approaches, and thus, help to propose best practices for stormwater and sediment management.
micro metallurgical wastes
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Incineration, a derelict technology, is strongly influenced 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 Beaune. 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 Contaetras aspennis 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 reaches 4.5 ± 0.6% MnO. With time, slag weathering, as testified by the decrease in the Mn concentration of olivine smelting slags and the broad availability of Mn in the 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. aspennis snails tissues allowed to show i) the slow decrease of Mn bioavailable in soil invertebrates and ii) the snail ability to efficiently regulate this element.

277 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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Biomass 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 comprised the following treatments, to assess the availability of Mn in soils, its bioavailability to earthworms and slugs, and a pot experiment, with Agrostis tenua Sibth, to evaluate the possibility of establishing a plant cover in the amended soils. The effects on soil quality were assessed evaluating: i) the soil chemical properties, ii) plant growth, (iii) immobilization of metals in the soil, (iv) the effects of the amendments on soil eluates toxicity, using organisms from different trophic levels: luminescence inhibition of Vibrio fischeri; 24-h mortality test with Thamnocephalus platyurus; 72-hours population growth of the green microalgae Pseudokineticella subcapitata; and Daphnia magna acute immobilization test; and; v) soil dehydrogenase activity. Contrary to non-amended control pots, it was possible to establish a plant cover with A. tenua in pots where correctives were applied, but with some variability between replicates. Phytotoxicity was observed in some of the pot eluates, preliminary analyses showed a decrease in the toxicological profiles in soil samples, in comparison to non-amended soils (controls) was further evidenced by the increase in the activity of dehydrogenase. The amendments were also able to correct soil acidity, and to increase extractable P and K. However, a significant increase in the organic matter, and N content, was only possible by the simultaneous application of MSWC. The Mn concentration increased the higher application rates of the correctives, due to a dilution effect. In general, amending the soil with biomass ash and biological sludge decreased the toxicity of soil eluates towards the organisms used. The formulation with 30% of biological sludge (applied in 2.5, 5.0 and 10%, w/w, dry matter), presented a better performance, although inducing a slight toxic effect in the microalgae. Concerning the amendment with MSWC, and despite its beneficial chemical effects, toxicological results did not reflect this improvement, since the presence of MSWC did not promote the decrease of toxicity towards the microalgae. Further research is needed with different plants species, since Agrostis tenua showed some phytotoxicological response.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)
278 Profile of microplastics in water and sediments of Antuã river in Portugal
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The accumulation of plastics in aquatic systems, especially, microplastics (particles with < 5 mm) is of particular apprehension since they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. These microplastics (MPs) differ in their physico-chemical properties (e.g. size, shape, colour, density and polymer type) as well as in their origin (primary or secondary). Notwithstanding, the occurrence of microplastics (MPs) in freshwater systems is less understood than in marine environment. Hence, the present study aims to fill this knowledge gap providing new insights into MPs contamination in 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 Aguinechega, 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) underlined 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 and PP particles were 54:38:55/50% and 55:35:50%, indicating that few 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 Aguinechega and Esteareia in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential carriers of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.

279 Microplastics in German rivers - first monitoring results
Plastics are an indispensable component of our daily lives due to their diverse applications. In consequence of improper handling or disposal, plastics can enter surface waters and persist over a long period due to their low 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 in terms of (i) point-source analysis and (ii) large-scale surveys. The programme comprised microplastic monitoring in two large river basins (Rhine and Danube), including tributaries of various sizes, thereby covering a wide range of hydrological conditions and anthropogenic influences. A total of 52 measuring points distributed over 25 rivers and streams were examined for MPs near the water surface. MPs were sampled via MantaTrawl and analysed by FTIR spectroscopy. In total, 5,176 items were collected. For these par-
Exploring the relation between plastic concentration and river discharge in an urban river

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Rivers play a major role in transport of plastic debris from inland sources into the marine environment. Presently the relevance of various individual sources and emission pathways of plastic in rivers such as wastewater treatment plants, combined sewer overflows, surface runoff and littering can hardly be quantified. Therefore plastic emission from sub-catchments are determined by integral approaches. This study examines plastic particle concentration upstream (P1) and downstream (P2) of an urban catchment 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) upstream (P1) and downstream (P2) of an in-basin wastewater treatment plant 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 sub-catchment. To explain the observed concentration and load increase, plastic input in both sub-catchments 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 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.

Microplastic pollution in upstream river catchments

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Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally. It is commonly associated with wastewater treatment plants and centres of population and industry. However, the extent to which they pervade upstream catchments is comparatively underrepresented in the study of freshwater microplastic pollution. Results presented here form part of a year-long project that aims to quantify the spatial and temporal variation of microplastic pollution in rural headwaters and urban rivers that do not receive wastewater treatment effluent across England’s Midlands, as well as in atmospheric fallout. FTIR analysis of three months’ samples identified microplastic particles in 30 litre water samples taken from the headwaters of the River Trent and its tributaries. It has also been used to identify non-fibrous microplastic fragments in rural and suburban atmospheric fallout. Moreover, spherical particles that resemble those used in cosmetic / personal care products have been identified in rivers that do not receive wastewater treatment effluent, some of which have proven not to be polymer-based following FTIR analysis. This brings into question the source, and chemical composition, of spherical particles that have previously been visually identified as plastic spheres likely derived from cosmetic particles. The findings of this study have identified the need for the more extensive consideration of upstream catchments and reaches of rivers and in the receive wastewater treatment effluent in the study of freshwater microplastic pollution. The work conducted here suggests that, though wastewater treatment facilities and large centres of population and industry are suitable predictors of microplastic pollution, the cumulative contribution of headwaters and tributaries are likely to influence a river’s microplastic load.

Microplastics in stormwater ponds

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Stormwater runoff contains pollutants from land surfaces. As the majority of production and consumption of synthetic polymers is happened on land, microplastic (MP) is one group of problematic pollutants in urban stormwater runoff. However, MPs in stormwater has barely been investigated. A large part of the urban stormwater runoff is treated in retention ponds prior to discharge. This study looked into the occurrence, composition and concentration of MP in stormwater ponds, aiming to evaluate the retention efficiency of MP by these systems. The results will contribute to the understanding of MP emission from urban areas, and potential impacts on adjacent environmental compartments. Seven stormwater ponds in Denmark were selected as study sites. Surface water was collected using a pumping system equipped with a 10 µm mesh stainless steel filter. Sediment samples were collected using an Ekman bottom grab sampler. The filters from the water samplings were pre-oxidized by H₂O₂, followed by enzyme treatment. secondary oxidation was applied afterwards. Inorganic particles were separated by density separation using ZnCl₂. Sediment samples were freeze dried and incubated in SDS solution. Enzymes were then added, followed by hydrophobic compounds were removed by density separation using ZnCl₂. After extraction, particles (from 10 to 2000 µm) were concentrated in 50% ethanol solution. A sub-sample was deposited onto a ZnSe window and dried. The window was scanned by micro-Fourier Transformed Infrared Spectroscopy imaging applying an Agilent Cary 620/670 system with a 128x128 pixel FPA. The software MPHunter was used to interpret spectrums. MPs were detected in water phase of all ponds. The most abundant polymers were PP, PE and PS. The highest concentration in terms of particle number was 10.8 particle/L, while the other 6 ponds ranged from 0.07 to 2.45 particle/L. For MP mass the highest concentration was 1.2 µg/L, while the other 6 ponds ranged from 0.06 to 0.4 µg/L. High density polymers were also detected in some of the ponds, this is likely due to the resuspension of sediment by wind and traps of MPs by organisms. Sediment samples are still under processing and will be included in 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.

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

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

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 Lendinusa (LN), Cisternino (CI), Torcianoaro (TR) and Lecce (LE). The Lecce site is located at the Adriatic Sea-Observed-Consolidated Observation station of the Global Atmospheric Watch (GAW-WMO) program. Daily PM$_{10}$ samples were collected at the different sites during measurement campaigns in different seasons (summer, autumn and winter) between 2013 and 2016. Specifically, three measurement campaigns were performed simultaneously at the four sites in 2016 and the dataset was enriched with previously available data collected in 2013 and 2015 at the sites in the province of Brindisi (LN, CI, TR) for a total of 457 daily samples. Collected samples were chemically analyzed 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 Al, 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 two receptor methods: CULTEX® RFS and CULTEX® ECBC. Numerous studies have been conducted in the last years to investigate the interactions between humans and nanoparticles (NPs) at different scales. In particular, the (ECBC- 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.

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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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).

In the last decades several toxicological studies have investigated the mutagenic and cytogenetic effects of air pollution on different biological models. Two main models are commonly used in these studies: in vitro and in vivo models exposed to PM samples previously collected on filters, then detached and resuspended in suitable media. This procedure, although extensively applied, has always posed the question about the representativeness of extracted PM in comparison to airborne PM$_{10}$. However, the lack of exposure systems directly working under environmental conditions has always posed the question about the representativeness of extracted PM in comparison to airborne PM$_{10}$. Currently produced by burning fossil fuels, the evidence of elevated environmental PM$_{10}$ concentrations is becoming a sanitary concern because French people spend 80% of time in indoor environment and young children, a particularly sensitive population, are the most exposed.

287 Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM$_{2.5}$ in different Italian towns

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Children are a high-risk group in terms of the health effects of air pollution, and early exposure during childhood can increase the risk of developing chronic diseases in adulthood. The aim of MAPEC_LIFE (Monitoring Air Pollution Effects on Children) project was i) to evaluate the associations between air pollution and effects on children and ii) to propose a model for estimating the global risk of early biological effects due to air pollutants and other factors in children. The study was performed on 6-8-year-old children (n=1,149) living in 5 Italian towns in different seasons. Micronucleus (MN) frequency and DNA damage were investigated in buccal cells of children. Socio-demographic and lifestyle features were collected using a questionnaire. Child exposure to air pollutants was assessed analyzing PM$_{10}$ (chemical composition and genotoxicity) and collecting data on air quality. In winter, the 52.7% of children showed at least one MN in cells (0.44 MN/1000 cells). A significant difference was observed among the towns. In spring, MN frequency was higher in children living in rural and forest sites with elevated PM$_{2.5}$ concentrations than rural and forest ones. Furthermore, for most pollutants, indoor air is more contaminated than outdoor. Therefore, PM$_{2.5}$ and PM$_{10}$, due to non-communicable diseases, are the most exposed.
implementing policies of public health protection.

288 Source apportionment of PM near steel plant by electron microscopy A. Genova, University of Salento / Dept. of Biological and environmental Sciences and Technology; M. Siciliano, University of Salento; C. Maltitesta, T. Siciliano, University of 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 analyzed by SEM-EDS and based on the morphology and chemical composition they have been classified into the following main groups: Alumosilicate particles; Silicium reach particles; Ca-rich particles; Biological particles; Carbonaceous particles; Soot; Kish flakes; Salts of Sodium (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, particles of different groups are merged. The source apportionment analysis performed with the single particle analysis let to investigation the dimensional and mass distribution of the sources in PM10-2.5, PM2.5-1, PM1 fractions, showing that the antropic sources are mainly present in the fine and ultrafine particles, while the natural sources are characterized by coarse dimension.

289 Oxidized transformation products of polycyclic aromatic hydrocarbons in secondary organic aerosol particles A. Kramer, 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 particulate matter (PM2.5) remains a global health concern as transport models continue to fail 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 β-pinene SOA experiments. Dibenzo[a]anthracene (DBT), phenanthrene (PHE), pyrene (PYR), and benz[a]anthracene (BaA) were measured along with their oxidation products in freshly formed β-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 provide 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 organelles induced by various biochemical and environmental stressors. 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 triolsan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus J. Paik, J. Lee, Sungkyunkwan University Tigriopus japonicus (TCS) is an anthropogenic compound 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 437.47μg/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 (SOD, CAT, GST, Glutathione transferase) 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, Cu/Zn superoxide dismutase, catalase) genes was modulated in response to TCS exposure at different concentrations over a 24 h period. Our results revealed that TCS can reduce fecundity and induce oxidative stress with transcriptional regulation of oxidative stress-induced defense genes along with the activation of the antioxidant system in the copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP3026A3 and CYP3037A1) are likely to have a potential role as biomarkers in response to TCS in T. japonicus. This study will be helpful for a better understanding of how TCS affects 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 xenobiotics exposure in aquatic environments. ABC transporters (P-gp and multidrug resistance-associated protein (MRP)) are ATP-binding cassette (ABC) transporters that confer multixenobiotic resistance (MXR) via their efflux activity, which enables a variety of xenobiotics to be expelled from cells. MXR has been proposed as the first line of defense against xenobiotics. In this study, the protective role of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and molinate) using fluorescent substrates and inhibitors specific to P-gp and MRP. The efflux activities of P-gp and MRP in the rotifer B. koreanus were increased by biocide exposure, since the fluorescence intensities of the accumulated P-gp and MRP fluorescent substrates were lower in response to different biocides. Thus, exposure of rotifers to the four biocides resulted in increased P-gp and MRP activity. Moreover, the rotifers became more sensitive to the biocides, with reduced survival and slower population growth rates, when P-gp or MRP was inhibited. These findings suggest that P-gp and MRP are involved in the defense system in response to biocide exposure. Furthermore, the transcriptional levels of the genes encoding P-gp and MRP were examined to uncover the mechanism by which MXR is induced. Taken together, our results demonstrate the role of the MXR efflux system in the defense response to biocides, thereby providing a better understanding of rotifer defense mechanisms on the molecular level.

293 CRISPR/Cas9 genome editing generates Daphnia magna (loss of function) mutants for TRH and ABCB1 genes. Implications for (eco)toxicological testing. C. Rivetti, IDAEA CSIC Barcelona / Environmental Chemistry; B. Campos, Unilever R&D / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; H. Watanabe, Osaka University / Biotechnology; Y. Kato, Osaka University / Department of Biotechnology; C. Barata, CSIC / Environmental Chemistry Unravel the toxicological mode of action of pollutant to non-target keystone species may allow us to model and predict environmental risks of similar acting chemicals. OMICs technologies approaches developed in model
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated *Daphnia magna* clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and other three having the transporter protein gene ABCB1 mutated. Bi-allelic del TRH mutants lack serotonin and have their growth rates impaired. Bi-allelic indel ABCB1 mutants had lower transcription activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoxetin indicated that effects of this drug enhancing offspring production was independent of serotonin. Acute toxicity test indicated that the transporter ABCB1 is involved in the detoxification of ivermectin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over for the use of reverse genetics in *Daphnia* to study the mechanisms of action of toxicants opening new avenues of research in a stress physiology perspective. This work was supported by the Spanish Government grant (CTM2014-51985-R.)

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

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

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

295 Poster spotlight: TU108, TU109, TU110

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

296 Linking chemical pollution and effects – How to identify drivers of toxicity? R. Altenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Chemicals in the aquatic environment do not occur in isolation but as mixtures. Their compositions, concentrations and effects are highly dynamic with regard to their temporal and spatial occurrence. Current approaches of the EU water framework directive for assessing chemical and ecological quality do not reflect the emerging challenges. The SOLUTIONS project (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Emerging mixtures (Altenburger et al. 2014, STOTEN 517:540). Now, there are options for utilising the advanced scientific knowledge for answers by either amending existing regulatory procedures of the EU water framework directive or by establishing novel assessment approaches. Priority mixtures can be conceived as a means to reduce the complexity of all real world situations into simplified archetypical scenarios. This might be achieved through modelling of typical emergents from different contaminant combinations emerging from chemical suspect pattern analysis. Identifying drivers of mixture risk can be tackled by various approaches all of which rely on a combination of chemical and biological information. Methods range from effect-directed analysis to compound class grouping by effect categories. To determine the impact of mixtures, multiple lines of evidence are emerging. They comprise of translating contamination information into expected adverse effect, effect-based monitoring using panel of bioassays and utilising trait-based parameters for analysing ecological monitoring data. In conjuction, they can be used to strengthen causal links between chemical and ecological status assessment. All these approaches were exemplarily tested within the SOLUTIONS project and should pave the way for improved water resource management.

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

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

An important route for human exposures to substances present in freshwater is through the consumption of fish. To protect humans against this route of exposure, the WFD defines specific quality standards for priority substances. In general, combined exposures are not considered, with the exception of quality standards for mixtures of specific contaminant groups, such as polychlorinated dioxins (PCDD) or polychlorinated dibenzofurans (PCDF) in fish. However, the possibility of combination effects across these pollutant groups is not currently considered. We present an advanced tiered mixture risk assessment for these groups of pollutants, first by using Water Framework Directive Quality Standards defined for PCDD and
PBDE in fish. We then make an attempt to expand the assessment by integration across these pollutant groups. While the definition of Quality Standards for specific pollutant groups is a step in the right direction, our analysis shows that more efforts are needed to protect humans from possible combination effects across pollutant groups. Such efforts are currently hampered by data gaps concerning common toxicities likely to arise in humans.

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

We present a proposal for an advanced methodological framework for identifying priority pollutants and priority mixtures of pollutants in European freshwater. 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). While high data availability is a key prerequisite 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-constituent mixtures. Environmental quality standards that have been established for single priority pollutants may not be sufficiently protective against mixture effects. Regulatory approaches for effectively tackling the problem are missing. The advanced framework integrates all available lines of evidence (LOE) on significant risks. This includes evidence from (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 onsite), (iii) chemical monitoring in combination with so-called component-based mixture risk assessment approaches, (iv) integrated modelling of co-exposure and resulting mixture risks. Where one or more lines of evidence identify groups of pollutants presenting a significant risk, these might be the basis for risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even one single component which can be demonstrated to explain most of the overall risk, so-called drivers of mixture risks. Wherever conclusive evidence on significant risks and needs for risk reduction cannot be reached because all possible LOEs are somewhat blocked by significant data or knowledge gaps, mixture components of potential significance can be prioritised for further research and testing. Some elements of the advanced methodological framework may be readily applicable under the existing WFD. Full implementation, however, requires changes in the legal text, as detailed in Brack et al. 2017 (Sci Total Environ 576:720-737).

301 A diagnostic toolbox for ecological effects of pollutant mixtures: a case study application using in situ experiments with microbial communities
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A toolbox for the detection of ecological impacts of chemicals was developed using a statistically supported, transparent and formalized weight of evidence (WOE) approach. It integrates four lines of evidence (LOE’s): (i) predictive mixture modelling, (ii) effect-directed analysis (EDA), (iii) in situ tests, and (iv) field-based monitoring studies. A systematic and quantitative method was developed for the aggregation of multiple in situ tests into LOE III, using an aggregated response index, which we termed the “average biomarker response” (ABR). The results of the four separate LOE’s are finally integrated using a systematic decision matrix that provides the main overarching conclusions that can be drawn from a given set of data and that pinpoints to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with phototrophic biofilms (periphyton) in wastewater impacted streams. Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential ecotoxicological effects by employing mixture risk 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, there 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 (ii) a subsequent upgrade of the STP plant with active carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfresh project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

302 Questioning annual average concentrations for plant protection products - TKTD modelling of real exposure profiles
M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF / Ecotoxicology Centre; R. Kuhl, E. Zimmer, IBACON GmbH; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; R. Ashauer, University of York / Environment

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

Environmental Quality Standards (EQS) are ecotoxicologically based threshold values that aim to prevent adverse 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 toxicological databases, provided, inter alia, by manufacturers. The reliability and relevance of ecotoxicological data were assessed using the CRED method. EQS derivation then largely followed the EU-Technical Guidance for Deriving EQS. After the revision, 60 AA-EQSs and 58 MAC-EQSs were proposed. The EQS revision did not generally lead to either lower or higher EQSs. AA-EQSs increased in 13 cases (max./median fold change +9.6/3) and decreased in 18 cases (60 AA-EQSs decreased in 12 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
substances, the number of AA-EQSs and MAC-EQSs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 11, respectively. For AA-EQS derivation, AFs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQS derivation, AF were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often reduced AFs associated with the derived EQSs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as amphibians or insects, and for which no SSDs could be calculated on the made of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

304 Endocrine disrupting properties: how far and consistent they are considered deriving Water Framework Directive Environmental Quality Standards? A case study tackling French and EU EQS values

A. James-Casas, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances ETES; A. Bothamy, INERIS; S. Andres, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

This paper presents a case study based on a group of 12 substances known to be endocrine disrupters. The aim of this study was to examine the extent to which these substances were issued EQSs in the French context and in the EU context. The methodology followed was based on a comparison of the available peer-reviewed literature with the EQSs and other guideline values present in the French and EU contexts. The study revealed that there were significant differences between the French and EU EQSs for the substances considered. The study also highlighted the importance of considering the potential endocrine disrupting properties of chemicals when deriving EQSs.

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

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One of the tools used by regulatory jurisdictions to deliver environmental protection is Water Quality Guidelines (WQGs) or Environmental Quality Standards. These are thresholds expressed as a chemical concentration, with an associated summary statistic (e.g. maximum) and period (e.g. “annual average”). These thresholds are used around the world for a variety of purposes including to assess the quality of surface water, the concentration and duration of effluent discharge permits. Historically, the majority of regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQGs within a regulatory jurisdiction and the inconsistent environmental protection levels between regulatory jurisdictions, despite having the same protection goals. Here we will address the feasibility of such a perception and attempt to understand its source. There is limited consistency in environmental protection, as judged by WQG for the same trace element, across regulatory jurisdictions. The absence of robust protocols (or any protocols that can be reviewed) for the derivation of the major factor is as the inevitable lack of resource and time 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 the best, whether particular factors are “arbitrary” etc. We believe that such differences are unhelpful and missing the point. There have been previous calls for increased collaboration between jurisdictions and even calls to harmonise the derivation methods with the ultimate goal of having a single global derivation process and a single set of global benchmarks. While having a single derivation method and set of benchmarks is a lofty goal it is also extremely unlikely to occur within our lifetimes. The key is to improve the efficiency and consistency of the parts of the derivation process that takes the most time and effort. At least 90% of the time and effort spent on deriving an EQB is used to assess which ecotoxicity data are suitable and of appropriate quality to use. We therefore advocate that efforts should focus on these methods. Possible ways to reduce effort include: acceptance of other jurisdictions' assessments; international acceptance of an existing method; developing a new assessment method and establishing an international archive for assessed data. Other components of the derivation process that could also be relatively easily harmonised and would have a significant impact in reducing effort will also be discussed. A realistic plan for achieving these gains will be set.
Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

308 The impact of anthropogenic activities on bacterial and viral diversity in the Eastern Mediterranean Sea
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The Eastern Mediterranean Sea is a low-nutrient low-chlorophyll marine ecosystem [1] but some variability within the basin does exist. Indeed, several coasts are influenced by anthropogenic processes, and specifically in the Greek coasts these include industrial, harbor, agriculture, mariculture activities, urbanization and tourism [2]. Our hypothesis was that prokaryotic and viral community diversity is differently affected in contrasting coastal systems by anthropogenic pressures. We used 16S rRNA gene amplicon and whole virome sequencing at stations characterized by different chemical features based on the “National monitoring project for the implementation the Water Framework Directive (2000/60/EE) in Greece” [2]. We focused on viral auxiliary metabolic genes and the influence of heavy metals (Cu, Cd, Co, Ni, Pb, Zn, Cr and Hg). Significant differences were found at the genus level between the sampling stations. Proteobacteria were dominant in all stations, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinades and Patraikos Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cu, and Pb. The highest concentrations of NO3, NO2, NH4, PO4, SiO2, and chlorophyll a were found in stations influenced by intensive, agricultural, and maricultural activities. The 3 stations of Anvrakikos 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 lysozyme (i.e. viral integrase and auxiliary metabolic genes’ abundance) is a prevalent life strategy. [1] Krom MD, Emeis K-C, Van Cappellen P. 2010. Why is the Eastern Mediterranean phosphorus limited?. Prog Oceanogr 85:236-244. [2] Pavlidou A, Simboura N, Rousselaki E, Tsapakis M, Pagou K, 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: 156-168.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments
K. van der Hoff, 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. Bärer, University of New South Wales; M. Sutherland, NSW Office of Environment and Heritage; V.X. Sin, University of New South Wales; T. Lachnit, University of Kieler Meeresforschung; S. Swamp, National University of Singapore; S. Kjelleberg, Nanyang Technological University / The Singapore Centre on Environmental Life Sciences Engineering; M. Doblin, Department of Environmental Sciences / Department of Environmental Sciences; G. Birch, Sydney University / School of Geosciences; P. Gribben, University of New South Wales; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre. Estuaries are diverse and productive ecosystems that are subject to high levels of disturbance. They are exposed to multiple stressors such as legacy contaminants in sediments and ongoing inputs of nutrients and metals via stormwater, but we still have little understanding of the consequences for ecosystem functioning. We surveyed sediment communities at four locations with large stormwater drains in Sydney Harbour, Australia. Locations were either poorly-flushed embayments or well-flushed channels. Sediment was collected monthly during base rainfall (<5mm/day) for 4 months from 3 sites at increasing distance from the stormwater drain (0, 200 and 1000 m). We also collected sediments after 2 large rain events (>150mm in 24h). Next-generation sequencing was used to characterize the microbial community and sediment was subsampled for metals, total organic carbon, total nitrogen and phosphate. Sediment cores were also collected to characterize the physical, chemical processes including primary productivity, community respiration and nutrient cycling. We observed major shifts in the microbial community related to exposure to legacy contaminants and new stormwater contaminant inputs. We also found trends of decreasing community respiration rates away from storm drains and lowest rates of primary production during base rainfall. The results have implications for future management of stormwater in estuaries and increase our understanding of how to conserve crucial sediment community diversity and function.

310 Drought as environmental driver on ciliates and micrometazoan communities in a multistressors scenario. An experimental approach
J. López-Duroval, F. Romero, V. Acuña, S. Sabater, ICRA Catalan Institute for Water Research
Climate change will affect agriculture practices and productivity because increased intensity and frequency of drought events will stress crops and change in phytochemistry, which means a future increase of the use of pesticides and, in consequence higher risk of freshwater pollution. In addition climate change will lead to higher severity of drought events and higher temperatures. Ciliates and micrometazoa in freshwater ecosystems play an important role in the processing of organic matter and as basal resource for consumer organisms. The present work aims to study how these environmental and chemical stressors, and their interactions, in a future scenario of climate change can affect these communities in freshwater sediments. To study how drought (D), warming (T) and a realistic environmental mixture of pesticides (P) can affect the communities of ciliates and micrometazoa in river sediments, we developed an experiment with a factorial design in experimental indoor channels with natural sediment from a pristine river (24 channels, 3 replicates, 3 severity of drought conditions). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoa communities was studied twice during the experiment (one week before and after 7 weeks of chronic exposure). Significant changes in community composition between pre- and post- exposure were observed for all treatments. Community was dominated by micrometazoa in all treatments in terms of density, but a trend of increasing the percentage of ciliates in these treatments with stressors was observed, indicating a possible advantage of ciliates in stressed environments. At the end of the experiment total density was significantly higher respect to control in D, DP and TDP treatments (p < 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (p < 0.001 Dunnet’s test). Taking into account community composition in pre- and postexposure 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
N. Correll, University of Gothenburg, Sweden / Biological and Environmental Sciences and Engineering Division; J. Håkansson, University of Gothenburg / Department of Biological and Environmental Sciences; A. Nilsson, University of Gothenburg / Section of Ophthalmology, Dept. Clinical Neuroscience, Institute of Neuroscience and Physiology, Sahlgrenska Academy; K. Johansson, University of Tartu / Institute of Technology; H. Spångfors, Halmstad University; M. Kahlert, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; J. Kureuger, Swedish University of Agricultural Science / Centre for Chemical Pesticides; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

Although the environmental risks associated with pesticide pollution in agricultural streams are quite well documented, little is known about its potential effects on periphyton quality. Periphyton provides many of the essential 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 (Hoje å, Skivarpsån and M42) located in the agriculturally dominated region of Skåne (SE Sweden) were sampled in September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpså and M42 than in Hoje å. Ecotoxicity tests using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Hoje 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 Hoje å. The nutritive quality of the periphyton differed among streams, and fatty acids considered high quality such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were also more abundant in pesticide polluted streams (Skivarpsån and M42). Overall, even though results from the lab show that the mixture of pesticide pollution in the studied
streams might be toxic for periphyton (i.e. inhibiting the photosynthetic activity), being herbicides the driving chemical stressors. Results from the field, indicate that when the levels of pesticide pollution are low and co-occur with high levels of nutrients pollution, nutrients might mask pesticides effects on periphyton quantity and quality because compensatory effects from nutrients.

312 Estrone and triclosan mixture alters soil metagenomics during degrada
don 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 or impact on soil microbial community processes are poorly understood. Estrone and triclosan are two common PPCPs of domestic wastewater. Soil microbial communities degrade a variety of PPCPs however; most studies have only addressed single compound designs neglecting the reality of their co-occurrence in nature. In this study, we examined the interaction between estrone and triclosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triclosan, and a 1:1 mixture of estrone: triclosan, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlates™. Microbial degradation rates were compared over the 90 days’ incubation period using high performance liquid chromatography. Metagenomic analysis by 16S rRNA was used to determine changes in microbial community over time. There was significant increase in substrate activity and substrate richness in all treatments. Each microbial community utilized different carbon substrates by day 90 whereas they had exhibited similar substrate utilization at day 0. Estrone and triclosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triclosan). The rate of degradation of the binary estrone:triclosan mixture was the same as the individual compounds. There was a decrease in species diversity between control at day 0 and all other treatments at day 90 with establishment of unique OTUs in each treatment group at day 90. Metagenomic analyses indicate distinct communities by treatment 90 days after exposure even though Bacillus sp. was dominant in all the 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 D.A. Turner, EMPA / Technology and Society Lab; G. Doka, Doka Life Cycle Assessments; A. Haarman, EMPA Technology & Society Lab / Technology & Society Lab; R. Hirschier, EMPA / Technology and Society Lab
Tailings, a waste material produced during mineral concentration (beneficiation), often contain significant quantities of mobile toxic metals and are typically produced in large quantities. To manage these wastes, tailings are commonly stored behind damned impoundments, known as “tailings ponds”. These ponds pose a significant long-term pollution risk as metals may leach out into the surrounding environment, potentially over very long timeframes. The management of tailings therefore represents an important environmental burden for primary metal production. To help life cycle assessment (LCA) practitioners quantify this important environmental burden, the ecoinvent database contains – since 2009 and the release of version 2.1 – a global average life cycle inventory (LCI) dataset for sulphidic tailings disposal, developed using a dedicated tailings emissions model. However, the dataset was intended only to serve as a first generic estimate and is based on highly aggregated data that attributes an identical burden to each kilogram of waste, regardless of its composition. Given their relevance to the overall impacts of primary metals production, access to more detailed, region-specific LCI data on tailings disposal is crucial for a more comprehensive and adequate integration of primary metals in LCA studies. Here, we present an extended model for assessing the long-term emissions from tailings disposal. The model can heed a specific tailings composition and local climate data, allowing for the creation of site- and region-specific specific LCI data based on an extended literature survey and data on tailings compositions and leachate concentrations from different mine sites worldwide. The model was used to develop new country- and region-specific datasets for tailings disposal from a range of ore types, which will contribute to improving the quality and hence reducing uncertainties in LCA studies worldwide. Our presentation will give an overview of the extended model and related datasets, which will be integrated in a later version of ecoinvent. We will also highlight its improvements compared to the previous model by presenting the results of an LCA case study of region-specific primary metals production in order to demonstrate the important differences between global average and situation-specific calculations in such an important sector as primary metals production.

315 Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction
L. Passari, Alma Mater Studiorum - University of Bologna; F. Passari, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry
Copper is widely used in modern society, finding application in traditional end-uses such as plumbing, infrastructure, and transportation, but it is also an essential material in emerging green energy technologies. Europe (i.e., EU-28) has modest natural deposits and strongly depends on imports to meet the domestic demand. In addition, even though there is a strong correlation and positive supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, as copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling economic function. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling economic function.
318 Towards global guidance on LCA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force

T. Sonderregger, ETH Zurich; M. Berger, Technische Universität Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprih, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treede Ltd.; J. Guiney, University of Leiden / Institute of Environmental Sciences; C. Helbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHIWA, National Institute of Advanced Industrial Science; and; S. Northej, Monash University, another damage tax approach termed Specific Damage Tax (SDT) is proposed that extends beyond LCA. DaVAT is the sum of UVAT, GD7 and SDT. DaVAT is conceived not as an additional burden but rather as a shift of taxation, as the rate of the old consumption taxes can decrease proportionally to the increase of GD7. DaVAT is also designed in such a way that the erosion of tax revenues, when pollutant releases would decrease, is offset by the extension of the tax to all goods and services and by the possibility to gradually re-increase the UVAT rate when the number of highly-polluting products decreases. To reduce the variance of the LCA results used for this purpose, the DaVAT system should use common databases, apply the same inventory, characterization, normalization and weighting methods, as well as refer to the same impact categories and the same cut-off rules. LCA as a whole can stay as it is, but for use in DaVAT specific impact categories (e.g. cumulative change 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.

320 Silica coating for the control of nano-reactivity

S. Ortelii, 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 Ag+Ag total distribution. We evaluated the effect that silica coating had on physicochemical properties (size, shape, and zeta potential), optical properties and biocompatibility. Furthermore, we evaluated the possibility of silication as technique in order to increase the range of toxicity results. We first demonstrated that both at colloidal and dried state a matrix of SiO2 surrounding TiO2 and Ag nanoparticles was formed, even by simply playing with colloidal attraction between the two hetero-phases. The presence of silica coating seems to have two important effects for the control of ROS and Ag+ toxicants, representing a safe by molecular design solution for the control of nanomaterials. 1) Silica acts as dispersing/glassing matrix for best, decreasing the production of ROS, but improving the photocatalytic performances of pristine sample; 2) Silica act as reservoir for Ag+ ions, decreasing the amount of immediately available fraction and so improving the range of concentration where the sample shows antibacterial properties despite to negligible cytotoxicity.

321 Framework for the optimal design of sustainable chemical processes

A. Gonzalez Garay, R. Calvo-Serrano, G. Guillem 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. Design alternatives. However, we have to realize that 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


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

Poster spotlight: TU214, TU215, TU237

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

SETAC Europe 28th Annual Meeting Abstract Book
323 Emissions of PFASs 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, PFASs have been used because their perfluorooalkyl chains have the ability to repel liquids of a wide range of polarities (e.g. water, sweat, and rain) and provide water- and wind-proofing. Researchers have argued that a long-term change in these DWR compounds is needed due to environmental impact, industry to start to use alternative chemicals that provide the DWR in outdoor clothing. Within the SUPPES (Substitution in Practice of Prioritized Fluorinated Chemicals to Eliminate Diffuse Sources) project alternative substances in use are assessed in comparison with the long–chain PFASs. As part of the SUPPES project we perform chemical alternative assessment including application hazards, exposure and life-cycle assessment studies. One of the studies focuses on the emissions of PFASs from outdoor clothing vs. emissions of alternative DWR chemicals such as short-chain PFAS (e.g. C4, C6) and silicones. We study the emissions using different emission scenarios which are based on real-life situations such as leaching to rain water, emission to air, weathering and washing and tumble drying. Within the SUPPES project different types of formulations, PFAS-based as well as silicon-based, have been applied to two different types of textiles, i.e. polyamide (PA) and polyester (PES). After testing the water repellence properties, a selection of four PFAS-based textiles and three silicone-based textiles have been used for assessing the emission of PFASs and silicones. For chemical alternative assessments it is highly important to include proper application tests in combination with experimental emission exposure scenarios. This information will provide valuable information to aid selection of safer alternatives. The emissions of chemicals out of the DWR-treated textiles are not only depending on the type of DWR, but also on the type of textile used. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emission of (short chain) fluorinated DWR compounds, like PFASs and silicones are emitted to air, as well as to rain water and washing water. During the use phase of outdoor clothing, DWR chemicals are emitted to the environment.

324 Chemicals in plastic packaging: Prioritization of hazardous substances

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Plastic packaging is increasingly used globally, causing rising concerns for the environment and human health from littering, release of microplastic and leakage of hazardous chemicals. Specifically, chemicals may migrate into foods or the environment during use, disposal, and recycling of the packaging material. Occupational exposure during plastic packaging manufacture is also relevant. One of the main obstacles to assessing the risks of chemicals originating from plastic packaging is the absence of information on the materials’ exact chemical composition. In order to provide an overview of the chemicals associated with plastic packaging, we compiled the Chemicals in Plastic Packaging Database (CPP-DB), which comprises unique substances with additional substance-specific information such as use data, physical-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 and Ranking Pipeline. We defined five hazard categories, and also including endocrine disrupting properties and PBT (persistence, bioaccumulative and toxic) characteristics. Due to the lack of empirical hazard data for many of the substances in the CPP-DB, we also used in-silico tools to bridge data gaps. In this presentation we will use the CPP-DB to present an overview of chemicals associated with plastic packaging, their hazards for human health and the environment, and we will highlight priority hazardous chemicals for substitution. Finally, we will discuss the research needed to allow for a more robust hazard characterization and ranking.

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

E. Giubilato, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; E. Badetti, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; M. Picone, D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. van den Berg, Food Packaging Forum Foundation / General Management

A Safe by Design framework to support the development of sustainable nano-enabled products for the restoration of works of art. Giubilato, E. Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; Semenzin, E. Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; Badetti, E. Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; Picone, M. D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; Brunelli, A. Department of Environmental Sciences Informatics and Statistics; van den Berg, A. Food Packaging Forum Foundation / General Management

Recent developments in environmental risk assessment for pollinators

326 Managing on the Margins: The confluence of Modern Agriculture and Apiculture

Z. Browning, Browning’s Honey Co., Inc.

In the USA, beekeeping is a hobby, a sideline business, and commercial enterprise. Pollinating our backyard gardens, and local communities is made possible by backyard beekeepers with one hive or more. Beekeepers who aspire to increase their honey production, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their hives to pollinate specialty crops. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial bees have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture encompass the urban and farm yard beekeeper. In the US, these areas are the urban areas of California, the farm yards of Texas, and the urban areas of California, Texas and the farm yards 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 issues, soil quality issues, or general use issues such as health and safety, well-intentioned policies, 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 practices 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 process 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. Both want all crops to thrive. 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 an 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 basis of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a qualitative manner for oversimplifying 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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Entomopollination is an important biological and economic factor for a number of crops. It is regulated by current environmental and agricultural decision making. In the use of pesticides, particularly insectsicides, is a potential area of conflict between economics and biology. For decades pollinator decisions in registration and re-evaluation of pesticides have been based almost exclusively on first- and higher-tier honey bee toxicity tests. This approach has been challenged and regulatory agencies in the EU and USA have started to review this process in respect of non-Apis bees. In this paper we focus on bumble bees (Bombus spp). The potential exposure routes and actual exposure of the bumble bee queen, workers and larvae are mapped and knowledge gaps are identified. The honey bee is compared. Some significant differences in susceptibility to pesticides between Bombus species have also been identified. It is concluded that there are significant gaps in current knowledge for bumble bee species on both realistic levels for some key exposure routes and cumulative exposure that are not accounted for in the current Apis risk assessment protocols.

329 Industry research and approaches to improve the bee risk assessment scheme in Europe

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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 example of laboratory chronic risk assessments, a method for evidence synthesis and weighting in bee 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 honeybee and bumblebee 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 insecticide, 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 stingless bees are pervasive species that occupy a large geographical area, mainly distributed in tropical and subtropical forests. They are popular and commercially valuable, and are considered essential for the crop protection industry due to their role in pollinating. Melipona scutellaris is among the species used in this work. We evaluated the effects of different larval rearing methods, comparing existing methods with the larval rearing method of Apis mellifera L., the economically most important bee species. The levels of food, the humidity within the Petri dishes was reduced to 75%, adding NaCl This incubator This incubator was sety around 95% within the Petri dishes during the first five days of larval rearing method of A. mellifera L., in its present over-conservative form, the EFSA guidance will make it difficult to register any new or existing insecticide, 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.
Understanding human and environmental exposure to chemicals in urban systems

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

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Is the threat posed to the environment by harmful chemicals increasing or decreasing? Due to the extremely large number of chemicals and variety of adverse effects, it is challenging to develop indicators for the success of our management of chemical emissions. Indicators for efficiency of chemicals management can be based on a) information on production, trade and use of chemicals, b) emissions, c) concentrations in humans and the environment and c) human and wild-life health, with data on the two latter being most relevant, but also difficult and/or expensive to produce for a wide range of chemicals. In this study, we used estimated consumption of products as point of departure to analyze trend 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

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Building materials have important contribution to the chemical exposure of the US population. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PiF, to assess consumer exposures during product use, i.e. the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharos database, 22 product categories for building materials and 218 chemicals were identified. We focus here on 632 unique chemical-product combinations, and assess doses based on PHAROS chemical content data. Chemical emissions from building materials are mainly determined by Dm (diffusion coefficient in building material) and Kma (material-air partition coefficient). Two simple emission models were developed for two types of behaviors: D-limited and K-limited. Use-phase exposures by inhalation, dermal contact, gaseous dermal uptake and dust ingestion were calculated using the PiF metric. Results showed that for SVOCs, the total PiF can be dominated by any of the four exposure pathways. Generally, the chemical-product combinations with low total PiFs are dominated by dust ingestion exposures, while the ones with high total PiFs are dominated by dermal contact exposures. For VOCs, inhalation PiF always dominates the total PiF. Generally, the PiFs of VOCs are similar between 50 days and 15 years, but the daily intake doses during 50 days are much higher than those during the entire 15-year use phase. In contrast, for SVOCs, the emissions and PiFs gradually increase when the duration of use is extended from 50 days to 15 years, but the daily intake doses remain similar over time. The total intake dose, which combine the total PiFs and chemical content in building product, can range from 100 to 10^8 µg/kg-d for children. This study demonstrates the approach of high-throughput screening of use-phase exposures for chemicals in building products, which can be further integrated into characterization factors and help improve LCA and Chemical Alternatives Assessment (CAA) of consumer products.
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

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

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Modelling microparticles in rivers is a challenge. Although many studies exist focusing on the composition of MP in freshwater, there is no comprehensive understanding of the sources, transport and fate of MP in rivers. This is a gap that can be filled by meso-scale modeling. Here we present a model called NanoDUFLOW which is based on two different modeling approaches: 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 transport of MP from WWTP point sources in an urban setting 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 coarse aggregates, 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 concentration 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 (~3500 km^2). Emissions were based on per capita usage 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 MP 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. In a parallel study, we assessed export to the Great Lakes for a range of particle sizes. This combines the mechanistic realism of NanoDUFLOW, accounting for formation and settling of coarse aggregates, 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 concentration 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 (~3500 km^2). Emissions were based on per capita usage 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 MP 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.
an ecologically relevant system, using the freshwater aquatic worm *Lumbriculus variegatus*, representing an entry point for nanoparticles from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorescently dyed nano-polystyrene (50 nm) upon their uptake is 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 nanoparticles and plastic particles contaminated with both waterborne and 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 nanoparticles to solid constituents of the sediment. Ongoing work addresses the potential for formation of an "ecocorona" to alter the bioaccessibility of nanoparticles for the worms. These results will also be presented during the platform presentation.

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

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

Freshwater basins are an integral part of microplastics life-cycle, being a repository of plastic micro-debris. In fact, the levels found so far are similar to those found in marine environment and shoreline regions. The deposition and persistence of plastic micro-debris in sediments (lakeshores and rivers/banks) 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 (phenoloxidase). Exposure to PE 40-48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagoes and on emergence rate. PE 40-48 µm were then selected to assess effects on physiological homeostasis. Acute exposures to PE 40-48 µm generated alterations in *C. riparius* larvae antioxidant and biotransformation enzymes activities (CAT, GST and total glutathione) and activation of immune response (induction of phenoloxidase). Larvae exposed to microplastics showed also a depletion in energy reserves. Our study highlights the potential deleterious effects of microplastics for aquatic invertebrate populations. Results will be discussed in terms of effects of different sized plastic particles on different levels of biological organization within freshwater invertebrates and on the needed and ongoing research aiming to address the long term and indirect effects of these particles for natural populations and ecosystem functioning.

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

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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 the observed effects are based on the polymer type and associated ecosystem processes. Some pollutants such as systemic insecticides are taken up by terrestrial plants and may enter aquatic systems with plant parts such as leaves that are an important energy source in stream food webs. Therefore, effects of imidacloprid on survival and growth of decomposers and its leaf processing were assessed in a microcosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosms. Every 6 hours the number of dead individuals was recorded. Potential propagation of imidacloprid effects were assessed by transferring surviving decomposers to cages containing the predator. The caged were deployed in an unpolluted stream for 9 days after which predators' growth was analysed. Imidacloprid concentrations increased within the contaminated microcosms over time. The presence of imidacloprid in the water was associated with lower survival rates and reduced leaf decomposition in contaminated microcosms compared to the control. Furthermore, decomposer's biomass and length decreased in the contaminated but not in the control microcosms. Predators hunting decomposers from contaminated microcosms decreased in body size compared to the control. Systemic insecticides in plant materials can be a relevant source of exposure for decomposers with consequences for their population dynamics (e.g. increased mortality and reduced growth) and the associated ecosystem processes (reduced leaf decomposition). The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid leaches from plant material and may influence downstream food webs directly and indirectly.

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

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

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**When ecotoxicology meets trophic ecology**

**343 Poster spotlight:** TU149, TU150, TU151

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

E.L. Fernandes, University of Koblenz Landau; M. Bundscha, 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 food web structure. 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 merolimnic invertebrate decomposers (*Protonemura sp.*) and predators (*Isoperla sp.*). Effects of imidacloprid on survival and growth of decomposers and its leaf processing were assessed in a microcosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosms. Every 6 hours the number of dead individuals was recorded. Potential propagation of imidacloprid effects were assessed by transferring surviving decomposers to cages containing the predator. The cages were deployed in an unpolluted stream for 9 days after which predators' growth was analysed. Imidacloprid concentrations increased within the contaminated microcosms over time. The presence of imidacloprid in the water was associated with lower survival rates and reduced leaf decomposition in contaminated microcosms compared to the control. Furthermore, decomposer's biomass and length decreased in the contaminated but not in the control microcosms. Predators hunting decomposers from contaminated microcosms decreased in body size compared to the control. Systemic insecticides in plant materials can be a relevant source of exposure for decomposers with consequences for their population dynamics (e.g. increased mortality and reduced growth) and the associated ecosystem processes (reduced leaf decomposition). The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid leaches from plant material and may influence downstream food webs directly and indirectly.
EU. From these results, e.g., median concentrations can be calculated per catchment or over all catchments. Concentrations in fish depend on local exposure pattern and differ per subcatchment. They also depend on trophic position in a compound-specific way: any of the three fish components can be worst-case. To indicate risk to human health, concentrations need to be related to standards of e.g., acceptable daily intake.

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

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

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

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Riparian areas in Romania are exposed to chemical pollution via fluxes of material and organisms. Agricultural land use related stressors can differentially alter arthropod communities in water and on land, resulting in complex response patterns of aquatic-terrestrial predator prey relationships. Therefore complex response patterns may arise in terrestrial predators feeding amongst others on aquatic prey. While agricultural landscapes in most European countries have been intensiﬁed, resulting in the co-occurrence of pesticide use, habitat degradation and excessive nutrients, traditional low-intensity agriculture can still be found in Central Romania. We investigated the potential effects of land use related stressors including pesticides on aquatic-terrestrial predator-prey relationships using stable isotope analysis. We sampled spider communities and measured their intake of aquatic prey in 19 riparian areas around Cluj-Napoca, Romania. To investigate the spiders’ diet, aquatic and terrestrial prey organisms were caught. We collected the orbweb Tetragnatha sp. and the ground-dwelling spider Pardosa sp. to analyse their stable carbon and nitrogen signals. Nutrient concentrations in the stream were slightly positively associated with the proportion of aquatic prey of Pardosa sp. This may be explained by nutrients in the streams increasing productivity of primary producers and in turn resulting in a larger biomass of emerging insects. The toxicity gradient was negatively related to the number of individuals of spiders and the number of spider species. Although we found clear differences in the proportion of consumed aquatic prey of spiders, the proportion of it was not related to the toxicity gradient. Thus, potential effects of pesticides in the aquatic system did not affect the proportion of consumed aquatic prey organisms of riparian spiders. We found less individuals of Tetragnatha sp. when they consumed more aquatic prey. This might be due to an accumulation of toxins in the spiders or a higher competition between the species due to resource shortage. Riparian spiders can be affected directly by agricultural land use but also indirectly via prey consumption. Changes in riparian spider communities and their diets are presumably driven by multiple stressors.

### 348 Migration effects on pollutants in eggs of Arctic-breeding geese

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Terrestrial and Arctic breeding barnacle geese (Branta leucopsis) are a herbivorous species that migrate from the United Kingdom to the Arctic every summer to breed. Females utilise resources towards reproduction along the flyway, including distant resources (United Kingdom and Northern Norway) and local resources (Svalbard) relative to the breeding grounds. Depending on migration route, allocation of resources towards egg production may differ within a breeding goose population. Thus different energy sources may also affect how pollutants are taken up and deposited to eggs, including those which are both protein and lipid soluble. In order to examine the effect of migration on pollutants in eggs, a field study was carried out during the breeding season of 2016. Eggs (N = 60) were collected at an island breeding colony in Svalbard and several hundred grams of vegetation (N = 15 samples) were collected at different sites along the goosel_s flyway. Results of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon (δ13C) and nitrogen (δ15N), as well as pollutants including protein-associated poly- and perfluoroalkyl substances (PFASs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be related to PCBs, but emerged POPs like perfluorinated compounds due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs. This suggests that POPs, bioaccumulating in 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 bioavailability of persistent organic pollutants (POPs). However, new POPs 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)

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Several types of legacy persistent organic pollutants (POPs), such as PCBs and DDEs, but not for PBDEs, can be biomagnified in terrestrial systems. Arctic-boreal systems are far less developed compared to aquatic systems. Stable isotope ratios in eggs could not be related to PCBs, but emerged POPs like perfluorinated compounds due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs. This suggests that POPs, biomagnifying in 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 bioavailability of persistent organic pollutants (POPs). However, new POPs 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.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling
Toxicokinetic-toxidynamic models as new tools for environmental risk assessment

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Today, the Environmental Risk Assessment (ERA) for chemicals is based on fitting standard dose-response (DR) models to quantitative data. Such data are usually collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (LC₅₀ or EC₅₀) is usually estimated at the end of the exposure. In this form of evaluation, the fact that endpoints are monitored over time is not fully exploited. Standard DR models do also assume that the exposure concentration remains constant during the experiment, what makes it difficult to extrapolate the results of more detailed models 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/ECᵅᵯ for arbitrary effect strength α and any given exposure duration τ. Nevertheless, being based on differential equations their mathematical complexity makes it necessary to numerically integrate the equations when fitting the model to data, so that in practice TKTD models are still not used. The aim of this research is to assess the impact of those modern toxicokinetic-toxidynamic 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 ‘morph’ 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 in 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-pesticides on the energy budgets of an estuarine amphipod

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Neonicotinoids are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through LC₅₀ values. However, the AhR pathway, but the toxic mechanism is poorly understood. The next step of our research will be to combine our TKTD models with a biology based model and reproduction data in a dynamic population model. This model will predict regulated but increasing concentrations of copper in 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 repetitive experiments: new born juveniles (10-15 mg), juveniles (90-110 mg) and large juveniles (260-340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetic model (TKTD). The accumulation of growth and differences between development stages) concluded with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.

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

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Comprehensive and efficient management of ecological risk depends on our ability to quantitatively extrapolate the effects of stressors across levels of biological organization. Adverse Outcome Pathways (AOPs) connect sub-organismal mechanistic molecular data to organismal outcomes, while bioenergetics models, such as Dynamic Energy Budget (DEB) can extrapolate from individual- to ecological-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 downstream outcome is lethality may not be informative to the DEB processes, which are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through LC₅₀ values. However, the AhR pathway is known to be an important target for DHCs. Further, sublethal effects of DLCs are less studied, but preliminary data indicate that sublethal PCB1216 exposure leads to slower growth in larval killifish (Nacci unpublished data). Therefore, this system offers a framework to test our ability to connect effects observed at the suborganismal level to bioenergetic processes through AOP and DEB modeling. We will measure suborganismal effects of DLCs (cytochrome P450 activation & transcriptomics) along with effects on development, growth, and reproduction. We will give an overview of our objectives and methods and report preliminary findings fitting DEB models and predictions of the effect of DLCs on the bioenergetics of killifish.

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

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We are investigating best approaches to utilizing in vitro derived toxicity data for estimating impacts on reproduction in trout and salmon. Our goal is to facilitate development of quantitative in vitro – in vivo extrapolation (IVIVE) methods to support adverse outcome pathway (AOP) based toxicity testing. We tested a diverse suite of toxicants using cellular assays based on the female rainbow trout pituitary, ovary and liver. Each assay measures an essential reproductive endocrine function

fauna, such as earthworms, which are recognized as ecosystem engineers providing very valuable ecosystemic services. To assess effects of copper on earthworm populations, we tested the impact of a commercial formulation of copper fungicide, i.e., Cupra Micro® (50% copper oxychloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of repetitive experiments: newborn juveniles (10-15 mg), juveniles (90-110 mg) and large juveniles (260-340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetic model (TKTD). The accumulation of growth and differences between development stages) concluded with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.
such as estrogen synthesis and secretion by ovarian follicles. In vitro results are extrapolated to metrics of reproductive performance (fecundity, fertility, egg size) in trout using a mathematical model of the trout hypothalamus-pituitary-ovary-liver (HPOL) axis. We evaluated IVIVE by comparing predicted effects against laboratory results obtained from a yearlong exposure of female trout to four different chemicals: tamoxifen (biotransformed into the anti-estrogen 4-OH-tamoxifen), prochloraz (interferes with oocyte maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and 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 larval at 20 dph. The HPOL model, guided by in vitro testing, accurately predicted the reproductive effects of prochloraz and tamoxifen and the lack of effect by fluoxetine. Our results support the use of biologically based mathematical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

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

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Fish are affected by both exposure to metals and infection. Each of these stressors may have effects on the response of fish to the other. Some effort has 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 organ-specific accumulation of pollutants. However, the capability of this model for simulating fish-parasite systems has not been investigated. We developed a PBPK model for simulating Ag accumulation in the host-parasite system: chub (Squalius cephalus) and the acanthocephalan Pomphorhynchus 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 diffusion 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 constants for Scinlport 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 deprivation 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 gills, blood, 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 pollutors - Towards a holistic chemical quality status assessment in European freshwater resources (III)

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

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

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

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One challenge in the quality assessment of water bodies in Europe is the ongoing difficulty to link the chemical and the ecological status. Currently, new approaches are developed to link chemical monitoring datasets to effects by providing the means to elucidate possible chemical impact on the ecological status of European water bodies in a retrospective way. Ecological modelling provides an alternative approach to connect exposure information to potential impact on biota, having the advantage that such modelling can be performed in a prospective way. This presentation will show results of ongoing modelling efforts in the EU 7th Framework Programme R&D project SOLUTIONS, to increase our understanding of issues related to emerging chemicals and for large numbers of chemicals ("real world exposure scenario"). The STREAM-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tens of km². Links between exposure and effects are realised using linear or log-logistic dose-response relationships. The ecological models account for lethal and sublethal effects on the population dynamics of a number of families of aquatic macroinvertebrates. Impacts of multiple chemicals are added up in the model following basic mixture modelling rules. Results depict the simulated inhibition of population growth rates and hence the chemical impact on population viability at European scales. Ecological modelling results are for some selected parts of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

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

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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 leach ecosystem responses to mixture toxic pressure under natural, variable and multi-stressed conditions. We collected vast amounts of monitoring data to explore those diagnostically, in line with the Father of Epidemiology, Dr. Stocks, who famously provided a solution to a cholera outbreak in Soho, London, 1854, by epidemiological reasoning. So, this paper presents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in surface water systems, and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g. a Mixture Assessment Factor and endocrine disrupting chemicals such as bisphenol A. 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 ec-epidemiological analyses as well as various types of results, from diagnostics to prognostics and also the future EU projects MARS (Mitigating Aquatic and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.

359 Unravelling the cocktail of stress: toxics and other stressors impacting on the ecological status of Europe’s rivers
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Water management requires solid understanding of how multiple stressors affect ecosystem state and function. The European MARS project is one of the large EU projects utilizing a large database of field data on toxics and other stressors in aquatic ecosystems and its use was introduced in this paper. This project has recently concluded four years of in-depth research on this topic. MARS looked into multi-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing multi-stressor effects and guided management of multiple stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European multi-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

360 Mitigation options for chemicals of emerging concern in surface water systems: analyzing 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 past decades. Knowledge on the critical use of these substances and the measures to mitigate its use is a significant issue in water protection and in the chemical risk management. This paper presents 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 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 commonly available. Not all technologies tested in research are available on the market. The 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 light 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 these criteria to evaluate removal efficiencies as collected in a dataset on removal efficiencies consisting of approximately 2000 entries, 93 compounds and 9 treatment technologies for wastewater (ozone, oxygen + H2O2, conventional WWTP, UV, UV + H2O2, PAC, GAC, NF, UF) and drinking water treatment (ozone, ozone + H2O2, UV, UV + H2O2, PAC, GAC, UF, NF).

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 develop alternative uses for substances, which means that substances may be replaced. New substances may also be introduced into ecosystems, for instance flame retardants or nanomaterials but may also introduce new substances with negative impacts on aquatic ecosystems. Four societal sectors have been identified where major changes within the next two decades can be expected which have potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these future developments and the resulting introduction of new substances from new sources, an adaptation of current regulatory frameworks is required. However, to prepare for a future with unknown scenario for use and emissions of potential chemical pollutants is naturally difficult but a general approach can be developed and adopted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solutions-focused approach, when the same approach is put to use, e.g. for river basin management, evaluation options for minimising risks as to quantifying risks for new substances under development or introduction; (2) Transparency and openness of information and knowledge. Current applied research aimed at providing solutions to identified problems of chemical contamination in e.g. water ecosystems is severely limited by a lack of information on the production and use of chemicals in society as well as emissions to water. Linkage of national databases on use volumes of industrial chemicals such as SPIN (Substances in Preparations in Nordic Countries) would allow tracking quantitatively substitution of the most problematic substances; (3) Increased international cooperation and strengthened global agreements. The world is globalised and the transport of chemicals is transboundary – both via the atmosphere and via global trade.

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

362 Towards a systematic approach for the assessment of multiple stressors: Making Aquatic Ecosystems Great Again (MAEGA)
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In the Anthropocene, ecosystems are exposed to a range of stressors that if not properly managed can lead to ecosystem state shifts and significant losses in ecosystem services. We held a workshop (September 2017, Wageningen, The Netherlands) to develop a conceptual framework to assess the effects of multiple stressors on the structure and functioning of aquatic ecosystems. This framework was subsequently applied to three ecosystem types (ditches, floodplains and harbours). The proposed framework consists of two parts: an environmental filter and a transmitting function to allow effects to propagate to higher levels of biological organisation. Applying the framework consists of the following steps: (1) Select an ecosystem of concern; (2) Identify stressors and potential interactions; (3) Identify receptors/sensitive groups for each stressor; (4) Identify stressor-response relationships and group stressors according to their mode of action; (5) Construct an ecological model that includes relevant functional groups and endpoints; (6) Predict the resultant impact of multiple stressors; (7) Confront the predictions with experimental and monitoring data; and (8) Adjust the ecological model if needed. We demonstrated that the framework can integrate the known effects of individual stressors on organisms and predict how these effects propagate through higher levels of biological organisation. In light of this, a workshop was held at Wageningen University and Research, the Netherlands, (September 2017) to determine the current status of knowledge of multiple stressor effects on aquatic ecosystems and to assess how these effects can be better predicted. The workshop was attended by experts from the Netherlands, Australia, Germany, and Canada and covered a range of ecosystem types considered to be at high risk from multiple stressors. The workshop resulted in a “best-approach” conceptual framework for assessing multiple stressor effects on aquatic ecosystems. The framework was subsequently applied to three case studies: harbours, agricultural drainage ditches, and floodplains. Here, we present the application of this framework to agricultural drainage ditches. Agricultural drainage ditches are an under-appreciated and undervalued habitat for a range of aquatic and terrestrial organisms. Although these man-made features can maintain high biodiversity in agriculture landscapes, they are often ignored for their conservation value and are not protected under the EC Water Framework Directive 2000/60/EC. Using the framework developed during the Wageningen workshop, we developed a conceptual food-web model using functional groups to assess known direct effects of stressors on ditch communities. We identified the most important stressors (nutrients, pesticides, dredging and mowing, salinisation, and sediment inputs) upon which to focus a literature search for each stressor-functional group combination to identify sensitive and non-sensitive groups. We also reviewed the literature on experiments using at least two of the identified stressors and identified potential interactions. The conceptual food-web model was updated using this knowledge to capture interactions. Finally, the conceptual model and its predictions regarding the response to multiple stressors will be compared to large scale ditch biomonitoring data to assess the validity/predictive power of the model. We demonstrate that the framework provides a useful conceptual template to assess and predict multiple stressor impacts as well as to unravel research gaps.

364 The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses

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Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong 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 their effects on invertebrate population and community responses. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted 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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Pesticides from agricultural usage are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide use agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Europe (Romania), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture reyling largely on animal husbandry (medio-intensive) and organic agriculture. To differentiate pesticide toxicity, excessive nutrient and sediment input would be unrelated to agricultural intensity. Consequently, this would allow distinguishing effects from pesticides and these other stressors. We analysed the relationships between pesticide toxicity and other agricultural stressors. Additionally, we analysed combined and individual effects of these variables on the biodiversity, as well as on the composition of stream macroinvertebrate communities. We examined 19 low-order streams across a gradient of agricultural intensity in terms of average field sizes. Pesticide concentrations were investigated using two different passive sampling methods. Firstly, we used styrene-divinylbenzene (SDB) disks to sample hydrophilic compounds, which enabled the determination of approximate time-weighted pesticide concentration in streams during heavy rainfall events. Secondly, we used polydimethylsiloxane sheets (PDMS) focusing on 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 and other agricultural stressors. We found that pesticide toxicity 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

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Synergistic interactions between pesticides in mixtures and between pesticides and warming may improve the efficacy of vector control. Particularly, synergistic interactions between biopesticides and chemical pesticides would be promising as these could potentially result in the combination of efficacy of control, slowdown of resistance build-up and lower ecological damage. One understudied aspect of global warming is the increase in daily temperature variation (DTV). While DTV may increase the toxicity of chemical pesticides, it is unknown whether it also interacts synergistically with biopesticides, and magnifies the toxicity of pesticide mixtures. We tested whether DTV influences the toxicity of pesticides with a
different mode of action (the chemical pesticide Chlorpropryp, 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 of CPF on larval population growth rate (r*) and its key components. The experiment was done in three steps: (i) 4-day exposure in L4 to DTV, (ii) 2-day exposure to DTV and the pesticide treatment and (iii) exposure to DTV until metamorphosis. The presence of a large DTV increased the toxicity (based on r*) of the chemical pesticide, but not the biopesticide. Moreover, a large DTV changed the community structure of the.Given this result, 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 damselsflies
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Current risk assessment of pesticides fails to protect aquatic biodiversity. A key reason is the lack of realism: pesticides are tested under ideal laboratory conditions at one mean temperature. To strengthen current risk assessment it is crucial to incorporate effects of global warming on the toxicity of pesticides. Global warming studies largely overlook that climate scenarios also predict stronger daily temperature fluctuations (DTFs), which can have greater fitness effects for organisms than increases in mean temperatures. While many pesticides (like organophosphates) get more toxic at higher temperatures, it is largely unknown how DTFs influence the pesticide toxicity. We examined a multi-factorior 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 (C.PF). CPF imposed mortality and more so in high-latitude compared to low-latitude larvae. Moreover, CPF was more toxic at 24°C compared to 20°C, confirming the higher toxicity of organophosphates at higher temperatures. A key finding was that DTF also increased the toxicity of CPF, providing novel evidence that DTFs can amplify the toxicity of pesticides. Furthermore, the increased toxicity of CPF by DTF was more pronounced at 24°C. This novel pattern is likely general as at a higher mean temperature, DTF will expose the animals to even higher temperatures during the daily cycle, thereby increasing exposure to stressful temperatures. Also, the negative effect of CPF on larval growth strongly depended on DTF. CPF did decrease larval growth considerably, but only in the 10°C DTF treatment. Probably the higher metabolic demands for cell maintenance in the 10°C DTF treatment resulted in lower growth rates. Our results convincingly show that the organophosphate pesticide chlorpyrifos is not only more toxic to damselsfly larvae at the higher mean temperature (24°C) but also at higher daily temperature fluctuations (DTFs). The behavior and performance of larvae is influenced by oxygen concentrations, lower and sublethal effects (growth rate). Notably, the synergistic effect of DTF on pesticide sensitivity was higher at the higher temperature. Our results highlight that incorporating higher mean temperatures and especially DTFs in ecotoxicology testing will increase the realism of the risk assessment of pesticides under global warming.

PBT/vPvB & PMT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (I)
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RPLC-HILIC and SFC coupled with Mass Spectrometry: Polarity Extended Screening of organic molecules in the aqueous environment
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Trace organic compounds are important in environmental analysis, because they impact water quality and introduce potential (eco)toxicological effects. Current analytical methods mostly rely on gas chromatography (GC) or reversed-phase liquid chromatography (RPLC) coupled with (tandem) mass spectrometry. However, neither method can easily separate various compound classes. Two chromatographic separation strategies, a serial RPLC- hydrophilic interaction liquid chromatography (RPLC-HILIC) coupling and an analytical scale supercritical fluid chromatography (SFC) system will be presented, and their separation effectiveness as polarity-extended chromatographic methods for 274 environmentally relevant compounds were validated in a recent publication. Compounds tested were grouped into three polarity classes, “very polar” log D (pH 7) below -2.5, “polar” log D (pH 7) -2.5 to -2, and “non-polar” log D (pH 7) higher than -4). 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 mechanisms and for “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant effluent samples) as 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. Grocco, S. Grosse, T. Letzel: RPLC-HILIC and SFC with mass spectrometry: Polarity-extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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Removal options and transformations of persistent mobile organic chemicals during production of drinking water
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Phenolic and hydroxylated analogues of organophosphorous (OP) and chloralkanes (PAH) get more toxic at higher temperatures, and are thus mobile in the water cycle. Because of their intrinsic properties, they are able to penetrate natural and artificial barriers and may constitute a threat for drinking water. Advanced treatments like activated carbon and oxidation processes can be used to limit the presence of organic micropollutants in drinking water. However, low removal by activated carbon is expected for PMOCs of their high polarity. The behavior of pesticide plant effluents were 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 N-captolactam (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 guanidines, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in water resources showed a very low reactivity with ozone with rate constants below 100 M-1s-1 and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-diphenylguanidine and the 1,3-di-o-tolylguanidine, an olefinic sulfonate and an amine compound, the N-benzyl dimethylamine, were rapidly transformed by ozone. Transformation of both guanidines occurred in few seconds at neutral pH during disinfection by chlorine. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. USE EPA toxicity prediction tool showed that chlorinated and hydroxylated analogues of PMOCs were more toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl9/guainidine 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 N-captolactam, halogenated methanesulfonates, adamantane-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor by oxidation processes and could thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

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Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study
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The occurrence of polar micropollutants (PMs) in drinking water sources is regarded as one of the most challenging issue of our times. Polar PMs 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. Reverse osmosis (RO) is a membrane process that retains organic compounds depending on physicochemical properties such as size, charge and polarity. The aim of this study was to assess whether riverbank filtration followed by RO can provide sufficient removal of PMs and thus be considered for further implementation. We also aimed to elucidate the transport of organic solutes through RO membranes by relating solute physicochemical properties to solute passage. A novel pilot-scale RO system capable of operating in anaerobic conditions was built for this study. Raw anaerobic riverbank filtrate was used as feed water. The feed was spiked with 30 target polar PMs selected from scientific literature and considered relevant for the quality of source waters and critical for
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultrahigh-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzotriazole, tolyltriazole and phenylurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MPs was mainly governed by size exclusion. For neutral and moderate polar MPs the invasion of water treatment was well demonstrated as an area for bisphenol A, which displayed 4% passage. The higher passage of moderately polar and hydrophobic MPs could be attributed to solute-membrane hydrophobic interactions followed by diffusion. All anionic MPs displayed less than 1% passage, opposed to cations for which up to 10% passage was observed. The negative charge of the membrane surface 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 (PMOCs) against microbiological and chemical degradation, their removal during water and wastewater treatment and drinking water purification may prove difficult. Toxic PMOCs can be classified as PMT (persistent, mobile, and toxic) substances. Based on the work of Arp et al. and hydrophobic MPs, we developed a qualitative HILIC tandem mass spectrometry (HRMS) method to detect the behaviour of very polar substances in aqueous matrices, reversed-phase high performance liquid chromatography - tandem mass spectrometry (RP-HPLC-MS/MS), is only of limited use for the analysis of very polar substances, little is known about PMOCs in the water cycle and only few (e.g. acetaldehyde, glycolate) have been extensively studied and monitored2. PMOCs may be, among others, industrial chemicals, or transformation products thereof. Most transformation processes usually result in the formation of transformation products (TPs) with increasing polarity until either mineralization is achieved or a dead end TP is formed, thus potentially resulting in persistent and highly polar water pollutants. Many PMOCs derived from transformation processes may still be unknown and thus not be represented in suspect or target screening campaigns. As a consequence, no information about their occurrence and origin is available, which severely exacerbates the sophisticated monitoring and effective regulation of their precursors. Based on the work of Arp et al. and Schulze et al. we selected 15 industrial chemicals with a high expected potential to foul membranes and studied their transformation and Behaviour during hydrolysis, biotransformation, oxidation with MnO2, and photolysis experiments. After structural elucidation of the 9 detected transformation products with high resolution mass spectrometry (HRMS) we developed a qualitative HILIC-MS/MS (Hydrophilic interaction liquid chromatography – MS/MS) method and screened 25 Hessian surface waters for the presence of these TPs. While some TPs were not detected others were only detected in the major part of the monitoring data provides first information about the potential environmental relevance of the identified TPs, which can be used to prioritize them for inclusion in future quantitative screening campaigns.
accounted for as such, in fact, when a byproduct enters the market, a share of it can lead to a decrease in supply (substitution approach) but another share can also lead to an increased demand and thus consumption, which satisfies needs that were previously unsatisfied (production benefit approach). A consideration of both effects is needed in CLCA.

375 Assessing nutritional impacts and benefits on human health in LCA: A new midpoint impact category
K. Stylianou, University of Michigan - School of Public Health / Environmental Health Sciences; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jolliet, University of Michigan

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

376 Combining Operational Research and Life Cycle Assessment to optimize the environmental performance of Peruvian diets
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Food production and security has been highlighted as one of the most threatened sectors worldwide due to consequences of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 10% of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socioeconomic sectors, mainly in the 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. The optimization 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 CPLX® as the solver. Results demonstrated that substantial reductions can be attained in GHG emissions through the optimization of diets in Peru. For instance, in Lima the reduction could reach 200 kg CO2eq per person and year (22%). These results constitute an important framework to understand the current situation of the GHG emissions of the average Peruvian diet, as well as to mitigate these emissions while improving nutritional aspects and controlling economic costs.

377 Using the first Swiss dietary survey to determine the environmental and health benefits and impacts of various dietary patterns
A. Ernstoff, Quantis / Quantitative Sustainability Assessment; S. Humbert, X. Bengoa, M. Vargas Gonzalez, Quantis; O. Jolliet, University of Michigan

Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what people eat. Our study looks into the monetary values 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
Y. Dong, Technical University of Denmark; R. Rousselet, Ecole Centrale de Marseille / Engineering School; H.J. Sørup, Technical University of Denmark / DTU Environment; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering Division / Quantitative Sustainability Assessments

Climate change has gained increasing attention over the past decade in response to the revelation that we need to maintain a viable climate for humans and the environment. The increasing emission of greenhouse gases (GHG) such as CO2 may accelerate climate change and cause subsequent damages. Correspondingly, countries and companies actively develop strategies to minimize their GHG emissions and thus climate impacts, but which strategies that will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategies, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the reduction is a crucial step. Our study looks into the monetary values of GHG, represented by CO2 (or CO2-equivalent), and their underlying cause-effect chains in three Life Cycle Impact Assessment (LCIA) methods LIME2, EPS2015 and ReCiPe2016. The damage cost for CO2 is in the same order of magnitude in EPS2015 and ReCiPe2016, but one order of magnitude higher than that in LIME2. Climate change-related damages on human health are well represented in all LCIA methods, and the monetised damages from this category contribute to more than 70% of the total CO2 cost in all three methods. Social assets and ecosystem damages, on the other hand, are only counted for in two of them. Furthermore, a range of potential socio-economic damages from a changing climate are discussed in IPCC reports, including economic loss from extreme weather events, costs of potential climate-related society security and poverty, but they are not included in any of the LCIA methods. This may limited the suitable application area of the CO2 cost evaluated by LCA, especially in studies where social and economic consequences are the major concerns. The CO2 costs from the three LCIA methods are further evaluated in comparison with approaches from other research fields, such as Social Cost of Carbon (SCC), and discrepancies and associated uncertainties are discussed.

379 Poster spotlight: WE257, WE258, WE259

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

380 The measurement of Human Health Benefits and Risks of Contaminated Sediment Remediation
J. Kvasnicka, University of Michigan, Ann Arbor USA / Environmental Health Sciences; K. Stylianou, University of Michigan - School of Public Health / Social Cost of Carbon (SCC), and uncertainties are discussed.

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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 also create health impacts from the dispersion of sediments and the associated exposure to toxic chemicals. 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 per year. For the remediation scenario, the health impacts are 0.09 and 3.95 DALYs per year. Although the remediation would have provided a health benefit of 10.91 DALYs per year, the upper bound estimate suggests that the intervention would not provide a health benefit.

381 Six inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement S. Abel, J. Akkanen, University of Eastern Finland / Department of environmental and biological sciences

The application of activated carbon (AC) based thin layer caps is a promising and novel in-situ remediation method for contaminated sediments. The method utilizes the adsorptive capabilities of AC, allowing it to strongly bind persistent organic pollutants, thus greatly reducing the contaminants’ bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. In this study, the method was retrospectively tested in a field test site in the PCB-contaminated Lake Kernaalanjärvi, a 30 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 highly re-suspended sediments, leading to a low measurable impact of the AC remediation. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different compared to the amended plot and the surrounding reference site. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying amounts of sediment (thicknesses of the overlying sediment layer ranged from 1 - 40 cm). The results indicate that the growth and PCB bioaccumulation in Lymbricus variegatus and Chironomus riparius. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling L. variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling C. riparius, this effect could only be observed with minimal sediment coverage of the AC (< 5 mm).

382 Ecosecure nanotechnologies for environmental remediation: the NANOBOND project L. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grassi, G. Liberatore, University of Siena / Department of Physical, Earth and Environmental Sciences; c. murano, University of Siena; A. Bellingeri, University of Siena / Department of Physical, Earth and Environmental Sciences; a. Fiorati, Politecnico di Milano; G. Musso, f. trotta, Università di Torino; C. Punta, Politecnico di Milano

In situ remediation of sludge and dredged harbour sediments is currently highly cost-effective despite an ever increasing number of sites requiring swift treatments to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and their associated cost/benefit trade-offs. 

Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments A.O. Murtaś, Czestochowa University of Technology / Department of Infrastructure and Environment; M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A. Grobelak, Czestochowa University of Technology / Department of Infrastructure and Engineering

The use of soils at many agricultural sites would allow for the increased use of land and reduces 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 per year. For the remediation scenario, the health impacts are 0.09 and 3.95 DALYs per year. Although the remediation would have provided a health benefit of 10.91 DALYs per year, the upper bound estimate suggests that the intervention would not provide a health benefit.

383 Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments A.O. Murtaś, Czestochowa University of Technology / Department of Infrastructure and Environment; M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A. Grobelak, Czestochowa University of Technology / Department of Infrastructure and Engineering

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384 Scorpion of pharmaceuticals in soil systems L. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grassi, G. Liberatore, University of Siena / Department of Physical, Earth and Environmental Sciences; c. murano, University of Siena; A. Bellingeri, University of Siena / Department of Physical, Earth and Environmental Sciences; a. Fiorati, Politecnico di Milano; G. Musso, f. trotta, Università di Torino; C. Punta, Politecnico di Milano

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been detected at fairly high levels in aquatic systems (0.33–611 ng/L), terrestrial environments (0.53–340 µg/kg), and in the tissue of organisms (4.6–23.6 µg/kg in crop tissues, 61–127 µg/kg in terrestrial invertebrates) (Chen and Ying, 2015; Kinney et al., 2006; Pan et al., 2014). Long-term exposure to the residues of pharmaceuticals can 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 behaviour and the ultimate fate of pharmaceuticals (Drillia and Lyberatos, 2005). However, relatively few investigations of the sorption of organic compounds at the group level based on the dissociation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trupp, 2008; Franco et al., 2009; Kah and Brown, 2007). The main aim of this study was to explore the effects of properties of the chemical and soil characteristics on sorption of some organic compounds in the soil environment. First, sorption behaviors of nineteen pharmaceuticals across four groups (neutrals, strong bases, weak bases, acids) were explored in five test soils. Using the measured sorption coefficients for each group, we evaluated the applicability and accuracy of existing predictive models that have been proposed to predict the sorption behavior of organic chemicals in soil. Finally, Pearson correlation analysis and Principal components analysis (PCA) have been carried out at the group level to systematically assess the potential factors (both soil and drug properties) influencing the sorption behavior of pharmaceuticals in soil and to get better understandings of the sorption mechanisms of different pharmaceuticals in the soil.

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

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Chlordecone (Kepone) (CLD) is a highly persistent pesticide formerly used in France and in New Zealand.

In this study, the authors investigated the potential of soil to reduce the bioavailability of CLD to earthworms and piglets. The study also aimed to evaluate the effectiveness of soil treatments to reduce the transfer of CLD to animals.

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

**386**

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

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The sources of environmental pollution with polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN (polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 77, 81, 105, 114, 118, 123, 156, 157, 167, 169, 170, 180, 189. Quantitative determination was carried out using chromatography with electron capture detectors (ECD) equipped with glass capillary column with stable phase DB-5MS UI and the following parameters: 60 m x 0.25 mm i.d. x 0.25 µm. Special attention was paid to the total amounts of polychlorinated biphenyls, as the total amount of these compounds correlates with the hygienic standards, which as such are integral values. In all investigated soil samples dioxin-like PCBs were detected, however, in this case, we mainly recorded congeners NN 77, 81, 105, 114, 118, and 123, while NN 169 was determined less frequent and at insignificant quantities. Attention was drawn to the following: - out of 7 randomly selected soil sampling sites, a 2 to 3.5 times exceeding of the total/summary standard level was found at four sites; - in all cases, the excess of the standard was due to PCBs NN 81 and 114. Of special attention is the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.5-fold exceeding the standard, almost dioxin-like PCBs were found.

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Associated Health Effects of Veterinary Pharmaceutical Residues in Livestock around Selected Livestock Agriculture Farms in Western Cape Province

O. Fatoki, Cape Peninsula University of Technology / Chemistry; B. Opeolu, Cape Peninsula University of Technology / Faculty of Applied Sciences; B. Gente, CSIR South Africa; O.S. Olatunji, Cape Peninsula University of Technology / Chemistry.

Livestock farming is a major industry in the Western Cape Province of South Africa and livestock agricultural farms have been suggested to be a major source of pharmaceutical residues in many aqueous matrices, due to their enormous use. Pharmaceutical products such as steroids and non-steroids hormones, antibiotics and non-steroidal anti-inflammatory drugs from agriculture have been indicated to have the potential to show significant endocrine and other health effects. In this study, a High Performance Liquid Chromatography coupled to ultraviolet detector (HPLC-UV-Vis) method was modified and validated for the detection and separation of the selected pharmaceuticals in effluents for livestock farms with major activity in the study area. Multi-residue solid phase extraction (SPE) procedure was developed and validated for the recoveries of acetaminophen (AP), dichlorophen (DP), salicylic acid (SA), tetracycline (TC), chloramphenicol (CHR), ciprofloxacin (CP), bisphenol A (BPA), estradiol (E2), estrone (E1) and ivermectin (IV) from agricultural wastewater using the hydrophilic-lipophilic balance (HLB)-SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions spiked concentrations of between 2 and 10 µg/L were: E2, 76.62 – 85.47 %; AC, 78.29 – 94.34 %; TC, 88.35 – 92.15 %; CHR, 76.62 – 88.35 %; SA, 79.38 – 81.49 %; E3, 85.42 – 92.15 %; BPA, 80.27 – 89.42 %; CP, 76.58 – 90.21 %; DP, 75.46 – 87.55 % and IV, 80.27 – 84.89 %. Various levels of veterinary drugs - AC, < 0.48 – 1.07 µg/L; SA, < 1.37 – 15.49 µg/L; TC, < 3.45 – 4.57 µg/L; CP, 0.45 – 2.46 µg/L and IV, < 1.74 – 1.63 µg/L were detected in the grab water samples. The results of the health risk assessment clearly showed mutagenic activity being observed in samples from sheep and poultry farms. It also showed high estrogenic activity in the pig farm. The results indicated that making use of the maximum concentration of 17β Estradiol found in the samples, there was a slight risk of developing cancer through accidental ingestion via recreational activities with higher risk if the water was used for domestic purposes without treatment to remove them or if the water was used for irrigation purposes.

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

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In recent decades, the introduction of environmental monitoring programs in rivers and their tributaries has allowed to draw attention to the levels of pesticide contamination. In this study, the authors aimed to characterize the contribution of agricultural and urban sources to pesticide contamination in a peri-urban river in France.

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 receptacle for micropollutants in general. It is thus necessary to consider pesticide impact to prioritise their treatment. Treatment of pesticides can be quite expensive and inputs may not be clearly identified or collimated. Reduction of reduction at source can be considered as an interesting alternative (dose reduction, practice changes, etc.). However this approach requires first of all the identification of uses responsible of inputs, as few information is available nowadays. The study monitored for 4 years a peri-urban continuum formed by a river, SSO and a WWTP also as wastewaters to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important concentration of plant protection products while WWTP effluents presented important concentrations of biocides and veterinary molecules which are among the most toxic pesticides. Flux calculation allows identifying agriculture as the major source of plant protection products while WWTP brought the most part of biocides and veterinary products, especially in low-flow period when the WWTP contributes up to 40% to the overall flow of the studied river. Storm sewers had an intermediate status, with less consequents inputs but are still significant because of lack of treatment on these effluents and a potential increase of concentration around the
discharge site. Investigation in the wastewater network identified uses responsible for introduction of some molecules like fipronil or glyphosate which is essential in order to implement actions of reduction at source.

389 Study of bioconcentration of benzophenone-3 in gilt-head Bream and characterization of inorganic compounds

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Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation, and owing to its 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, biaccumulation 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 gilt-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-ionizable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipidic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolism activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography – high-resolution mass spectrometry allowed the identification of a broad suite of BP-3-by-products in several drugs and food 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 CTM2014-56628-C3-1-R and CTM2014-56628-C3-2-R, Xunta de Galicia (ED431C12/1736) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Education 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 growth solutions and plant tissues were measured by HPLC-QqTOF-MS. The uptake, translocation and metabolism of tebuconazole and imazalil inside Phragmites australis were documented for the first time using enantioselective analysis. The pesticides removal efficiencies from water were 96.1% and 99.8%, respectively, by the end of the experiment (day 24). Removal from the solutions could be described by first-order removal kinetics (k=0.14 d−1 for tebuconazole and k=0.31 d−1 for imazalil). Four different processes occurred simultaneously: 1) removal of the pesticides from the hydroponic solution, 2) plant uptake, 3) pesticides translocation in the plant, and 4) degradation within the plant. Tebuconazole and imazalil concentrations inside Phragmites showed a maximum level at day 10 and 5 d, respectively, followed by a decrease of both compounds concentration. Two TPs of tebuconazole could only be quantified in solution, while two imazalil TPs were quantified in both solution and plant tissue. The uptake of both pesticides was positively correlated with evaportranspiration. 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

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The non-steroidal anti-inflammatory ibuprofen is one of the most frequently detected pharmaceuticals in wastewater treatment plants. Its metabolism has been widely studied in mammals, fungi and microbes. However, little is known on how ibuprofen is metabolized by plants, mostly due to analytical methodology gaps for determining these compounds at low concentration in complex matrices. In this study, the effects of ibuprofen treatment on the growth and its comprehensive metabolic profile in whole plant cultures and seed germaines of Vigna unguiculata were investigated using ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry (UHPLC-QqTOF-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 Gizan area of Saudi Arabia, were germinated in Petri "plates or sown in micro-tubes (n=10) and cultivated in mineral medium (control: 400 μM mg−1 L−1 of ibuprofen). Seeds and plants were incubated in a growth chamber in the dark at 26 °C for 5 days. Forty-six metabolites of ibuprofen in V. unguiculata were successfully identified. The 1-hydroxy and 2-hydroxy ibuprofen were confirmed and quantified using their analytical standards. The structures of the other metabolites were proposed using high resolution mass spectrometry (HRMS) and high resolution tandem mass spectrometry (HRMS/MS) data. In particular, the combination of mass accuracy and the fragmentation patterns of metabolites and parent compounds allowed proposing plausible structures for each metabolite. Six hexosides were already reported in study on Phragmites australis and Lemma gibba. Thirty-eight of the identified metabolites were already reported in a study on cell cultures of A. thaliana and 9 of them (conjugates of ibuprofen or hydroxyibuprofen with amino acids) are, up to our knowledge, reported for first time in plants.

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

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

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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 the environmental impact of these compounds. The European Medicines Agency (EMA) guidance for the environmental risk assessment of human medicinal products has been in place now for over 10 years. The introduction of this guidance marked a step change in the ERA requirements for human medicinal products, with a shift from short-term acute to long-term chronic environmental effects assessment, 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 concentrations (PECs) and exposure ratio (ERP) for human consumption) 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
393 Estimation and prioritization of hospital API emissions
A. M. Ragas, Radboud University / Department of Environmental Science; C. van Lennep, M. Galpen, K. Tipetut, Radboud University; R. Oldenkamp, Radboud University / Center 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 is very time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-side emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speedisk as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LCMS. Most of the estimated loads were within a factor of 10 of the measured loads. On average, estimations for Hospital 2 were more accurate than for Hospital 1, which was probably due to the use of monthly purchase data and some other small model improvements implemented for Hospital 2. APIs which are typical for hospitals (e.g., antineoplastics and contrast media) were relatively well predicted. The prioritization of the APIs based on environmental impact was substantially influenced by the availability and interpretation of toxicological data. Diclofenac ranked highest, but this ranking was determined by one particular toxicity study of which the validity is being disputed. Ciprofloxacin consistently ranked high, and to a lesser extent also paracetamol and metoprolol. Azithromycin and isoprenal also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

394 Development and validation of a model to predict concentrations of human APIs in European surface waters
R. Oldenkamp, S. Hocks, 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 potency. Consequently, the issue of human APIs in the environment has been acknowledged as an emerging environmental problem requiring scientific and regulatory attention. A crucial step in environmental risk assessment of APIs is the estimation of their environmental exposure potential. Since there are currently more than 4,000 different human APIs in use, monitoring individual APIs is practically impossible. The aim of the present study was to develop and validate a model for the prediction of API concentrations at receiving sites on the basis of 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 sewage system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g., physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.

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

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

The majority of active pharmaceutical chemicals (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to assess the uptake rate in aquatic organisms in relation to pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitryptilin, an antidepressant compound, in L. variegatus. Toxicokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake of amitryptilin into L. variegatus at four different 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 amitryptilin in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data from two other pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4.

Predictions of internal concentrations of amitryptilin in L. variegatus varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Ouse (which had a concentration range of 0.52 - 2 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 explain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

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

**398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines**

G. Cernigoi, 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 suitable for aquatic plants or non-standard species. Most tests were performed based on the Lennox 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 (Aquatic Macrophyte Risk Assessment Procedure) network for their credibility for risk assessment. Especially on community-level, the number of suitable plant models is scarce. Existing models are often not validated with experimental data, although the validation of ecological models is an important point for their credibility for risk assessors. Nevertheless, ecological models are a suitable tool to extrapolate individual-level greenhouse experiments to the plant communities in the off-field. Especially bearing in mind that protection goals for non-target terrestrial plants as defined by EFSAs are on population and community level. Reuter and Siemonitet-Gast (2007) performed an experiment that includes not only the test of monocultures but also the test of small artificial communities consisting of 6 plant species. This study is suitable to be coupled and compared to a plant community model, since it covers the population as well as the community level. We adapted the plant community model IBC-grass to the settings of the empirical study by Reuter and Siemoniet-Gast (2007). Specifically, we analyzed to which degree the model is able to represent realistic community level effects not only by comparing visual patterns but also by calculating model adequacy and reliability as a measure for the model fit. The predicted effects of the model IBC-grass show a good agreement with the experimental data, for the monocultures as well as for the communities. Model adequacy was lower in the monocultures. However, model adequacy increases in the communities. In general, model reliability is high in the monocultures but also the test of small artificial communities is simulated. Population level and community level effects on plant biomass predicted by the plant community model IBC-grass were in good agreement with the measured effects from the experimental study of Reuter and Siemoniet-Gast (2007). This agreement indicates the model is able to reasonably represent intra- and interspecies competition and predict community level effects based on different response data. Therefore, the model can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

**399 Applying the EFSA Scientific Opinion on NTPP: 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 areas can adversely affect non-target terrestrial plants growing at field margins. According to the recent EFSA Opinion for non-target terrestrial plants (2014) one important goal is maintaining the biodiversity of plant species in the agricultural area. It is therefore recommended to include also non-crop species in the testing scheme from the list provided in OECD guidelines 208 and 227 to assess the life-cycle with flowering and seed production. The objective of this study was to assess the viability of generative traits of non-crop species for risk assessment. For this purpose generative traits were evaluated if they provide more relevant information for the risk assessment. For this purpose they were compared with the vegetative traits, such as mortality and biomass production, which are currently assessed in the OECD guidelines 208 and 227. The selected non-crop species are included in commercially available seed mixtures for flowering strips. Our experimental design consists of one control and four different herbicide application rates, with 6 replicates. The field rates were chosen to cover a range of 0.1 to 10 times the proposed application rate. Assessed were mortality, growth, flowering, and phytotoxicological effects. The number of flowers and plant height were assessed for selected species to evaluate differences in development and flowering. In addition, seeds were sampled to evaluate differences in seed quantity and quality. Furthermore, the results will be compared to a non-target terrestrial plants pilot field study (Knaebe et al. 2017; Presentation (SETAC Europe 2017). References: EFSA PPR Panel (2014). Scientific Opinion addressing the state of the science on risk assessment of plant protection products for non-target terrestrial plants. EFSA Journal 2014;12(7):3800, 163 pp. OECD (2006). Test No. 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. OECD Publishing, Paris. OECD (2006). Test No. 227: Terrestrial Plant Test: Vegetative Vigour Test. OECD Publishing, Paris.

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

L. van der Wart, University of Potsdam / Plant Ecology and Nature Conservation; S. Hein, Bayer Ag / Effect modelling; C. Mihan, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer Ag / Environmental Safety; F. Jeltsch, University of Potsdam

Ecological models are rarely found in terrestrial ecosystems. A major reason is that prediction of potential impacts on natural environments with information obtained from greenhouse studies on individual species.

**401 Use in risk assessment of recovery in plants from exposure to chemicals**

T.A. Springer, EAG 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 leaf damage a few days after exposure but, after two weeks of growth that damage may no longer be apparent as old damaged leaves have senesced and only new unaffected leaves are visible. While it is relatively easy to design studies to assess recovery of vegetative growth in terrestrial plants, this may not be indicative of recovery of the ability of a population of plants to sustain itself. In algae or lema studies, an aliquot of cells can be transferred to untreated media at the end of a test and after several days, the growth rates of the affected groups may approach that of the controls indicating recovery. Recovery in terms of growth rate of these simple aquatic plants is likely to be indicative of a population’s ability to sustain itself.
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, Lemma, and myriophyllum studies will be presented as well as results from mesocosm studies. Statistical procedures and experimental designs will be presented for these examples and interpretation of results will be discussed.

402 Aquatic primary producers and plant protection products: endpoints and level of protection achieved in the first tier of the risk assessment scheme S. Duquesne, UBA, Federal Environment agency; L. Hennemann, S. Matezki, M. Solé, K. Swarowski, 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 (YEC50) or as the integral under the growth curve (EtC50). The lowest available EP among ErC50, EtC50 or YEC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use EtC50s 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 level 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, ErC50 (erC50, EtC50, etc.) and assessment factor would ensure an adequate level of protection. Recommendations are provided for an optimization of the risk assessment.

403 Poster spotlight: WE152, WE153, WE154

Environmental monitoring of contaminants using terrestrial ecological biomonitor

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and 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 needles collected for the German Environment Specimen Bank (ESB). The moss samples were collected in areas located in the vicinity of tree sampling sites from the ESB in fall 2016. Deciduous tree leaves and coniferous shoots were sampled in 2015 or 2016 according to the ESB protocols. Overall, 17 polychlorinated dibenzo dioxins and furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoroalkyl substances (PFAS), 3 isomers of hexabromo-cyclododecanes (HBCD), 7 polychlorinated biphenyls (PCB), 24 polym brominated diphenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PCBs 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 following sites located at Söder (forestry) and Scheer (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


405 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry J. Franzaring, A. Fangmeier, University of Hohenheim / Institute of Landscape and Plant Ecology; L. Paoli, University of Siena / Dept. of Life Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; S. Schlösser, University of Hohenheim / Core Facility Hohenheim; E. Monaci, University of Siena / Dept. of Environmental, Earth and Physical Sciences

Passive biomonitoring is being used for many years to assess changes in the state of the environment. Existing programs make use of international, national, regional and local monitoring networks addressing the effects of the widespread deposition of air pollutants and eutrophying compounds and the accumulation of these in e.g. forest and agricultural ecosystems. Reference [1] to [2] This work explores which combination of EC50, ErC50 (erC50, ErC50, etc.) and assessment factor would ensure an adequate level of protection. Recommendations are provided for an optimization of the risk assessment.

Keywords - Bioaccumulation of atmospheric deposition, European moss survey, heavy metals, nitrogen. Acknowledgement - The authors thank the German Environment Agency for funding.

406 Passive biomonitoring and nutrients in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry J. Franzaring, A. Fangmeier, University of Hohenheim / Institute of Landscape and Plant Ecology; L. Paoli, University of Siena / Dept. of Life Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; S. Schlösser, University of Hohenheim / Core Facility Hohenheim; E. Monaci, University of Siena / Dept. of Environmental, Earth and Physical Sciences

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Keywords - Bioaccumulation of atmospheric deposition, European moss survey, heavy metals, nitrogen. Acknowledgement - The authors thank the German Environment Agency for funding.

407 Examining historical trends in diet and contaminant exposure in bats using buccal guano deposits from Jamaica L. Gallant, University of Ottawa / Department of Biology; C. Grooms, Queens University / L.E. Kimpe, University of Ottawa / Department of Biology; J.P. Smol, Queens University / Biology; W. Bogdanowicz, Museum and Institute of Zoology;
Bats are excellent ecological indicators owing to their long life span, global distribution, and predictable responses to environmental stressors. Bats play important roles in pollination, seed dispersal, and insect population control and thus it is important to determine whether bat diets change over time as a result of exposure to contaminants such as metals. Bat guano deposits are of particular use as they may serve as contaminant archives in the cave environment and preserve valuable isotopic and metal data which allows for the determination of historical exposure to contaminants as well as any fluctuations in diet. This research provides the rare opportunity to examine two bat guano deposits from Jamaica: bat guano was heavily mined for gun powder and fertilizer and as such, there are few bat guano deposits that have been unaltered by human exploration or exploitation. The objective of this research is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the 210Pb, 137Cs, and 14C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the δ34S, δ13C, and δ37S profiles in order to determine the long-term dietary trends in the bat guano deposits.

Preliminary results suggest that the 3,000-year-old bat guano deposit is tracking a change in stable isotopes associated with the agricultural history of Jamaica, specifically, the introduction of: nitrogen fertilizers, the Bordeaux mixture, and sugar cane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholesterol and stigmastanol, for example, could be evidence of fluctuations in feeding habits (or bat colony composition) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the bat guano deposits associated with contaminant exposure in relation to the onset of the Industrial Revolution, a period characterized by an increase in atmospheric emissions of metals owing to increased mining and production. Lastly, we present the decrease in 210Pb within the bat guano deposit in association with the introduction of leaded gasoline.

408
Perfluoroalkyl substances and metallic elements in South African dragonflies
H. Bothman, North-West University / Unit for Environmental Science and Management; V. Lesch, North-West University; Y. Shibata, National Institute for Environmental Studies / Fellow; A. Kinoshita, National Institute for Environmental Studies

Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallic contamination is available. Perfluorinated substances (PFASs) and metallic elements or perfluorinated substances (PFASs) pollution have been documented in South Africa. Perfluorooctanesulfonic acid (PFOS) occurred at similar concentrations at all six sites, when quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (PFASs = 21 ng/g wm), 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 have isolated water sources, showed lower metallic element concentrations when compared with other sites. Based on these results we conclude that dragonflies would be excellent indicators of environmental metallic elements and PFAs.

Bioavailability of Arsenic and Antimony co-contamination to vegetable crops in agricultural soils
L.P. Egedawata, University of Wollongong / School of Chemistry; A. Holland, La Trobe University; R. Halford, University of Wollongong / School of Chemistry; X. Cao, National Institute for Environmental Antimony (Sb) is an emerging contaminant that is assumed to behave 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 contaminant soil and food, a reduction in food quality (or bat colony composition) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the bat guano deposits associated with contaminant exposure in relation to the onset of the Industrial Revolution, a period characterized by an increase in atmospheric emissions of metals owing to increased mining and production. Lastly, we present the decrease in 210Pb within the bat guano deposit in association with the introduction of leaded gasoline.

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

410
Transcriptomic responses of the endangered freshwater mussel Margaritifera margaritifera to trace metal contamination
A. Marchetti, F. Pleron, University of Bordeaux / UMR EPOC CNRS 5805; J. Thébault, Université de Bret / LEMAR UMR 6539 CNRS/UBO/IRD/Ifremer; C. Kjöpp, INRA Institut National de la Recherche Agronomique / Plate-forme bio-informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Bellé, Université de Bret / LEMAR UMR 6539 CNRS/UBO/IRD/Ifremer; F. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Baudripou, University of Bordeaux / UMR EPOC 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 renal transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect we identified mRNAs that were co-expressed and verified through mass spectrometric techniques may reveal the exposure to direct detection of xenobiotics and their metabolites (xenometabolome) and the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The renal transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect we identified mRNAs that were co-expressed and verified through mass spectrometric techniques may reveal the exposure to direct detection of xenobiotics and their metabolites (xenometabolome) and the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The renal transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect we identified mRNAs that were co-expressed and verified through mass spectrometric techniques may reveal the exposure to direct detection of xenobiotics and their metabolites (xenometabolome) and the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies.
4'-hydroxy-diclofenac, and 10 were phase II metabolites such as amino acids conjugates. Five were reported for the first time in an aquatic organism. Regarding the effects, two main metabolic pathways were found to be impacted by diclofenac exposure. The tyrosine metabolism was mostly down-modulated and the tryptophan metabolism was mostly up-modulated. To our knowledge, such DF effects on muskells have never been described despite being of concern for these organisms. Astatelamines and serotonin are involved in osmoregulation, and in gamete release in mussels [2-4]. Our results highlighted potential impairment of mussel osmoregulation and reproduction following a DF exposure in agreement with recent publications that have shown reproductive disturbance following DF 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 Fang et al., Exp. Zool. 267, 475 (1993) 4 Fang 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 Metabolomics used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in F. candida

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

Worldwide, serious concern has arisen about the increased incidence of learning and developmental disorders in children. From a scientific point of view, there is no doubt that exposure to neurotoxic chemicals during early brain development can adversely affect learning and development. Various recent epidemiological studies have indicated that exposure to low doses of environmental biologically active contaminants (e.g. pesticides) during human development can have deleterious effects on cognitive development in childhood. The European commission-funded project DANAMIC “Developmental Neurotoxicity Assessment of Mixtures in Children” investigates neurotoxic effects (e.g. learning and developmental disorders) of low-concentration mixtures of pesticides and a number of common environmental pollutants in children. We focus on (subclinical) effects on learning (cognitive skills) and developmental disorders in children (e.g. ADHD, autism spectrum disorders and anxiety disorders). The aim is 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.danamic-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 DANAMIC 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 Pollutant and Metabolomics Profiles in Tissues of Polar Bears From Hudson Bay, Canada

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

Metabolomics profiles are comprised of targeted endogenous metabolites (< 1 kDa) such as amino acids (AAs), fatty acids (FAs), and membrane lipids such as phosphatidylcholines (PCs) to identify how changes in the metabolome relates to extrinsic factors, including e.g. exposure to persistent organic pollutants (POPs) and metals. Polar bears (Ursus maritimus) from Hudson Bay (Canada) are differentially exposed to complex mixtures of POPs and metals including total mercury (THg = inorganic + methyl-mercury), and legacy and new POPs. In the present study, quantifiable profiles of 295 organic POPs and THg in fat and liver (representing the most environmentally relevant tissues for polar bears: SHB; n = 14) and Western Hudson Bay (WHB; n = 15) male polar bears were compared 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), polychlorinated diphenyl ethers (PBDEs), p,p'-dichlorodiphenyl dichloroethylene (DDE) and some ortho-polychlorinated biphenyls (PCBs) were greater in the SHB bears and changes in the metabolite concentrations had some consistency with previous laboratory studies. Arachidonic acid (ARA), glycerophospholipid and amino acid pathways 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

T.E. Simoes, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Sousa, University of Coimbra / Department of Life Sciences; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; T. de Boer, Vrije Universiteit; D. Roelofs, Vrije Universiteit / Department of Ecological Science; N. van Stralen, Association of Research Environmental Scientists (ARES) / Department of Ecological Sciences; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

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 and pioneering of its kind 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 (Bravo500®), with active compound chlorothalonil (CHT), in F. candida, by linking effects at different levels of biological organization like reproduction, gene expression and protein levels, following a time series exposure. Therefore, arthropods were exposed to Bravo500® at a recommended concentration for disposal of 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 on the gene expression of several single-gene mutants (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 when interpreting biological effects as they can give useful insights, exhibiting 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 Chlamydomonas reinhardtii

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

At present, environmental risk assessment of chemicals is limited to measuring physiological endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best method for gene function discovery is functional genomics based on genome-wide gene expression analysis of single-gene mutants or other 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: atrazine and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II which leads to production of reactive oxygen species. The pooled library was exposed to the EC20 concentration of each herbicide for 3-4 days, at which time samples from the library were taken for DNA sequencing to find mutants that have become enriched or have disappeared from the culture after exposure (compared with non-exposed control). The expectation was that the functional genomic profiles of atrazine and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutant 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**

416 *Harmful effects of plastic litter on Mediterranean Biodiversity: what and what's new?* M. Fossi, M. Baini, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

Concern about the occurrence, quantity and effects of marine litter in the world’s ocean and seas has grown rapidly in recent years, attracting interest from a wide range of stakeholders, environmental NGOs, the scientific community, the media and the general public. Mediterranean Sea, which is a crucial biodiversity hotspot and a critically polluted area, has been also described as one of the areas most affected by marine litter, including microplastics, in the world. Recent studies in the different regions of the basin suggested that some areas are affected by important concentration of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on the 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 potential biological effect. A new integrated monitoring tool that would provide the information necessary to design and implement future mitigation actions in the Mediterranean basin is proposed. Applying ecological and biological criteria to the most threatened species obtained by statistical analysis, biondicator species for different habitats and monitoring scale were selected. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethal effects to organisms related marine litter ingestion. The gaps pointed out by this research and the biondicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

417 *Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD* F. Giliani, IFREMER

Periodic assessments of the state of the marine environment, monitoring and the formulation of environmental targets are perceived as part of the continuous management process within the MSFD. Of the 13 descriptors listed in Annex I of the MSFD for determining GES, Descriptor 10 has been defined as “Properties and species affected by marine litter ingestion.” Periodic assessments provide the information necessary to design and implement future mitigation actions in the Mediterranean basin is proposed. Applying ecological and biological criteria to the most threatened species obtained by statistical analysis, biondicator species for different habitats and monitoring scale were selected. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethal effects to organisms related marine litter ingestion. The gaps pointed out by this research and the biondicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

418 *Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface* T. Vlahogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

The growing urgency and complexity of interconnected societal challenges, such as marine litter, demand that they be addressed through the strengthening of the science-policy-society interface so as to provide the necessary conditions for translating research-based knowledge into effective action. NGOs are essential partners in promoting environmental awareness 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 areas. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. The term “biodegradable” could be misunderstood and induce the false idea that any plastic that decomposes or can be broken down to biowaste. 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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 the cooperation within the Mediterranean region, and a further step has been reached, towards a more effective marine litter management at regional level. One of the latest developments of the UN Environment/MAP is the 2017 Mediterranean Quality Status Report (QSR) that dedicates two chapters on marine litter related to beach, floating, and seafloor marine litter.

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

G. Zampetti, Legambiente

"Science and awareness: a Mediterranean connection against marine litter" is the title of the voluntary commitment that Legambiente and the University of Siena presented at the last UN Ocean Conference in New York, in June 2017. There was a connection between scientific research and raising awareness built to tackle marine litter in the Mediterranean Sea by sharing experiences and developing new integrated action. In 2013, Legambiente started the monitoring of floating macro litter within Goletta Verde, one of the most popular campaigns of analysis and information about sea pollution. In the last few years, there has been an increase in the marine-litter-related activities, including surveys using citizen science and awareness raising projects. Following the Scientific Environmentalism purpose Legambiente applied official methods and protocols to contribute to the estimation of the marine litter amount in seas and along the coastline, cooperating also with national research institutes, universities and other research organizations. Now, thanks to the cooperation with the University of Siena, a further step has been reached, resulting in the last developments of the commitment 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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Phytoplankton are crucial for lentic ecosystems productivity and foodwebs, but facing multiple anthropic challenges that may lead to complex alterations of their ecology and function. Climate change is expected to decrease the stability of aquatic 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

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acclimated to. Many species of algae are highly adaptive and can respond by growing rapidly after disturbance. However, the diffuse burden of chemical pollutants concomitantly present in freshwater ecosystems, can favour species of algae that are more tolerant to chemical pollution to the detriment of more adaptive ones. We carried out a field experiment, using a non-invasive mesocosm approach, to study the response of phytoplankton communities to combined physical and chemical anthropogenic stressors. We aimed at investigating if chemical pollution can prevent the ecosystem to promptly re-gain structures and functions after extreme events. An extreme meteorological event was mimicked by sampling and mixing phyttoplankton communities over the entire water depth of the lake. The chemical stressors comprised of a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC_{50} of individual pollutants). The mixture included 12 pharmaceuticals and personal care products commonly detected in lakes and rivers in Europe. In addition, a mixture isolated from treated waste water effluents was used as a treatment of its own. Individual level traits (cell size, pigments), community parameters (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 3-months experiment. Our results show that long-term contamination by environmentally relevant concentrations have a drastic persistent impact on the different levels of organisation of the phytoplankton community. At community level, contaminant decreased the photosynthetic yield. At higher concentration levels these effects persisted throughout the duration of the experiment, resulting in lower productivity and communities with contrasting. This suggests that diffuse chemical pollutants can disrupt the capacity of natural communities to handle environmental changes.

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

A. Maulvault, Università del Sannio / Department of Environmental Science; A. Bellin, University of Trento / Department of Civil, Environmental and Mechanical Engineering; E. Stella, University of Trento / Department of Civil, Environmental and Mechanical Engineering; E. Capri, Università Catolica del Sacre Cuore / Institute of Agricultural and Environmental Chemistry; I. Muñoz, University of Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; A. Bellini, University of Trento / Department of Civil, Environmental and Mechanical Engineering

In this study the combined effects of hydrological and chemical stressors on benthic macroinvertebrates are evaluated in order to explore the response of the biological community in relation multiple pressure factors. The Adige River, located in the Southeastern Alps, was selected as a case study because representative of a variety of catchment characteristics in the Alpine region. As expected, streamflow showed a seasonal pattern, with higher values in the spring-summer period; however, in some sites the natural hydrological regime was altered by the presence of hydropower plants, which management affected most low values of streamflow. Statistical analysis showed a clear seasonal and spatial pattern in both chemical and hydrological parameters; in detail higher concentrations of nitrate, Personal Care and Pharmaceutical products were found in winter season associated with lower 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 Ploexoptera, and Gommarus sp diversity. 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 Argyro somus regius exposed to venlafaxine

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Anthropogenic activities have contributed to great environmental challenges: remarkable chemical contamination and dramatic climate change. Both factors strongly affect marine ecosystems and are expected to worsen in the future, threatening marine species’ welfare and survival. Yet, information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-regulated pharmaceutical and personal care products (PPCPs) have recently become a great environmental concern, since these compounds are often discharged into the aquatic environments, but their elimination through conventional wastewater treatments is rather limited. Within pharmaceuticals of human use, venlafaxine (VFX) is one of the most ubiquitous in the aquatic environment, often reaching higher concentrations than other well-known psycho-active drugs, such as fluoxetine (i.e. Prozac). In this context, the present study was aimed to shed light on 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)

M. Assunção, Celas Lowestoft Laboratory; P.E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M.G. Hutchins, Centre for Ecology and Hydrology

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

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. Nöthig, 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, Analytisches Laboratorium 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 socioeconomic analysis (SEA), which is generally defined to be a tool for assessing all relevant positive and negative impacts from substances’ use or non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals’ use, including PBT/vPvB, are use-specific. Furthermore, due to stock pollution properties of PBT/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 and compartmentation 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 a particular chemical 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

M. Nedzda, Analytisches Laboratorium; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; G. Slentes, Bayer AG Division CropScience/Environmental Fate / Development

The assessment of PBT/vPvB substances under REACH may evaluate long-term exposure dynamics and impact potential. Grouping and relative ranking of PBT/vPvB substances can support comparative assessments of either several substances with the same use, or for a particular substance with different uses (emission patterns) in the context of socio-economic analysis (SEA). The aim of the grouping and ranking is to classify a multimedia chemical with respect to its similarity of properties/behaviour with chemicals with known impacts, serving as points of reference for the impact evaluation. The relative ranking of PBT/vPvB substances is based on an impact score, which captures diverse properties and effects of target substances. The impact score consists of individual scores assigned to expected environmental stocks, possible effects of 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/sediments 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 of using fingerprints to describe and evaluate differences of PBTs/vPvBs with regard to impact potential. Based on current knowledge, this grouping and relative ranking can guide the formation of concern-based categories for a possible read-across or comparative evaluation of impact potential of PBT/vPvB substances. Acknowledgement – This work was funded by the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, contract number: 30-CE-08307200-26 ‘Approach for evaluation of PBTs subject to authorisation and restriction procedures in context of socio-economic analysis’.

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


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/ECTOCT 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 application, limitations and potential technical challenges of those extraction methodologies will be discussed. Preliminary results have already indicated that further research on the methods is necessary. The project will also include recommendations for further research needs and for addressing the limitations identified in the current testing guidelines. The main outcome of the project will be presented at the SETAC meeting.

433 Quantification of different NER types in soil - Extraction matters


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 methodologies are used for NER quantification. This paper will limit itself to the described and the seperated 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 biomass. These residues are considered to be irreversibly bound to the soil 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 test guideline, which allows a mass balance of the soil and the analysed residues. These non characterised standardised soils were used with and without antibiotics, triclosan and fenoxycarb, three radiolabelled test compounds were selected representing a pharmaceutical, a biocide and a pesticide. The substances are already well described with regard to their degradation kinetics and the formation of different NER types. Different mild to harsh extraction procedures like shake flask extraction and macerated 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 Plant Protection Products. In Non–NER and -Cebiotics, 241-264. [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

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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. 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 macerated liquid solvent extraction are comprehensively discussed. They could not be fully converted into the soil 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 test guideline, which allows a mass balance of the soil and the analysed residues. These non characterised standardised soils were used with and without antibiotics, triclosan and fenoxycarb, three radiolabelled test compounds were selected representing a pharmaceutical, a biocide and a pesticide. The substances are already well described with regard to their degradation kinetics and the formation of different NER types. Different mild to harsh extraction procedures like shake flask extraction and macerated 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 Plant Protection Products. In Non–NER and -Cebiotics, 241-264. [2] Eschenbach et al. - Sequential extraction procedures to characterize non-extractable residues (NER). 2013. Poster at SETAC 2013, Glasgow.

94 SETAC Europe 28th Annual Meeting Abstract Book
Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Development in the Biopharmaceutical Industry

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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 nucleus represents one of the largest production scale processes within the biopharmaceutical industry. Environmental impacts 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. Necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, necessary, 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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 as a means to both “tailor” the approaches to be applied for an advanced assessment and to give a situational overview of a given situation. The goal and scope of an LCA, where LCA is part of said portfolio. As an application, we develop and present a causal loop diagram for sustainability assessment of mining in general, and apply this to specific mine sites in Finland, Portugal, and South Africa, where this approach is currently applied, led by GreenDelta, in the European H2020 research project ITERAMS. In the presentation, the developed causal loop diagram and the approach for obtaining the diagram for the case will be explained, with results from the ITERAMS project. Results are quite promising and we believe that using causal loop diagrams in sustainability and life cycle assessments helps to clarify selection of the (combination of) appropriate tools for the assessment, and help to structure the goal and scope setting in LCA.

Life Cycle Sustainability Assessment for Improved Space Mission Design

A.R. Wilson, M. Vasile, University of Strathclyde / Department of Mechanical & Aerospace Engineering; K. Baker, Glasgow Caledonian University / School of Engineering & Built Environment

The adoption of the Paris Agreement and Sustainable Development Goals in 2015 has been the driver for a more coordinated global approach towards achieving environmental sustainability. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is an important environmental management technique increasingly applied within 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 the space sector, creating the first set of LCA guidelines for space systems in 2016 and now in the process 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, outlaying the technical, methodological, and economic aspects with environmental LCA to evaluate the life cycle impacts of space systems. As adverse impacts are more difficult to modify the later into the design process that they are identified, the integration of LCsA into the concurrent design process is essential for the early mitigation of sustainability issues. As such, the intention of this platform is to help decision-makers choose sustainable technologies and products at the design stage by determining those that are not only cost-efficient, eco-efficient or socially responsible, but also ones that can easily justify and evidence their sustainability.

How can Agent-based Modeling improve decision making in Life Cycle Assessment?

A. Selleri, Autostrade per l’Italia / direzione tecnica; S. Frisiani, Spea Engineering S.p.A.

Those who choose to pursue 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 adherence to bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and if produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.

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

G. Mininni, CNRIRSA; A. Sciotti, F. Martelli, Italtuner 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 ESR, up to several millions of tons. Their management as a waste certainly requires a huge amount of financial and logistic resources, including bye-passing, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments as normal industrial practice should be clearly stated. Current legislation may have a non-unique interpretation and therefore the operators are exposed to uncertainties. The general principles of fair competition inside Europe are totally disregarded.

REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICITY AND FUTURE PERSPECTIVES

A. Selleri, Autostrade per l’Italia / direzione tecnica; S. Frisiani, Spea Engineering S.p.A.

Decisions that choose to perform 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 adherence to bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and if produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.
The increasing use of Earth Pressure Balanced Shields (EPB-TBM) in the tunnelling industry has been due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of EPB-TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of surfactants, mainly sodium lauryl ethel sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material of the excavation 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 ecological 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 lithostratigraphic 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 M. Greenhill-Hooper, Imerys / Performance Additives; H. Spengler, Imerys / Imerys Metalcasting; G. Collard, Imerys / Performance Additives; C. Egeron, Consultant / Tunnelling

A novel product, based on a natural mineral has been developed for use as a foaming agent and soil conditioning agent with earth pressure balance (EPB) tunnel boring machines (TBMs). It is available as readily water dispersible granules or pre-prepared aqueous suspension form and can be dispersed and diluted readily in water with low shear mixing. The resulting dilute suspension can be converted into a foam using an industrial foam generator, or by other mixing methods. It can be used with existing equipment found on EPB TBMs, without the need for further modifications and investments. The product has been developed for use 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 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.

448 Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy R. Kaezi, A. Gogos, Eawag Swiss Federal Institute of Aquatic Science and Technology

Fascinating properties of Carbon Nanotubes (CNTs) allow the development of novel materials with increased functionalities (e.g. reduced weight, increased strength). Nevertheless, CNTs do pose potential environmental and human health risks and reliable methods to quantify CNTs at low concentration in complex matrices are still lacking. The development laboratories have demonstrated a good stability of the foams produced using the product (half-life measurements of water drainage), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and spoil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (II)
 extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400 FEI) operated at an acceleration voltage of 20 kV in emission mode and using a bright field transmission electron detector. A ridge detection algorithm implemented in the image processing software Fiji was used to detect and characterize individual CNTs. The number of CNTs on the TEM grids 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 on images with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 µg L⁻¹ – 100 µL L⁻¹) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of ~2. Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 mg 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/kg soil, which would represent huge step forward in detecting of CNTs in complex matrices.

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

H. Lee, National Institute of Environmental Research (NIER) / Geum River Water Environment Research Center; Y. Cho, J. Khan, National Institute of Environmental Research (NIER) / Geum River Water Environment Research Center; B. Lee, National Institute of Environmental Research NIER / Han river water environment research center; B. Seol, M. Chae, S. Cheon, National Institute of Environmental Research NIER / Geum River Water Environment Research Center

A multidisciplinary 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 quantifications (LOQs) were 0.9 – 21.1 ng/L (Insecticides), 15.4 – 35.0 ng/L (PFCs), and 15.4 – 35.0 ng/L (BFRs). For understanding the background levels of PFCs, insecticides, and BFRs in the river water, those compounds were monitored in Geum river main stream, So-ok stream, Juwon stream, and Daechung Lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were PFDA, PFHxA, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

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Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water resources, it is being increasingly viewed as an ecologically and economically 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 characteristic persistence to the environment, their mass spectrometry, and their enthalpy of formation. CECs have revealed a multitude of effects including increased mortality and development time, reduction in weight, changes to the microbiome and up-regulation of enzymes associated with oxidative stress. Further, the study has highlighted the potential for higher plants to take up, translocate and detoxify CECs.

451 Occurrence of pharmaceuticals and their metabolites in Euthynnus alletteratus bile


The presence of pharmaceuticals in surface waters has been attributed to the effluents of WWTP among others. The widespread occurrence of pharmaceuticals in the aquatic environment has raised concerns about their potential adverse effects on exposed wildlife. Little is currently known on exposure levels of drugs in fish, but some studies reported the detection of pharmaceuticals and endocrine disrupting compounds in this type of biota. Due to possible accumulation processes, pharmaceuticals and metabolites could be thousand times more concentrated in fish than in polluted living waters. By other hand, fish are known to possess a hepatic detoxification system which are likely capable of metabolizing pharmaceuticals taken up from polluted waters. Some studies proposed the analysis of bile from fish to evaluate pharmaceuticals exposure including the identification of metabolites by UPLC-HRMS. In this context, we propose the evaluation of the metabolism of frequently detected drugs in fish, performing a rapid screening of bile by HR-MS for the presence of stable intermediates. Fish were collected from different regions in the Mediterranean coast of Spain. Afterwards, their bile was isolated from the fish and analyzed for the detection of parent drugs and some metabolites listed in an in-house suspected list. A sampling campaign was planned to collect tuna fish, Euthynnus alletteratus, from the Mediterranean coast of Spain. Tarragona, Girona and Barcelona (Spain) were used as sampling areas. 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 accurate 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, this practice increases local contamination sources 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 (dilofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, midazolam, and methadone), an illegal drug (cocaine) and two transformation products (acetonide 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 cultivation period, leaves root system, and 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. 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 (dilofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, midazolam, and methadone), an illegal drug (cocaine) and two transformation products (acetonide 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 cultivation period, leaves root system, and 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.
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 Epistic. Five plants (radish, arugula, lettuce, spinach and green pea) planted in those soil were initially irrigated by fresh water and next with water contaminated by a single compound or their mixture. After 3 or 4 weeks, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant parts and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds’ transformation depended on a plant family. Considerably higher concentrations of atenolol, sulfamethoxazole and metabolites of atenolol were measured in roots in comparison to those in leaves and soils. In the case of carbamazepine, the highest concentrations were measured in leaves followed by roots and soils. Both indicate a high potential of plants to accumulate studied pharmaceuticals in their bodies and a high ability to transform studied compounds. Particularly in the case of carbamazepine, the considerably higher concentrations of metabolites were measured in leaves in comparison to concentrations in roots and very low or negligible concentrations in soils. Transformation of compounds in plant bodies is attributed to enzymes CYP450. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (mixture of compounds) that were grown on a surface soil 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 substance divided by a dry mass of soil).

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

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish
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A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in advance of any adverse effects, if their molecular targets are conserved in wildlife and if circulating blood plasma concentrations approach therapeutic concentrations established in humans. Fish generally display high levels of conservation of human drug targets and may be exposed to pharmaceuticals via discharges from wastewater treatment plants. The Non-Steroidal Anti-inflammatory Drugs (NSAIDs) ibuprofen and diclofenac are present in effluents, resulting in low mg/L concentrations in surface waters and fish blood plasma below or bordering on “therapeutic” concentrations. However, some studies suggest that diclofenac and ibuprofen can induce harmful effects in fish at measured environmental concentrations. Here we seek to refine the estimates of the risk of effects of NSAIDs by gaining greater understanding of their bioavailability, pharmacologically effective concentrations and inter-individual variation in fish. We quantified plasma prostaglandin (PG) and plasma NSAID concentrations in individual female rainbow trout during and after 12 days continuous flow-through exposures to ibuprofen (0, 10, 200 mg/L) or diclofenac (0, 5, 100 mg/L). High-level NSAID exposures significantly reduced plasma PGE2 concentrations, while low-level exposures were not detectable for the respective level exposures, due in part to considerable inter-individual variation in plasma PGE2: 2.6-143 pM for ibuprofen; 0.8-188 pM for diclofenac; versus 0.8-316 pM in control fish. There was no significant correlation between plasma PG and plasma NSAID concentrations within exposure treatments; plasma NSAID concentrations exhibited much lower inter-individual variation, with blood plasma: water partition coefficients ranging from 1-3 for ibuprofen and 1-9 for diclofenac. To identify factors affecting PG levels in individual fish we measured plasma lipid content and plasma protein binding influencing partitioning and bioavailability, haematocrit and in vivo-reactive protein concentration quantifying baseline immune system status, and plasma cortisol concentrations as a measure of stress in fish, potentially affecting plasma NSAID and PG concentrations. From our analyses, no single factor could explain the observed variations in NSAID uptake and pharmacological response. Our data highlight some of the complexities in interpreting biological exposure and effects data for NSAIDs.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward
J. Bachmann, German Environment Agency (UBA) / Section IV.2 Environmental Risk Assessment of Pharmaceuticals; S. Schwarz, German Environment Agency UBA / Section IV.2.2 Pharmaceuticals; U. Brandl, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals; I. Rönnefahrt, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals

Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/4447/00 corr 2) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are double quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Based on the level of evidence provided for data sets of substances the regulatory influence is anonymous and encoded form. One discussion point will be the question whether the current base of data is sufficient to draw general conclusions. Although the results are based on more than 10 years of experience with environmental risk assessment within the authorization of new human medicinal products, the data basis is still lower than desired. So for some pharmaceutical ingredients detected in surface waters environmental effect data are lacking, because they entered the market before implementation of the EMA guideline. Furthermore, the tailored assessment approach for substances with very specific mode of action will be addressed, especially regarding the remaining uncertainties for protection of biodiversity and the environment. This does apply e.g. for endocrine active substances, like contraceptive drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach is replace long-term data (up to 14 days) with shorter testing periods. Those shorter testing periods, as well as chronic no-effect concentrations, can be based on knowledge about the potential factors as applied usually for chemicals without any specific mode of action will be analogized.

456 Prioritising human health risk of environmental residues of pharmaceuticals and personal care products in use in southern Nigeria
U. Agusiegbie, Environment Department, University of York / Environment; C. Eze, UNIVERSITY OF NIGERIA NSUUKA NIGERIA; A. Boxall, University of York / Environment Department

Pharmaceutical and personal care products (PPCPs) are used worldwide for medical treatment and personal hygiene. PPCP residues are usually discharged into the environment during wastewater treatment. The environmental fate of these chemicals is poorly understood, leading to concerns about potential health effects and ecological impact posed by their use and release. In many developing countries, information regarding the consumption patterns of PPCPs is often limited, even though consumer product usage data are crucial for more realistic exposure estimates, like for non-clinical cancer research. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach is replace long-term data (up to 14 days) with shorter testing periods. Those shorter testing periods, as well as chronic no-effect concentrations, can be based on knowledge about the potential factors as applied usually for chemicals without any specific mode of action will be analogized.
ciprofloxacin, ampicillin, cloxacillin, sulfamethoxazole, trimethoprim and pseudoephedrine) and 4 PCP ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thioglycolate and dichlorvos). This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

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Aquatic toxicity related to pharmaceutical 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 since the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamine as model substances in Daphnia magna and the green alga Raphidocelis subcapitata. 

Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative joint programme (the iPIE project (IM Grant no. 115735)—IP). These in silico methods provide a first tier of screening, but we are likely still faced with hundreds of compounds to assess at multiple concentrations. We have been developing in vitro tissue micro-organs (organoids) that replicate the in vivo tissue. These can be used to built a virtual fish that will allow the screening of pharmaceuticals (or other compounds of concern or even metals) without testing live fish (BBSRSC/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 gill or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

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

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Neuroactive pharmaceuticals are of growing concern as aquatic contaminants due to environmental and human health risks. Even low concentrations can interfere with molecular pathways and population-relevant behaviors. At the same time there is no EU regulatory framework for environmental neurotoxicity assessment. This project aimed to contribute for establishing a neurotoxicity testing approach by integrating molecular (transcriptomics) and endpoints validated in the iPIE grant agreement n° 115735, resources of which are composed of financial contribution from the European Union's Seventh Framework Programme (FP7/2007–2013) and EFPIA companies’ in kind contribution.

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

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Little is known about the effects at cellular, tissue and individual levels of emerging contaminants such as fullerenes C60. C60 is a very 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/threonin protein kinase that senses and integrates a variety of cellular physiological and environmental signals to regulate cell growth. mTOR activity is involved in the control of cell growth and other cellular processes (such as transcription, ribosome biogenesis, protein synthesis), and by inhibiting catabolic processes (such as autophagy); mTORC2 is primarily involved in actin remodeling, whereas mTORC1 contributes to increase autophagy and to decrease protein synthesis as phosphorylation of mTORC1 and mTORC2 may explain most of C60 effects. mTOR activity was evaluated by measuring the presence and cellular distribution of C60 in mussel tissues, already at the lowest concentration. Our data demonstrated that the changes of the phosphorylation of mTORC1 and mTORC2 may explain most of C60 effects studied at cellular and tissue level. Indeed, the C60 induced dephosphorylation of mTORC1 contributed to increase autophagy and to decrease protein synthesis as the reduction of lysosomal membrane stability and the enhancement of lysosomal/cytosolic volume ratio of the digestive gland cells; and mTORC2 to affect cytokskeleton organisation as revealed by the changes of actin/tubulin structures. Transcriptomic data are important to understand the cellular adaptive responses to the chemical. For this purpose, a novel low density oligo microarray (470 genes, suitable to follow 15 stress response pathways) was used. Transcriptomic analysis identified the number of DEGs showing a bell-shaped trend with a maximum in animals exposed to 0.1 mg/L C60. In terms of processes related to the DEGs depicted in all conditions, the most affected are associated to...
translation, cytoskeleton organization and mitochondrial activity. Transcription of selected genes was verified by RT-qPCR. These represent the first data on C60 tissue subcellular distribution and on the possible involvement of mTOR in the physiological alterations due to nanoparticle accumulation.

461 Protonic responses to nanoparticulate and ionic silver in freshwater microorganisms with different background

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Enhanced use of AgNPs (Ag nanoparticles) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC50 (effective concentration) were assessed based on the variations in the overall proteome in 2 aquatic fungal strains of Arthrobotrys oozora tetracaudia, 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 AgNP agglomeration explaining its lower impacts on their growth. In fungi, ≈40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ 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 inevitable. This has raised a global concern regarding the risk of silica nanoparticles and was in 2010 selected as one of the priority substances by the OECD Working Party on Manufactured Nanomaterials. In order to thoroughly examine the toxicity of silica nanomaterials to deuterants, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), 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 5.1 mg/L after exposure to the smallest particle at a concentration range of 12.5-100 mg/L. Toxicity to fish cells was determined to be surface dependent, except for particles coated with ethoxy silane, which did not show any toxicity. For bacteria and algae, the cell wall seems to play a major role in the uptake and toxicity of silica nanoparticles. Keywords: hazard assessment, silica nanoparticles.

463 Toxicity Assessment of Engineered Titanium Dioxide Nanoparticles

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Titanium dioxide engineered nanoparticles (TiO2-ENP) are extensively employed in manufacturing of commercial materials, 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 sentinel, 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 content of proteins involved in 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 ZnO and ZnO/CHP, 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 amount 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 depending on a combination of ZnO and CHP as well as 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)

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Aquaculture is a major food production subsector that will play a major role in filling the growing seafood supply gap, estimated to be of the order of 47.5 million tons by 2050. However, aquaculture cannot be practiced everywhere; it requires a particular set of natural, social and economic resources which must be used wisely if the development of the sector is to be sustainable. Appropriate environmental characteristics, good water quality, well-understood social interactions and use of inland and coastal resources are essential to maintaining in existing and future aquaculture systems. Consequently, suitable zoning, selection of sites and application of carrying capacity are among the most important issues for the future success of European aquaculture, and also predicate the need for sustainability, resilience and best practice guidelines, as provided by the Ecosystem Approach to Aquaculture. The four-year Horizon 2020 TAPAS research project, which started in March 2016, aims to consolidate the environmental sustainability of European
aquaculture by developing tools, approaches and frameworks to support EU Member States in establishing a coherently and efficient regulatory framework, implementing the Strategic Guidelines for the sustainable development of European aquaculture and delivering a technology and decision framework for sustainable growth. The ultimate goal of the project is to create cost-efficient management tools and practices for the European aquaculture sector to investigate the scope of fish farming activity, social interactions, potential environmental impacts and any future risks.

467 Preliminary investigation on the occurrence of multifunctional organic micropollutants in offshore seawater and fish farm L. Lin, N. Shi, N. Kuo, Y. Gao, National University of Singapore / Civil & Environmental Engineering

Limited research has been conducted on the occurrence and distribution of antibiotics, pharmaceuticals, personal care products, endocrine disrupting chemicals and artificial sweeteners in the marine environment despite being increasingly impacted by these micropollutants (MPs). In this study, the presence and distribution of antibiotics and endocrine disruptors in seawater and fish farm environments in Singapore were investigated. Seawater samples were collected in 14 different areas and fish farms in Singapore. The sampling area is affected by various anthropogenic pressures including treated effluents, fish farming, shipping and port activities. A total of 23 MPs were found in offshore seawaters, 9 of them with detection frequencies higher than 50%. The highest detected values corresponded to cyclamate, salicylic acid and sucralose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality
B. Gonzalez, J. Hernandez-Benavides, R. Alarcon, C. B. Valencia, B. Gonzalez, IMDEA Water (G84912732) / Environmental C

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 different waste management capacity. Yet high population densities in urbanizing regions result in concentration of food, energy, water and other resource consumption. Urbanization also leads to concentration of chemical use, which inherently results in exposures to human populations and ecosystems receiving waste streams within and from these urban centers. In developing nations, where many of the megacities will continue to emerge over the next few decades, agriculture will be a key driver of urban growth. Current pollution management and environmental management systems being implemented. Unfortunately, 80% of the global sewage treatment is not performed, 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 that the mentioned bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and diffuse discharges of marginal quality, in Hong Kong. Our findings from laboratory uptake and depuration studies with channel catfish and tilapia focus on contaminants with diverse physico-chemical properties (e.g., weak base medicine, phosphorus-based flame retardant, perfluorinated compound, cyanotoxin) and provide an approach to improve aquaculture practice and to support bioaccumulation assessments for chemicals falling outside of applicability domains for nonionizable organic contaminants. In North America we are examining intersections among water reuse practices and aquaculture for various products. Such efforts appear warranted at the global scale.

469 Bioaccumulation of selected veterinary medicines in the blue mussel (Mytilus edulis) S. Brooks, N. VIVIA / Ecotoxicology and Risk Assessment; B. Belyich, NIVA; A. Ruus, NIVA / NIVA; J. Rundberget, NIVA; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included teflubenzuron, emamectin, deltamethrin and azathiphos. Due to the low solubility of teflubenzuron and deltamethrin a saturation column was employed within a flow-through system to deliver a stable concentration of test chemical over a 14-day uptake phase. Water and mussel samples were collected at time intervals during the 14-day uptake phase, and again following transfer of the mussels into clean flowing seawater during the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation of teflubenzuron also limited bioaccumulation, whereas other mussels in brackish waters show different bioaccumulation dynamics. So far, our results have shown a clear uptake of teflubenzuron over 14 days, reaching maximum concentrations (~1500 ng/g) after 10 days. Depuration of teflubenzuron was fast for the first 2 days, although still present at approximately 250 ng/g after 7 days depuration. Salinity had no apparent effect on the bioaccumulation of teflubenzuron. In contrast, deltamethrin showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.

470 Contribution of nuclear applications to better understand bioaccumulation of contaminants in aquaculture species
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Environmental pollution from aquaculture is often seen as a major concern, but today, increasingly is the potential exposure of aquaculture to contaminants. In order to fully understand the contamination risk of farm-raised species, nuclear applications can be used. This is a very powerful approach that allows identifying the susceptibility of economically important species (fish and seafood) to be contaminated. Marine fish farming is regarded as the future of aquaculture and thus, the safety of these farm-raised fish is paramount particularly as 50 % of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current aquafarming practices is essential. Such work will attempt to better understand the role the fish feed or key environmental parameters on contamination of fish that may affect the health of the farmed species and/or the human consumer. This has been commonly done in a natural setting but is now beginning to be examined for fish farming practices. Major advantages of radiotracer techniques over conventional techniques are their very high sensitivity and discrimination capacity: it permits the measurement of bioaccumulation kinetics of several elements at realistic (viz. low) environmental concentrations in a single experiment. Furthermore, some radiotracer permits the non-destructive analyses of contaminant levels in living organisms. This paper identifies present and future threats on farm-raised fish from a contamination point of view, and presents a synthesis of experimental results completed on farm-raised fish raised species, nuclear techniques in aquaculture and delivering a technology assessment frameworks for the European aquaculture sector to investigate the scope of fish farming activity, social interactions, potential environmental impacts and any future risks.

471 Effects of antibiotic’s medicated fish feed in the marine environment B. Gonzalez-Gaya, IMDEA Water (GR4912732) / Environmental Chemistry; N. Garcia Bueno, I. Gomez, B. Martinez-Lopez, P. Franco, University of Murcia / Ecology and Hydrology; E. Buelow, Limoges University / Medicine Faculty, Inserm UMR 1092; A. Marin, University of Murcia / Ecology and Hydrology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics used in aquaculture have been reported to accumulate on sediments and non target aquatic organisms, modifying the biodiversity and the environmental conditions in areas close to fish farms. Moreover, recent studies have shown that long-term use of these resistant genes in environmental bacteria next to fish farms, which indicates the assembly, selection and dissemination of antimicrobial resistance through open aquaculture installations and might thereby compromise environmental and human health. A field experiment was performed in a moderately impacted bay in the south east coast of Spain (Aguilas, Murcia), which consisted of a series of sediment traps covered with a net vs. uncovered and ripped through with local fish feed. Different accumulation rates were found in covered/uncovered traps due to wild fish influences in the availability of feed and bioturbation. Physico-chemical characteristics of the sediment also changed; with a higher S and lower N content and a larger percentage of fine material in feed affected treatments. Invertebrate
presence was also correlated with the food availability, although no evident effects of the antibiotics were found over the analyzed samples. Bioaccumulation of the target antibiotics in the invertebrate community and evaluation of the antibiotic impacts over the microbiome and resistome of the sediment bacteria is still ongoing. This is one of the first studies describing fish feed and antibiotic impacts produced by aquaculture under Mediterranean conditions.

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

### 472 Systems toxicology approach for the assessment of zebrafish cardiac and neurotoxicity


A major goal in the field of toxicology is to predict long term animal health risks and/or environmental hazards associated with a particular substance(s).

Traditionally utilised classical toxicology methods involve animal exposure over a relatively short period and recording adverse outcomes. These data are then extrapolated to human effects and to other species. The accuracy of such extrapolation would benefit from mechanistic understanding of toxicity. However, molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present our systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to 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, citolopram, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236). We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the network model in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.

### 473 Time response relationship between gene expression and life history in a Daphnia population exposed to heavy metals

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

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

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Microorganisms (e.g. bacteria, fungi and algae) are involved in various ecosystem functions such as biogeochemical cycles or pollutants degradation meaning that they are crucial for ecosystem functioning. In the environment, organisms are exposed to anthropogenic pressures which are known to potentially induce structural and functional changes. If such causal links are identified, little is known about the involved biochemical pathways supporting specific functions. Moreover, most of the prior ecological risk assessment (ERA) tools are based on structural endpoints and do not necessarily ensure the protection of these functions. The recent rise of OMICS approaches (e.g. transcriptomics and metabolomics) opens the perspective in ecotoxicology to explore pathways involved in ecological functions. The main aim of this study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICS approaches) of microalgae. We present a functional response model named the Ecottoxnet that 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 vasculatus 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 (transcripts/metabolites) and generated a network for each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. 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 metalloenzymes and endocrine disruptors

E. Caamaño-Gutiérrez, University of Liverpool / Computational Biology Facility; F. Alliche, University of Liverpool / Institute of Integrative Biology; L. Rahai, The University of Birmingham / School of Biosciences; K. Gruntzalis, The University of Birmingham; M.R. Viant, University of Birmingham / School of Biosciences; F. Falciani, University of Liverpool / Institute of Integrative Biology

The assessment of environmental exposure to toxic chemicals released by human activity as well as their impact on biological systems is key to protect the biosphere. Current ecotoxicological approaches are based on chemical data and do not necessarily ensure the protection of these functions. 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 vasculatus 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 (transcripts/metabolites) and generated a network for each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. 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.

**Overall, our work shows that it is possible to predict a compound MoA from its resulting MOA profiles.**
molecular state and also predict additive or synergistic effects of mixture exposure.

476 Data-driven systems biology approach gives insight into a complex process of water remediation
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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. Waterwetorica 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 (stickyback liver gene expression), physiological parameters and more traditional measures of toxicity. We first integrated all different measurements into static similarity networks and modularised these so that in each module, genes are responding in a similar way during different stages of remediation. We see that some chemicals with high chemical risk (alidcarb, chlorpyrifos, fluoranthene, pirimiphyl methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in only one sex of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCB 5 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 trichlosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450“. However, we found a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation“; „type I diabetes mellitus“ and „cytokine-cytokine receptor interaction“). Conclusion. We have shown the potential of data-driven systems biology approach integrating various types of data to give insight into the effects of a complex remediation system.

477 Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology.
D. Devolié de postiche, IRSE / UR RIVERLY Laboratoire Ecotoxicologie; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, IRSEA Lyon / UR MALY Laboratoire Ecotoxicologie; J. Trapp, IRSEA Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, IRSEA / UR MALY Laboratoire Ecotoxicologie; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics During mining of biotechnology databases on 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 Gammarus fossarum to identify biological modules, which were 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

478 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 expert-fed – in which scientists respond directly to real, unedited questions from the public – breaks through polarised and difficult debates because conversation is led by the questions and issues people raise. It allows researchers to identify gaps and misunderstandings in the public debate and to respond to them. With this approach, rather than fighting the public resistance against new technologies, researchers can work in an alliance with citizens to fight misinformation and improve the public debates.

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

480 How to communicate the risks posed by endocrine disrupting chemicals? (I)
J. Legler, Utrecht University / Institute for Environmental Studies

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on 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 as well as the regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

481 How to communicate the risks posed by endocrine disrupting chemicals? (II)
M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

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

482 Discussion Endocrine Disrupting Chemicals
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. ‘aThis 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

487 The impact of chemical pollution on the resilience of soils under multiple stress exposures: integrating chemical effects with environmental drivers (III)

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturase and elongase transcriptome: The freshwater fish M. Fadhlaoui, INRS - Eau, Terre et Environnement / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Couture, INRS / Centre Eau Terre Environnement

In this project, two freshwater fish commonly found in areas affected by metal contamination were acclimated to different temperatures (9 and 28°C for yellow perch (Perca flavescens) and 15, 25 and 30°C for fathead minnow (Pimephales promelas)) and exposed either to Cd or Ni during 8 weeks. At the end of exposures, we measured cell membrane phospholipid fatty acid composition, the activities of superoxide dismutase, catalase, glutathione-S-transferase, glutathione peroxidase (enzyme indicators of antioxidant capacities), the concentrations of glutathione (antioxidant) and malondialdehyde (indicator of lipid peroxidation (LPO)) as well as the transcription levels of desaturases (fas2, desg2, scd2) and elongases (elov5, elov15, elov16). Both yellow perch and fathead minnows counteracted the effects of changes in acclimation temperature on cell membrane properties by remodelling their phospholipid fatty acid composition. Specifically, in the muscle of both species, polyunsaturated fatty acids increased in cold-acclimated fish compared to warm-acclimated fish, in agreement with the theory of homeoviscous adaptation. However, the brain cell membrane composition was more conservative, especially in fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than saturated fatty acids and metal contamination leads to oxidative stress. We therefore tested the hypothesis that temperature-induced changes in cell membrane polyunsaturation are accompanied by variations in LPO in metal-exposed fish. Unexpectedly, in both species, metal exposure itself affected membrane fatty acid composition. In yellow perch, the normal response of cell membrane composition to thermal acclimation was reversed by exposure to both metals. Yet, in spite of the high polyunsaturation level in warm-acclimated fish under Ni exposure, MDA concentration was the lowest, suggesting a massive response of the antioxidant system to fight against LPO. In fathead minnow, metal exposure also affected the membrane fatty acid composition of both tissues, but - in contrast to yellow perch. We observed a mismatch between desaturase and elongase gene transcription and membrane composition. Overall, our results suggest that levels of control of cell membrane fatty acid composition other than gene transcription can 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. Voit, RWTH Aachen University / Department of Ecosystem Analysis; S. Vogt, RWTH Aachen University / Biological Sciences; H. Hollett, 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 Muenchen / Research Unit Environmental Genomics; S. Schulz, Helmholtz Zentrum Muenchen; T. Streck, University of Hohenheim; M. Rob-Nickoll, RWTH Aachen University / Institute for Environmental Research

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 odors were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on Cd-induced olfactory impairment, fish were exposed to the EOG-based 24-h IC50 of Cd (210 µg/L) in reconstituted water with varying hardness, pH, and dissolved organic carbon (DOC) concentrations for 24 h. Cd inhibited the EOG response of rainbow trout in a concentration dependent manner. Fish exposed to 210 µg/L Cd for 24 h showed reduced olfactory response to TCA by 50%. Changes in water chemistry had a significant impact on Cd-induced olfactory impairment. Decreasing water hardness from 130 to 40 mg/L as CaCO3 increased the inhibitory effect of Cd on the EOG response from 55% to more than 95%, respectively. Hence, hardness 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 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.
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 oxidative impairment. In order to enable the prediction of site-specific oxicatory toxicity, the development of a BLM parameterized to the oxicatory system of fish would be very beneficial. However, more data on the effect of water chemistry on metal-induced oxidative 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. Pires, Universidade de Aveiro / Biologia; R. Freitas, University of Aveiro / Department of Biologia 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 distribution. We tested the effects of multiple stressors (salinity and temperature) on the functional ability of a benthic community, mainly on those organisms living in sediments, such as polychaetes, which also support much of the diversity at higher trophic levels. So, this work examines the interactions of elements contamination and change in salinity and polychaetes performance, highlighting modifications that coastal systems may undergo due to alterations driven by salinity change. Polychaetes were exposed to sediments contaminated with metals from the Aveiro lagoon, Portugal) and salinities 21, 28 and 40, for 28 days. This study aimed to evaluate physiological (regenerative capacity of Diopatra neapolitana), behaviour (burrowing tests with Hediste diversicolor and Arenicola marina) and biochemical responses: indicators of cell damage (LPO: antioxidant (SOD and CAT), and biotransformation (GSTs) enzymes. After exposure, both types of sediments had lower total elements concentration (TEC), when compared to original sediments, mainly in sediments with A. marina and H. diversicolor. Sediments exposed to salinity 40, mainly those containing H. diversicolor had even less TEC than remaining sediments, which seems that salinity changes may influence elements availability. LPO levels were higher at salinity 40 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. neapolitana. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently efficient to fight against the excess of ROS, leading to LPO. Furthermore, in H. diversicolor, the burrowing behaviour was impaired in polychaetes in fine sand sediments and salinity 40. For A. marina exposure to median sand sediment for all salinities and to fine sand for salinities 21 and 40 led to a decrease in bioturbation capacity in marine neapolitana individuals exposed at salinities 21 and 40, for both sediments, exhibited lower capacity to regenerate their body when compared to salinity 28 (control). Overall, this study demonstrates that variations in salinity can strongly affect elements availability. Interaction of both variables impacted polychaetes responses differently.

491 Do trace metal contamination and parasitism infestation influence the activity of the bioturbator Upogebia pusilla?

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

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

R. 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 stressors to evaluate and plan 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 effect research. Moving beyond an ad-hoc approach requires multiple stressor research to shift its focus from identifying statistically significant interactions to the use and development of mechanistic (null) models. We discuss how ecotoxicological and ecological concepts will aid in achieving this.

Improving the Quality of Ecotoxicological Testing and Assessment

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

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The Organisation for Economic Cooperation and Development (OECD) Guidance Document (GD) on Aquatic Toxicity Testing of Difficult Substances and Mixtures (GD 23) was first published in 2000 and provides crucial guidance that supplements OECD Test Guidelines. Since its release much experience has been gained in handling difficult-to-test chemicals in aquatic exposures as well as progress made in developing methods for testing difficult test chemicals. The GD was revised as recently as 2016 to include state-of-the-science approaches. We provide an overview of the updated GD 23. One significant revision was the expansion of the guidance on testing of poorly water soluble test chemicals. Attention was paid to updating exposure methods that do not employ a solvent in order to eliminate the need for a solvent control, and thus, reducing the number of animals used in aquatic toxicity tests. Another major revision was the addition of more detailed guidance for substances of unknown or variable composition, complex reaction products, and biological materials (UVCBs). The presentation also briefly describes other aspects of the updated GD of interest to those involved in aquatic toxicity testing. The updated GD 23 will help government agencies, industry, and contract research organisations conduct valid and reliable aquatic toxicity studies on difficult test chemicals while minimising both the number of animals used and the need to repeat studies. The views, conclusions and recommendations presented in this presentation are those of the authors and do not necessarily represent the policies or positions of the United States Food and Drug Administration, the PETA International Science Consortium Ltd., the International Council on Animal Protection in OECD programmes, the European Commission or the OECD.

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

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In developing methods for testing difficult test chemicals, the 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 test chemicals while minimising both the number of animals used and the need to repeat studies. The views, conclusions and recommendations presented 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.
outcome with other taxa were observed, these were considered jointly. As expected Tier 1 studies had the most sensitive endpoint and consequently the largest HQ. Using the recovery endpoint, it was found that for the off-field HQ’s of 1, 6 and 250 delimited recovery ranges of 0 weeks (no effects), 4 weeks and 8 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 2-6, 6-12 and 12-24 months were delimited by HQ values of 40, 375, 620 and 2500. Tier-2 studies had trouble with both sub lethal 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; BEAS SE / Experimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology
The Medaka Extended One Generation Reproduction Test (MEOGRT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The 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 relevant effects of a test chemical are detectable. Validity criteria assist regulators in determining study quality and reliability; studies that do not comply may be rejected and/or repeated. Compared to other fish TGs, the quantity of validity criteria in the 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, for the MEOGRT, there are 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 criterion is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a 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
Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pesticide effects includes factors for using and interpreting those data for decision 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) with Tier-2 studies raises the question about the biological 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 seedling emergence 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
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Avian reproduction studies are a regulatory requirement for pesticides in many regions. The data often require careful interpretation due to the nature of the study design and reporting. Here we present a historical control database of 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 programs 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 = µ + ε, where µ is the expected mean response in the Ith concentration, and the ε are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another is what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means, µ. It is possible to determine the size effect that can be estimated or detected from a given dataset and it depends largely on experimental design and response variability. Statistical models used for hypothesis testing or regression estimates have data requirements. Model assessment tools are well established and should be used in fitting models to ecological data. Ignoring these tools or model requirements can lead to poorly estimated effects and misleading results. Understanding these concepts enables the statistician 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
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Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, therefore, recycling of post-consumer wood waste requires special attention to the determination of chemical composition and quality of the wood waste. 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 incinerate the wood waste 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 Immission Prognosis Air Concentration Tool (IMPACT) of the Flemish government. The LCA scope includes the particleboard industry, relevant upstream and downstream processes of the particleboard industry, and the incineration of wood waste. To integrate RA and LCA results on human health effects the concept of disability-adjusted life years (DALYs) is adequate as a common metric. Results will be presented at the conference.

500 Development of non-conventional LCA indicators for circular characteristics of bio-based products

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This paper is dedicated to the identification of key "un-conventional" indicators that demonstrate the sustainability and circular characteristics of promising bio-based products, complementing conventional life cycle analysis. Some of the new LCA complementary indicators proposed as a part of this study emphasise on resource efficiency and material circularity of bio-based value chain and include (but are 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, that is not limited to the usage stage of the product, via use of holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

501 Toward a more sustainable biochemical industry - Early stage assessments and methodological overlaps between life cycle- and techno-economic assessments of biochemicals

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Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are challenges that need to be overcome in order to reach an overall high sustainability performance. While in some cases biochemicals have lower global warming impacts compared to fossil-based chemicals, other impacts may become higher, like eutrophication. One of the major sources of environmental impacts of biochemicals is the growing of biomass, which in most cases today is corn. This has led to investment in assessing opportunities of using side streams, like leftover agricultural lignocellulose, or other lignocellulose-based biomass like algae. Macro-algae is one such potential source that given they grow without being farmed, while simultaneously being an important sink for CO2. The objective of this study is to identify trade-offs between assessed environmental impacts and possible burden shifting between macro-algae compared to more conventional feedstocks like maize and lignocellulose. While it is imperative that any change in process configuration reflects in Techno-Economic assessment (TEA) and LCA, there are very few studies which couples these two assessment demonstrating the trade-offs for improved decision support. The focus of this contribution is to explore methodological overlap between the two assessments and develop a framework, supported by a proof-of-concept. When contrasting current results from the TEA and LCA cradle-to-gate study, some interesting trends were observed. The TEA show that idos biggest hot spots are identified as feedstock cost which is a function of growing, transportation of biomass and if drying is taking place at the refinery site or closer to the harvesting sites of the feedstock. Whereas, the LCA shows the biggest environmental hot spots occur in relations to growing of biomass. It requires external application of nutrients and intensity of chemical pretreatment. Today decisions on bio-based 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

D. Zanella, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; V. Rossi, Quantis; J. Golazowski, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; A. Ernstoff, F. Sessa, V. Rossi, Quantis

A risk evaluation approach for indirect land use change associated to biobased products also has insufficiencies, mainly the limitations in addressing the impacts compared to fossil fuel 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, that is not limited to the usage stage of the product, via use of holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

503 How to find sustainable applications for new materials and how to overcome the relativity of LCA

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The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to identify the most sustainable application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended to support the early stage of material development. Here, we present an expanded and further developed MPAS method that mitigates exactly these limitations meaning that the environmental assessment can be performed without a comparison case and also without the necessity of a lot of data. The development and expansions of the MPAS method are applied to each of its three steps. However, the main development of the method is made to Step 3, the environmental evaluation of the material. Our solution here uses a highly flexible set of criteria that are specifically adapted to the various cases and that are mainly LCA based. This means that the environmental score can now be obtained regardless of the ability to estimate the production data of the material and of the knowledge about the exact properties of the end-product. This evaluation can be applied absolutely or relatively/comparatively. Furthermore, the criteria are expanded with other criteria that go beyond only LCA relevant aspects and also include aspects like circular economy. The method is illustrated with a case study on nanoporous carbonaceous material. As a result, the most sustainable applications for this nanoporous carbonaceous material are identified and used to set parameters to be achieved for
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing the required amount of LCA data. This makes the method universally applicable.

### 504 Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecocivilizations

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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, ecocivilization and circular economy. The assessment framework is composed of two sets of consumption-based indicators: the Consumption footprint and the Consumer footprint. The Consumption footprint assesses the potential environmental impact of apparent consumption, focusing on a territorial scale and accounting for trade, assigning the impact to the country where the final consumer is located. The Consumer footprint assesses the potential environmental impact of consumption, based on the results of life cycle assessment (LCA) of representative products purchased and used in one year by an EU citizen. The Consumer footprint allows assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/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 BoP with the highest contamination, a scenario with modified contamination has been developed for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, by acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to envisage 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

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The Elbe river has one of the largest catchment areas in Europe (150 000 km²) of which two thirds lie in Germany. While it was once considered to be among the most polluted rivers in the world, 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 the long time to sediments in those ca. 1000 backwaters and flood plain lakes along the Elbe with regard to their contamination, their ecotoxicity and their mobility in times of high water discharges and flood plain submergence. Two studies, carried out in 2013 and 2014, were dedicated to this kind of structures with the task of evaluating a potential risk from these sites. Over a stretch of 230 km along the Middle Elbe, sediments from 25 backwaters were sampled, 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 13C analyses facilitated interpretation of the results. Samples were ecotoxicologically tested for inhibitory effects in the bacterial sediment contact test (Arthrobacter globiformis), the luminescence bacteria test (Allivibrio fischeri) with elutriates and methanol extracts and the algae growth inhibition test (Raphidocelis subcapitata) with elutriates. The studies showed that - more than 75 % of all sampled sites were contaminated with heavy metals and organics well beyond the threshold values of the Elbe River Commission. - ecotoxicological effects provided a distinct line of evidence and could not be simply related to analyzed contaminant concentrations. - when integrating chemical, ecotoxicological and erosion stability data into a weight of evidence approach, high risks could be identified for 50 % of the sampled sites in 2013. - dating of sediment cores from 2014 pointed towards a strong impact of the 4 extreme flood events between 2002 and 2013 on the erosion of highly contaminated sediments from backwaters into the Elbe river.

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

M. Schaaning, H. Tramnu, K. Ndhung, S. Othnæs, NIVA, Norwegian Institute for Water Research

Analysis of this mine deposits up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposits and reference sites were sampled for studies of macrobenthic communities, biogeochemical fluxes, metal mobilization and metal uptake in gastropods and DGT probes. O2 and pH in the sediments were measured using micro-electrodes. The tailings were easily traced in the sediments by high concentrations of fine fractions, Fe, Ni, Cu and Co. Tailings were still abundant in the top 0-1 cm of the sediments at both deposit sites, but clearly less abundant at the sediment surface than in deep deposit layers and also less in the outer basin deposit than in the fjord deposit. Compared to Norwegian and European quality standards [1], Cu exceeded MAC-EQS (“Maximum Admissible Concentration”) for coastal sediments indicating a “risk of acute toxic effect” on marine organisms. The DGT-profiles showed that Fe and Mn was recycled within the sediments, whereas Ni and Cu leaked to the overlying water from mobilization centers consistently located in the outer basin deposit and also less in the outer basin deposit than in the fjord deposit. All samples contained contaminants (HCH, HCB, PCB, PAHs, DDX) with elutriates. The bacterial sediment contact test (Allivibrio fischeri) with elutriates. The algae growth inhibition test (Raphidocelis subcapitata) with elutriates. The results showed that in addition to depth, fine fractions (< 63 µm) and Cu were the only significant environmental parameters explaining the variance in the benthic community data. We conclude that both the current discharge to the water column and the leaching of Cu and Ni from the sea deposits are likely to contribute to the moderate reduction of benthic biodiversity at the old deposit sites. [1] Guideline M-608, 2016. Norwegian Environmental Agency. 24 pp.

### 507 In situ metal fluxes for the assessment of metal bioavailability in sediments


Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS) and non-extracted metal (NEM) was used to evaluate and predict metal bioavailability in sediments. 1 When concentrations of bioavailable contaminants are determined to exceed sediment quality guideline levels, bioassays are usually performed to evaluate toxicity effects resulting from contaminant exposure. Although the chemical analyses used for bioavailability assessment have been shown to be useful for predicting metal toxicity in sediments, the predictions for metals oxidized surface sediments can be quite poor, frequently owing to a lack of an adequate range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffusive gradients in thin films (DGT) technique for predicting metal bioavailability in sediments. 2 The DGT device uses an ion-exchange resin (Chelax) which selectively accumulates divalent metal present in the sediment porewater and weakly-bound to the sediment particulate phase. 3 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 fluxes measured at the SWI (DGT) and adverse effects to reproduction and survival of the amphipod exposed to laboratory conditions. Useful predictions of bioaccumulation were obtained for both marine and freshwater bivalves in laboratory and field set-ups. Differences in bioaccumulation between organisms exposed to identical sediments in laboratory and field set-ups highlighted the importance of including in sediment quality assessments lines of evidence on in situ evaluations of metal bioavailability.

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

SETAC Europe 28th Annual Meeting Abstract Book
Sediment toxicity testing among other ecotoxicologic tests is currently reviewed under the premise to improve quality and consistency of regulatory environmental assessment. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on the use of sediment microorganisms where a water-spiked test system (OECD 219) is considered to study chronic effects on sediment organisms. Prominent test organisms are Chironomids, aquatic invertebrates which live in and on soft sediments. Due to the design of this study initially large gradients between the exposure in the overlying water and in the sediment layer are established. As a consequence, substantial temporal and spatial dynamics of local concentrations have to be expected, especially in the vicinity of the interface between water and sediment where the Chironomids are supposed to stay. To describe local concentrations in such water-sediment test systems we simulated the transport and the redistribution of two moderately mobile (KOC 200 to 300) plant protection products with the mechanistic model TOXSWA. The results of this study are compared with measured sediment concentrations in three different experimental studies.

Wastewater effluents: How research can improve risk assessment and regulation

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

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In the EFSA scientific opinion on sediments, one of the oligochaete worms Lumbriculus spp. or Tubifex tubifex, supplemented with a second standard species test system, which is Chironomus riparius or the amphipod Hyalalella azteca, are proposed as Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fludioxonil-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa measured. In a previous performed spiked-sediment outdoor microcosm experiment with fludioxonil the most sensitive sediment-dwelling organism was the oligochaete Dero digitata. The test systems used were 1.5L glass vessels containing approximately 2 cm sediment and 1 L aerated spring water. Tests were considered valid if control mortality did not exceed 20% or, in the case of the larvae of the midge C. riparius, if more than 70% emergence had occurred. Fludioxonil concentrations were measured at the start and end of the testing. Endpoints for both worms comprised survival and weight of the animals, including yield and growth rate. For Hyalalella both survival, weight and length were assessed, while for Chironomus and Eimeria total survival was monitored. All tests met the validity criteria of less than 20 percent control mortality or more than 70 percent emergence, with the exception of the C. riparius test on artificial sediment. Overall, tests with field-collected sediment gave better results. With C. riparius, apparent growth of the animals was better here, allowing for a better expression of effects. Sometimes a factor of 10 difference between the estimated 28EC50 value and its upper or lower confidence limit was present, indicating a high associated uncertainty. The confidence intervals were considerably smaller in corresponding 28-d EC50 values, indicating that these are more reliable. For C. riparius testing the most sensitive organism was an oligochaete. In general, biomass reacted more sensitive than length and survival endpoints. Using either field-collected or artificial sediment data to derive a Tier-1 RAC for C. riparius seems to be sufficiently conservative when compared to the outdoor microcosm response.

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

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Sediment toxicity testing among other ecotoxicologic tests is currently reviewed under the premise to improve quality and consistency of regulatory environmental assessment. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on the use of sediment microorganisms where a water-spiked test system (OECD 219) is considered to study chronic effects on sediment organisms. Prominent test organisms are Chironomids, aquatic invertebrates which live in and on soft sediments. Due to the design of this study initially large gradients between the exposure in the overlying water and in the sediment layer are established. As a consequence, substantial temporal and spatial dynamics of local concentrations have to be expected, especially in the vicinity of the interface between water and sediment where the Chironomids are supposed to stay. To describe local concentrations in such water-sediment test systems we simulated the transport and the redistribution of two moderately mobile (KOC 200 to 300) plant protection products with the mechanistic model TOXSWA. The results of this simulation are compared with measured sediment concentrations in three different experimental studies.

Active Pharmaceutical Ingredients Entering the Aquatic Environment From...
513 Impact of a wastewater treatment plant upgrade on amphipods and other macroinvertebrates: individual and community responses

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Conventional wastewater treatment plants (WWTPs) equipped with secondary and tertiary treatment steps do not or only partially remove micropollutants which makes them important point sources for the release of these substances in the water body. Micropollutants can cause short- or long-term adverse effects in aquatic organisms even at low concentration levels. One possibility to reduce the input of micropollutants into the water cycle is the upgrading of WWTPs with an additional post-treatment stage of, e.g., ozonation or biological treatments. The present work is part of the joint research BMBF project “SchussenAktiv plus” funded by the German Federal Ministry of Education and Research (BMBF) and the Ministry of Environment, Baden-Württemberg, Germany. In this project, the efficiency of an additional wastewater treatment based on powdered activated carbon for the ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany, has been investigated. Our part of the project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTP, as well as before and after the upgrading of the WWTP. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hs70) levels and lipoperoxides allowed us to draw conclusions about prototoxicity and oxidative stress in gammarids. Macrozoobenthos community integrity was determined by means of the saprobic index as well as by the number of sensitive taxa (EPT index). Prior to the WWTP upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTP effluent. After the upgrading of the WWTP, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTP with respect to the investigated health parameters. Furthermore, the overall number of taxa and particularly the number of EPT taxa within the macrozoobenthos community downstream of the WWTP increased distinctly after the upgrade of the WWTP with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and energetically varying substances from the effluent can plausibly be related to the improved integrity of macroinvertebrate health and community structure in the connected river Schussen.

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

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The work was carried out by molecular biology techniques. The results highlight a necessity to determine if D. polymorpha is able to live in good health in the multi-contaminated conditions in WWTP effluent and D. polymorpha is able under these conditions, to bioaccumulate protozoa. For this purpose, two experiments were performed: 1) Zebra mussels were caged in the WWTP’s outlet channel (Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutase, Catalase, Glutatione S-Transferase and Glutatione Peroxidase) at biochemical and molecular levels. The results suggest that D. polymorpha can maintain itself in effluent for 21 days. 2) D. polymorpha was exposed to different concentrations of protozoa (100, 1000 and 10000 protozoa per bivalve per day) for 21 days followed by 21 days of depuration in laboratory conditions. Detection of oocysts and cysts in tissues and heamolymph of bivalves was carried out by molecular biology techniques. The results highlight a time-dependent and dose-dependent bioaccumulation of protozoa by D. polymorpha. Moreover, the parasite load remains stable during the 21 days of depuration. Suggesting that the zebra mussel could be used as an indicator of biological contamination Considering these results, Dreissena polymorpha seems to be a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

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

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Aquatícal environments are subject to discharges of multiple contaminants (chemical and biological compounds). Wastewater treatment plants (WWTPs) are ineffective to remove environmental forms of protozoa such as Toxoplasma gondii and Cryptosporidium parvum oocysts or Giardia duodenalis cysts because of their removal in treatment plants. The aim with this study was to evaluate the removal of pharmaceuticals in WWTP effluents during ozonation and the environmental impact of these are largely unknown. The aim is to investigate the environmental impact of this effluent on the receiving river. All treated effluent from a minor WWTP (10000 PE) were treated by an addition of 8 mg h⁻¹ ozone during 6 months. Removal rates in the WWTP as well as levels of pharmaceuticals in the receiving river (both in water and biota) were monitored. Surface water data from 10 sampling sites. Several additional methods to evaluate the impact of ozonation was used including impact on microbial community composition, presence of antibiotic resistance genes as well as studies to detect endocrine, reproductive and behavioral effects in fish and its progeny.

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

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Reservoirs are aquatic environments that are impacted by anthropogenic activities. The main activities around reservoirs in Brazil are agriculture and settlement. Agriculture and increase of nutrients can result in cyanobacterial blooms and cyanotoxins contamination; and settlements can result in inputs of several contaminants such as pharmaceuticals. Iraí Reservoir, located in South of Brazil, is
used to water supply and has been reported as contaminated by cyanoxins and pharmaceuticals. Therefore, this contamination increases costs to the water treatment and can cause toxic effects to the aquatic organisms and human health. The aim of this study was to test 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 a concentration of paraquat, di- 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 di-locafen and 100% for microcystin-LR. Our results showed that the plants antioxidant system was not activated and the Green Liver System was a suitable methodology to clean the water and to implement in phytoremediation programs. Keywords: Green Liver System, Reservoir, aquatic macrophytes, phytoremediation.

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

518 Urban and rural antibiotic resistance
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Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resistome, debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for this rapid emergence continues to be debated. It is known that soil pollution is inherently linked to co-selection for ARGs yet limited information exists on large scale, multi-contaminated sites. This study tested 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 PAsHs, and nutrient conditions to understand the evolution and dissemination of modern antibiotic resistance due to pollution.

519 Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents
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The occurrence and dissemination of antibiotic resistant bacteria and their resistance genes from clinical settings to environmental compartment have become a major concern because of serious threat human health worldwide. Given the serious clinical threat of Extended-spectrum β-lactamases (ESBL) and carbapenem-resistant Enterobacteriaceae (CRE), studies are available in many countries from clinical settings. However, there is the dearth of studies in environmental compartments for the presence of these high threat gram-negative bacteria. This situation is particularly alarming in developing countries in which the freshwater resources receive urban and hospital effluent water without previous treatment. Additionally, during the occurrence of the contamination of ESBL and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Republic Democratic of the Congo. 147 E. coli strains resistant to 3rd generation of β-lactams (ESBL) were isolated from water samples isolated along 5 rivers receiving hospital effluents. They were analysed for their clonality and the co-occurrence of multidrug resistance and virulence genes. The results highlight a high level of clonal diversity 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 gene, and LT1 are often present for the same strains and not only linked to untreated hospital wastewater discharge in urban receiving system and are widely distributed along the river, thus highlighting the risk of surface water use.

520 Methods for determining selective endpoints of antimicrobials
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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 determine appropriate 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 single published method for selective endpoint determination is always protective of the other; though there is good agreement between PNEC’s (PNECs for resistance) published previously and PNEC’s determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNEC’s for environmental risk assessment of antimicrobials.

521 Determining the minimal selective concentrations of macrolides in a complex microbial community
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Antibiotic resistant bacteria have been found throughout hospital environments and in rural and urban areas. Continuous release of antibiotics from human activity can and does lead to measurable concentrations in surface waters (ng/L - μg/L), however these are lower than minimum inhibitory concentrations (MICs) and concentrations used in the clinic. Due to these relatively low concentrations, until recently it was thought that selection for resistant bacteria did not occur within the environment. Research published in 2011 and 2014 by Gunther et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotics, azithromycin, clarithromycin and erythromycin, were added to the European Commission’s Water Framework Directive’s priority substances
watchlist in 2015 due to their measured environmental concentrations (MECs) and predicted environmental concentrations (PECs) being higher than their predicted no effect concentrations (PNECs). The aims of this study were to investigate the selective potential of these three compounds in a complex microbial community and to determine minimal selective concentrations (MSCs) for each. A number of week-long evolution experiments were conducted at a range of macrolide concentrations. QPCR determined the presence of a variety of macrolide resistance genes (ermF, lnuA, mwaA, msdE and mef [family]) and mlll 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 ermmF 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 mg kg soil⁻¹, and plots have been continuously cropped to soybeans. A library of large cloned fragments was constructed using DNA sampled in 2014 from plots receiving the highest application rates, or no antibiotics. The library was cloned into antibiotic-sensitive Escherichia coli, and antibiotic resistance genes (ARGs) in the library were discovered by identifying E. coli clones that grew upon plating on solid growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrases and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. intI1, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

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

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

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Microplastics (MP) are defined as plastic pieces smaller < 5mm are commonly found in the marine environment and originate either consumer care products and plastic production plants or from the disintegration of larger pieces. MPs need to be monitored in order to evaluate the effectiveness of Government initiatives to reduce plastic debris in the environment. The aim of the present study, therefore, was to contribute to the development of a hitherto lacking quantitative long-term marine MP database. We present the results of a three-year pilot project in the Firth of Forth, point to innovations in sampling and 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 MP particles. There was no apparent pattern of spatial distribution. Although a spike in MP particle abundance in May2015 and May2016, there was no significant difference in MP particle concentrations between May 2014 and May 2017. There was also no significant difference in MP fibre concentrations during the same three-year period. There was also no evidence of seasonal fluctuations in MP concentrations. The results show that, for intertidal sediments in the Firth of Forth, the MP concentration has remained stable. This is significant baseline information and will be instrumental in assessing the effectiveness of Government policy regulating industry and consumer behaviour towards the production and use of particularly single-use plastic products. However, in order to compare results between countries and laboratories, for the purpose of gaining a more global insight into the micropollution contamination issue, more standardized sampling and extraction procedures need to be developed.

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

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Nanoparticles are constantly used at world level leading to their presence in the aquatic environment to lead possible particle interaction with living organisms. The potential impacts of these particles on microalgae was observed in 2014 from plots receiving the highest antibiotic application rates, or no antibiotics. The library was cloned into antibiotic-sensitive Escherichia coli, and antibiotic resistance genes (ARGs) in the library were discovered by identifying E. coli clones that grew upon plating on solid growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrases and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. intI1, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

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

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Nowadays, nanomaterials are extensively used worldwide in many different fields and their potentially serious effects in aquatic ecosystems have become a global concern [1]. Poly(aminodioamide) (PAMAM) dendrimers are polymer nanoparticles, radially symmetric, monodisperse structures that have a typically symmetric core, an inner shell, and an outer shell. Due to these characteristics, their use is being tested in the implementation of targeted therapies in biomedicine so that they might end up in environment [2]. In this study, we have investigated the effect of high-generation cationic G5-NH2 and G7-NH2 PAMAM dendrimers in a prokraticary primary producer of aquatic ecosystems, the filamentous cyanobacterium Anabaena sp. PCC7120 (Anabaena). Dendrimers significantly decreased the growth of the cyanobacterium and both dendrimers induced morphological alterations of both filaments and individual cells. Furthermore, cyanobacteria exposure to dendrimers resulted in significant alteration of physiological parameters: increase in the formation of intracellular reactive oxygen species, damage in membrane integrity, membrane potential depolarization, increase in secretion of intracellular Ca²⁺, and alteration of intracellular pH and alteration of intracellular free Ca²⁺ homeostasis. Dendrimers also induced alterations in the photosynthetic responses of Anabaena. In conclusion, high-generation cationic dendrimers exhibited high toxicity towards

526 Interactive effects of carbon nanoparticles and benzo(a)pyrene on marine mussels, Mytilus galloprovincialis
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The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns over their potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) can interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels were exposed for 3 days to benzo(a)pyrene (BaP) of two different types of carbon nanoparticles, [CdS fullerene and multi-walled carbon nanotubes (MWNNTs)], both alone and in combination with BaP. Tissue specific distributions and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GCMS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology targeting 15 stress response pathways. Contrasting results were obtained as G. Granovskaia, University of Lorraine / LIEC, CNRS; S. Devin, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; M. Auffan, CEREGE / International Consortium for the Environmental Implications of Nanotechnology; C. Mouneyrac, Université Catholique de l'Ouest / UBL, Mer Molécules Santé; L. Giambertini, Université de Lorraine / CNRS, CNRS. Engineered nanoparticles (ENPs) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic marine amphipod Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 μg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea behavior by increasing burrowing, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

527 Transgenic fish 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, Roskilde University / Dept Science and Environment, where they will set out and accumulate in the sediment. Therefore benthic fauna is at particular risk of the uptake of carbon nanoparticles and biota. Scientists have 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 (Tubificidae tubifex) and further from worms to fish (Gasterosteus aculeatus). CuO NPs (< 50 nm; Sigma) were characterized with regard to primary particle size, shape, hydrodynamic diameter and dissolution at different experimental conditions using TEM, DLS, PALS and ultrattribution followed by ICP-MS analysis, respectively. Worms were exposed to sediment amended with CuO NPs or CuCl₂. Cu concentrations in sediment,Overlay 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-shape CuO NP and CuCl₂ spiked food packages produced from uncontaminated tubifex homogenates (2 μg Cu/g food/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 the 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 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study
C. P. van der Divo, LIEC - 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, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; M. Auffan, CEREGE / International Consortium for the Environmental Implications of Nanotechnology; C. Mouneyrac, Université Catholique de l'Ouest / UBL, Mer Molécules Santé; L. Giambertini, Université de Lorraine / CNRS, CNRS. Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic marine amphipod Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 μg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea behavior by increasing burrowing, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins
529 Applications of Luminous Bacteria Enzymes in Toxicology and Ecology
V. Kratsavuk, Siberian Federal University / Biophysical; E. Shimbeka, Siberian Federal University / Biophysics
A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to plan, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were 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 metabolite biosensors for preliminary toxicological assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

530 Toxic and adaptive effects via luminescent assay systems of different complexity - from cells trough enzyme reactions to proteins
complexity; bacterial cells, enzyme reactions, and fluorescent proteins
N. Kudryashova, R. Aleva, Institute of Biophysics SB RAS; T.V. Rozhko, Siberian Federal University; A.S. Petrova, Institute of Biophysics SB RAS; A. Lukonina, Siberian Federal University / Biophysics; E. Kovel, Siberian Federal University; A. Sachkova, National Research Tomsk Polytechnic University

Luminescence of living systems is a convenient parameter to monitor environmental toxicity. Luminescent systems of different complexity – luminous microorganisms, wheat, rice, and their chlorophyll-containing fluorescent proteins (CLM-CFPs) were used as biosensors to monitor toxicity of water solutions under model conditions; toxic effects were compared at cellular, biochemical and protein levels, respectively. Organic compounds, metallic salts, and radioactive elements (under conditions of low-dose irradiation) were applied to vary toxicity of media. Luminescence inhibition (toxic) and activation (adaptive response) effects were evaluated and discussed. Application of CLM-CFPs as toxicity biosensors of a new type is justified, they can serve as a proper tool for study efficiency of primary physiochemical processes in organisms under external exposures. Coelenteramide (CLM), fluorophore of CLM-CFPs, is a photochemically active molecule: it acts as a proton donor in its electron-excited states, generating several forms of different fluorescent state energy and, hence, different fluorescent color, from violet to green. Contributions of the forms to the visible fluorescence depend on the CLM microenvironment in proteins. Hence, CLM-CFPs can serve as fluorescence biomarkers with color differentiation to monitor results of destructive biomolecule exposures. Variations of spectral-luminescent and photochemical properties of CLM-CFPs under different exposures – chemicals, temperature (1), and ionizing radiation (2) as parameters depending on the reaction conditions. And different complexity for detoxification efficiency evaluation is discussed. Natural and artificial bioactive compounds, humic substances (3) and fullerolens (4-5), are used as detoxifying agents. Detoxification mechanisms were revealed to be complex, with chemical, biochemical, and cellular aspects conditioning those. Active role of the biosensor systems in the detoxification processes was demonstrated. 1. Alexeva R., Kudryashova N., Fomen, T., 170, 425. 2. Petrova A., et al. AnalBioanal. Chem, 2017. DOI: 10.1007/s00216-017-0404-9 3. Kudryashova N., Tarasova A. Environ. Sci. Pollut. Res., 2015, 22 (1), 155. 4. Kudryashova N., et al. Photochemistry and Photobiology, 2017, 93(2), 536. 5. Sachkova A., et al. Biochemistry and Biophysics Reports. 2017, 9, 1-8

531 Assaying the proxidant and antioxidant potentials of nicotine products: Tobacco versus electronic cigarettes
A. Trofimov, V. Menshov, O. Yablonsky, Emanuel Institute of Biochemical Physics Russian Academy of Sciences

Cytotoxic oxidative stress emerging from imbalance between the production of reactive oxygen species and the efficacy of the antioxidant defense, can be a consequence of using the nicotine products. Prooxidant properties of the tobacco smoke are accounted for by the abundance of the smoke oxidants. The antioxidant potential of the smoke is scantily addressed in the literature. However, one should take into account that any reactant in oxidation process may exhibit both oxidant and antioxidant propensities depending on the reaction conditions. And we have shown that smoke constituents indeed exhibit at the same time both prooxidant and antioxidant activities. Such smoke-born antioxidants may be assessed through both the direct chemiluminescence (CL) derived from the smoke samples as a function of the smoke tar content and using the probe CL prepreations of hydrocarbon substrates being oxidized. In addition to exogenous antioxidants detected from the tobacco, we have studied the oxidant properties of the second generation directly in smokers. For that purpose, we have developed a novel assay based on the CL of lumilin, which involves tobacco-smoke extracts, peroxidase and amino acids. Using such a system, we have demonstrated that under physiological conditions the oxidation of the smoke tar and its individual components, e.g. catechol, in the presence of H2O2, peroxidase, and glycine affords the products (first of all, catechol-glycine adducts) whose antioxidant potential is much higher than that of initial, unoxidized, chemicals. Conversely, we have not observed any significant antioxidant activity of aerosols derived from electronic cigarettes (ECs). For ECs, the following feature is noteworthy. We have found for the first time that all ECs, regardless of their technical complexity, generate in their emissions from dry smoke (0.01%) 100% of gaseous, lipid (100) of prooxidant e-liquids served as solvent for nicotine, which are potential prooxidants (ROS sources), whose physiological significance still requires elucidation. The content of these products depend on the type of EC and on the mode of its use, which makes possible to minimize the ROOH generation. The CL methodology has proved to be the most useful tool in assessing the oxidant and antioxidant potentials of nicotine containing aerosols, i.e. tobacco-smoke and emissions from ECs, which exhibit essentially different impact on oxidative developments in a smoker’s organism.

532 The possibilities of using fungal fluorophores to assess responses of filamentous fungi to external stimuli
E.V. Fedoseeva, Pirogov Russian National Research Medical University / Pediatric faculty; D. Khundzhua, Lomonosov Moscow State University / Department of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in biogeosciences is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogeochemistry is explained by the variety of reactions to environmental factors and their physiological and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamentous 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, Chlamydomonas chlamydomonas, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi Chlamydomonas mediana and agar Crake medium contained a varying level of sucrose (0.3 and %) 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 (under-sampling of how the NPs’ original “engineered” UV-excitation consist of two overlapping bands. The UV-bond 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 chromatophores like NADH and or melanin. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of sparse 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. Kulbakho, Moscow Aviation Institute; P. Uchanov, Institute of Ecology and Evolution RAS / Laboratory for soil ecological functions; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; K. Kyselyaeva, Institute of Chemistry and Chemical Technology and aga Crake Surface characteristics stands out as one of the most important, if not the main, determinants of biological performance, as the nanoparticles (NPs) surface is the most prominent and earliest point of exposure. Complexity of this issue is that the coordination of ligands on the surface of NPs can significantly enhance subsequent cytotoxicity. The principal challenges that have to be addressed are a detailed understanding of how the NPs' original 'engineered' UV-excitation influences two subsequent NP interactions with biosystems. In this work results of a complex study of Fe3O4 functionalized by humic acids (HA) were described. We hypothesized that, along with the NPs size, the surface functionalization was a major factor contributing to sorbent toxicity mitigation. The average particle size calculated by the Scherrer equation tended to decrease from 8.4 nm for Fe3O4-HA20 to 4.5 nm for Fe3O4-HA80. Optical spectroscopy indicated that the fluorescence quantum yield depended on the HA content in the nanocomposite and confirmed that the humic component interacted with ferric ions. Biosafety of Fe3O4-HA NPs was investigated in laboratory biostest systems using algae, infaunus, and higher plants as test-cultures. Concentration limits for using the Fe3O4-HA NPs suspended in water under controlled artificial conditions were found experimentally by ecotoxicological tests. Experiments with this "battery" of three biotests showed that, in controlled chemical conditions, water suspensions of the preparation can be safely used for biota given a certain concentration limit. It was found that samples of bare Fe3O4 and the Fe3O4-HA80, 0.01 (%), were remarkably more toxic than water suspensions Fe3O4-HA20 and Fe3O4-HA50 in this concentration in biotests with algae, higher and preferentially in 100 times dilution revealed that the effective concentration (EC50) for Sinapis alba did not exceed 0.1% Fe3O4. With that, algae appeared more sensitive: EC50 was 0.01% in the biotest with Scenedesmus quadricauda for Fe3O4, Fe3O4-HA50, and Fe3O4-HA20. Humic substances in natural conditions are likely to increase the permissible concentration limit and to mitigate harmful impact of the NPs. Obviously, before applying such remediation agent in specific biotope conditions, its biosafety should be additionally assessed by the biodiscination methods on response of biotope inhabitants.

534 Poster spotlight: WE209, WE210, WE211

Obesogens and lipid disruptors

115 SETAC Europe 28th Annual Meeting Abstract Book
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The evolution of obesogen-induced phenotypes in vertebrates
A. Capiati, M. Lopes-Marques, R. Ruivo, E. Fonseca, R. Jorge, M. Barbosa, CIIMAR - University of Porto; Y. Hiromori, Y. Ishi, T. Miyagi, T. Nakamishi, Gifu Pharmaceutical University; R. Santos, Hepia University of Applied Sciences Western Switzerland; F. Castrén, CIIMAR - University of Porto
Global obesity is an escalating pandemic in western societies. Triggered by numerous environmental and social factors, this epidemic consumption is also influenced by individual and environmental cues. Of note are the globally persistent man-made chemicals, with ever-growing ecosystemic consequences, a hallmark of the Anthropocene epoch. A striking example highlights the role of a group of compounds known as “obesogens”. In mammals, most examples involve the modulation of the peroxisome proliferator-activator receptor γ (PPARγ) nuclear receptor. To decipher the potential of PPARγ exploitation by a model obesogen, tributyltin (TBT), we employed an extensive analysis from comparative genomics to transcription assays, site-directed-mutagenesis, and homology modeling, to unfold the structural and biological determinants of PPAR exploitation by TBT.
Our findings endorse the modulatory ability of man-made chemicals and suggest an evolutionary diverse setting of “obesogenic” responses to TBT, with impacts for human health risk assessment.

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Aging Extension and Modifications of Lipid Metabolism in the Monogenont Rotifer Brachionus koreanus under Chronic Caloric Restriction
M. Lee, J. Park, J. Lee, Sungkyunkwan University
To examine the relationship of the aging extension and modification of lipid metabolism under chronic caloric restriction (CCR; concentration from 0 to 100% of the diatom Tetraselmis suecica) in the monogenont rotifer Brachionus koreanus, we assessed the life cycle parameters, fatty acid composition, and sirtuin and lipid metabolism-related genes expression. As a result, in the 5% exposed group, B. koreanus showed the decreased life reproduction. Based on this finding, we chose 5% of T. suecica and performed the rest of the experiment compared to 100%. As a result, up-regulation of sirtuin genes expression was observed. In addition, despite the reduction in the amount of total fatty acid (FA) and the area of triacylglycerol, the increase in the ratio of saturated fatty acid and monounsaturated fatty acid (MUFA) among the total FA in 5%–exposed B. koreanus were observed. Furthermore, the mRNA expression of Δ9 desaturase confirmed that CCR promoted the synthesis of MUFA through Δ9 desaturase. Moreover, the expression of docosahexaenoic acid (DHA) synthesizing gene, Δ4 desaturase, has also been up-regulated along with DHA content. These data suggest that CCR modified histone acetylation and lipid metabolism, leading to decrease in reproduction, consequently resulting in life span extension.

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Lipidomic and transcriptomic changes induced by compounds enhancing accumulation of storage lipids in Daphnia magna.
I. Figueres, Institute of Environmental Assessment and Water Research IDAEAE-CSIC; R. Jordà, Institute of Environmental Assessment and Water Research IAEECSIC / Department of Environmental Chemistry; B. Pina, IDAEAE-CSIC / Department of Environmental Chemistry; C. Barata, CSIC / Environmental Chemistry
The analysis of lipid disruptive effects in invertebrates is limited by our poor knowledge of the lipid metabolic pathways and of their complete lipidoma. Recent studies showed that tributyltin and juvenoids activated the ecdysteroid, juvenile hormone and retinoic X receptor signalling pathways, and disrupted the dynamics of triacylglycerols in lipid droplets in the crustacean Daphnia magna. This study aimed to explore how ecdysteroids, juvenoids and bisphenol A disrupt the metabolism under chronic caloric restriction (CCR; concentration from 0 to 100% of the diatom Tetraselmis suecica) in the monogenont rotifer Brachionus koreanus, we assessed the life cycle parameters, fatty acid composition, and sirtuin and lipid metabolism-related genes expression. As a result, in the 5% exposed group, B. koreanus showed the decreased life reproduction. Based on this finding, we chose 5% of T. suecica and performed the rest of the experiment compared to 100%. As a result, up-regulation of sirtuin genes expression was observed. In addition, despite the reduction in the amount of total fatty acid (FA) and the area of triacylglycerol, the increase in the ratio of saturated fatty acid and monounsaturated fatty acid (MUFA) among the total FA in 5%–exposed B. koreanus were observed. Furthermore, the mRNA expression of Δ9 desaturase confirmed that CCR promoted the synthesis of MUFA through Δ9 desaturase. Moreover, the expression of docosahexaenoic acid (DHA) synthesizing gene, Δ4 desaturase, has also been up-regulated along with DHA content. These data suggest that CCR modified histone acetylation and lipid metabolism, leading to decrease in reproduction, consequently resulting in life span extension.

Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
C. Prote, IDAEAE-CSIC / Department of Environmental Chemistry; M. Blanco, IDAEAE-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 gene signalling pathways involved in piscivorous fish (Brachionus 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 CEs (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:4, 36:5, 36:8) 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, 36:8, 40:6, 40:7). The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laetanus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CE), possibly due to an increase in the energy demand to respond to stress in polluted sites.

Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes
N.D. Denslow, M. Nouri, University of Florida / Physiological Sciences; K.J. Kroll, University of Florida / Physiological Science; C.J. Martynik, University of Florida / Physiological Sciences; V. Dang, Iowa State University
The organochlorine pesticide (OCP) contamination of two lake Apoka 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 Apoka 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 Apoka 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 Apoka 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 Apoka 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 Apoka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylcholines. 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.

Poster spotlight: WE027, WE028, WE029
Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (II)
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Nanoanotechnology: When shedding effects through agglomeration of carbon nanotubes (CNT’s) are confused with toxicity by media and the public - a case example revisited
J. 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 nanoparticle under investigation did not directly affect the algal viability, but indirectly reduced the algal growth via shading and agglomeration. To our surprise,
this press release led to a cascade of secondary articles and events. On the one hand, some online newspapers used our article to produce alarming articles about the dangers of nanoparticles for the environment (example translated from German: “Nanoparticles Identified as Potential Environmental Killers” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that went to this press release, and re-iterate the short- and long-term lessons learned from this case study. Most importantly, the ‘real’ work for a scientist writing a press release starts after its publication. News on topics of public concern such as the toxicity of engineered nanomaterials are very closely watched and instrumentalized both by the pro- and the anti-nano community for their respective intentions. Reactions on press releases concerning these topics have to be monitored closely, wrong quotations must be corrected and biased interpretations must be adjusted, in order to provide correct scientific information for the common public. The reward for this work is an overall more balanced communication. In the results [1] Schubert 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/newsip/shownews.php?&getnewsm=2011-11-09-3109&pc=02. Accessed 22 Nov 2017 Acknowledgements and Disclaimer - Schubert, F.was supported by an Ambizione fellowship of the Swiss National Science Foundation (grant number 168187). Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Adolphe Merkle Institute or the SNSF. This work has not been subject to their review and no official endorsement should be inferred. The author reports no other conflicts of interest and is responsible for the content of the abstract and presentation.

542 Nanotechnology: Communicating scientific findings through media – what could possibly go wrong? Lessons learned from Schubert’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 Schubw 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. Schubw and her colleagues were accused of fear-mongering. Things escalated to the point that Dr 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. Kotterman, IMARES / Fish Plastic has not only become a major research topic, it is also broadly covered in popular news. As result the general public knows about the plastic soup and how dangerous it is, supposedly, for wildlife and ultimately for human health. However, the history of plastic research is peculiar. Some of it was straightforward; wildlife choking in plastic does not need much additional proof or QC QA. But, as with many new research topics, the first articles about the dangers of plastic were soon followed by others. The focus was on the presence of small plastics particles even far away from sea food, 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. Waenger, 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 playground 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. Boris, Anti-Technalia / Marine and Coastal Environmental Management The H2020 project ResponSEable (www.responsable.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; M. van den Brink, Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
A common framework for the assessment of human and ecological risks from chemical stressors such as habitat degradation, nutrient pollution, oxygen shifts, hydromorphological changes or others, may also cause a site to fail achieving good ecological status. Since the EU Water Framework Directive (WFD) aims at a good ecological status of all European water bodies through addressing water pollution, for water quality monitoring and assessment under WFD it is necessary to discriminate the impact of such non-chemical stressors from the effects of toxic chemicals. This is challenging, and no single “one size fits all” strategy exists. Therefore, multiparametric approaches, so-called “toolboxes”, are often used. This presentation will show a toolbox for the detection of the ecological impact of chemicals that was developed within the Solutions EU project. It uses a statistically supported, health and environmental risk assessment (HESI) approach. The developed toolbox was applied to the Danube case study, to facilitate evaluation of the very comprehensive data set from Joint Danube Survey 3. The toolbox concept proved to be practical, simple and promising for further studies, with fairly high diagnostic power. The toolbox is an example of how to identify “drivers of mixture risks”. T. Backhaus, University of Gothenburg / Department of Biology 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 mixture risk. The European Commission has therefore emphasized in its communication the need to “identify chemical substances that are the main drivers of mixture toxicity”. This could tremendously help to steer future chemical monitoring efforts and risk mitigation measures. However, it is currently unclear how a common definition of the term “driver of mixture toxicity” is possible. In fact, empirical evidence seems to point to the fact that often only a very few chemicals dominate the mixture risk. The European Commission added that the mixture risk 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 ecotoTC approach and other type of acute to chronic exposure ratio (AF) 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, within the framework for environmental MRA previously mentioned. T. Backhaus, T. and Faust, M., 2012. Environ ScTechol 46 (5), 2564-2573. 554 Towards the development of a framework for applying non-target chemical analysis data within exposure 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 possibilities of advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. For instance, there is no framework for screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the possibilities of advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. The approach has been recently developed based on a database of more than 100 000 ecological assessments could look like, and the workflow is divided into three main tiers reveal clearly unac...
assumptions about modes of action are introduced. We tested the utility of the scheme by using data on the levels of more than 300 chemicals that occur together in the river Danube, from the Joint Danube Survey 3 (JDS3). For each of the 54 sites along the river Danube we ranked the chemicals in terms of their contribution to a mixture effect, separately for algae, daphnia and fish. We found that the overall mixture toxicity was driven by only approximately 10 chemicals. Substances not yet defined as priority substances under the EU Water Framework Directive made a substantial contribution to combined exposures. We also assessed possible combined risks to humans by evaluating whether water drawn from the Danube would be fit for human consumption. Overall, exposures of concern for humans could not be detected at higher tiers of the assessment. We conclude that the protection goals defined in the Water Framework Directive for freshwater aquatic communities are not achieved for combined exposures at many sites along the Danube.

555 Pesticides do rarely come alone, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX
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In the European Union, legislation so far strictly regulates plant protection by means of chemical pesticides on the level of single products. Common agricultural practice and manifold pest pressures lead to the exposure of non-target organisms to complex mixtures in a spray series. In the on-going COMBITOX project, we collated a dataset for the actual application patterns of pesticides in 12 representative crops in terms of acreage and pesticide application rates from the years between 2007 and 2015. The data was used for classification of sprayseries by typical mixture patterns, sequences and toxic combinations. Combining all information on empirical use patterns and their regional and temporal variation, we calculated indicators of use intensity and environmental risk. Toxicity exposure ratios (TER) were calculated using standard toxicity data (aquatic & soil organisms) from two recently developed species databases PDB (Lewis et al. 2016) and ECOTOX (US EPA 2017) and the mere application rates without consideration of exposure pathways. Only for focal sprayseries, first and higher-tier risk indices (including mandatory risk management measures) for different compartments were computed according to the standard approach as conducted by the UBA within the PPP-authorization procedure in Germany. In sum, 29 risk indices were computed (TERsingle-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. Amossé, S. Bart, INRAAgroParisTech; C. PELOSI, INRA (Institut National de la Recherche Agronomique); A. Schaeffer, 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 nature, where multiple stresses occur. In this study, we assessed the effects of two commercial formulations of fungicides, i.e., Cuprafo Micro® (composed of 500 g.L−1 oxadiazole oxadifen and 133 g.L−1 dimoxybosin), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Enchytraeidae) after 1, 6 and 12 months (i.e., t1, t2) of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait lamina method. Our results showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 ha−1 of Swing Gold® and 4.4 kg.ha−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 anecic earthworms was only observed at t12. We showed no overall significant difference in total feeding activity, enchytraeid diversity and between treatments with or without pesticide at different sampling periods. In the Swing Gold® treatment, earthworm community did not recover twelve months after pesticide application. We suggest thus going beyond the ISO norm 11268-3 (2014) - for the study of the effects of pollutants on earthworms under field condition - the ISO-11268 category Oligochaeta community and other functional endpoints (e.g. organic matter decomposition with the tea bag method) over two years to better assess environmental risks of plant protection product use and their mixture. Keywords: Cuprafo Micro®, Swing Gold®, agroecosystems, feeding activity

557 Toxicity of imidaclopid and thiadiazuron towards four Colembolan species C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Mainardi, Vrije Universiteit Amsterdam / Department of Ecological Science; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science
Folsomia candida has been used for assessing the toxicity towards non-target soil invertebrates since the 1960s, but only in the 1990s a standard reproduction test was developed. In 2009, after a ring test, OECD also accepted Folsomia fimetaria as a model organism. The first species, has been transported all over the world, therefore being considered a tramp species, having a parthenogenetic mode of reproduction. F. fimetaria is present in most of natural and agricultural soils worldwide, and has a sexual mode of reproduction. Following a suggestion of the ring test to use different species or spraytails to assess the toxicity of contaminants, in this study two additional species, Heteromurus nitidus and Sinella curviseta, were used together with F. candida and F. fimetaria to determine the toxicity of imidaclopid and thiadiazuron in Lufa 2.2 soil. The tests aimed at answering 2 main questions: (i) Is there a difference in the sensitivity to neonicotinoids between the different species? (ii) Are these species suitable for assessing the toxicity of neonicotinoids? Imidaclopid was most toxic, with F. fimetaria presenting around the same sensitivity as F. candida for survival (LC50 = 0.56 mg/kg dry soil Lufa 2.2 soil), and a slight difference in the sensitivity for reproduction, with EC50 for F. fimetaria of 0.10 mg/kg dry soil and for F. candida of 0.26 mg/kg dry soil. H. nitidus was slightly less sensitive with an LC50 of 1.6 mg/kg dry soil and an EC50 of 0.40 mg/kg dry soil. Thiadiazuron was tested on S. curviseta, F. candida and H. nitidus, with the survival of the first one being least sensitive (LC50 = 27 mg/kg dry soil), followed by F. candida (LC50 = 5.2 mg/kg dry soil) and H. nitidus being the most sensitive with an LC50 of 2.3 mg/kg dry soil. Thiadiazuron was more toxic to the reproduction of S. curviseta (EC50 = 2.6 mg/kg dry soil) followed by F. candida (EC50 = 1.5 mg/kg dry soil), and H. nitidus (EC50 = 1.3 mg/kg dry soil). The different species tested presented similar sensitivity to both survival and reproduction, with the exception of S. curviseta. The results suggest a specific mode of action of thiadiazuron towards reproduction, a trend that has been found in all tests, except for H. nitidus that presented around the same sensitivity to both survival and reproduction. The species tested presented good control performance and consistency in the results, pointing towards a possibility to be used in toxicity tests.

558 Dirty dancing: measuring pesticide responses to pesticide residues J. Witton, Environment Dept, University of York / Environment; T. Alvarez, EcoRisk Solutions Ltd / Dept of Ecological Sciences; M. Reid, HSE Health and Safety Executive / Chemicals Regulation Division; G. Weyman, ADAMA; M. Hodson, University of York / Environment Department; R. Ashauer, University of York / Environment
For a pesticide to be registered for use, the lethal and sublethal effects on non-target arthropods (NTAs) must be studied. Sublethal effects such as behavioural changes have been reported in NTAs exposed to some pesticides, with avoidance behaviour as one of the most frequently reported. Individuals that avoid risk/pesticide can lead to a pesticide – being of particular interest. More research is necessary to better understand pesticide avoidance behaviour so that population consequences of such behaviour can be estimated. We aimed to develop an efficient method to quantify changes in movement behaviour and identify avoidance behaviour in relation to pesticide exposure in the predatory mite Typhlodromalus pyri, a model species and a predator of mites found in fruit orchards and on hops. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mite movement behaviours when exposed to these in comparison to a control arena. We found that distances walked by mites were reduced by up to 87% compared to the control when exposed to 0.1 μL.L−1 deltamethrin, and that 54% of individuals exhibited avoidance through becoming wedged in the test arena glue boundaries at this concentration compared to 0% in the controls. When exposed to 18 μL.L−1 acetamiprid mean distance covered fell by 34%; however, when exposed to 0.45 μL.L−1 dimethoate the mean distance covered increased by 11%. No individuals
exhibited avoidance behaviour when exposed to acetamiprid or dimethoate. We report the variable effects of 3 insecticides on a range of standard movement behaviours in *T. pyri*, including distance walked, time moving/not moving, velocity and meandering behaviour. We also report avoidance behaviour measured as the time taken to become trapped in the test arena glue boundary due to attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects in NTAs by quantifying movement behaviour changes in *T. pyri*. We are also adding to the knowledge relating to movement behaviour which is an area of growing interest. We hope to improve the understanding of population-level consequences from changes in movement behaviours caused by pesticide exposure.

559 Should oral exposure in H. aculeifer be considered in order to keep them in Tier I test battery for ecological risk assessment of PPPs? - T. Natał-da-Luz, CFE - Centre for Functional Ecology / Department of Life Sciences; T. Gavaert, 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. Amrani, EFSa - European Food Safety Authority / Pesticides; J. Sousa, University of Coimbra / Department of Life Sciences

The recent scientific opinion of EFSA addressing the state of the science on risk assessment of plant protection products (PPPs) for non-target arthropods highlighted the need for the inclusion of other relevant exposure routes, besides contaminated soil, in tests from lower tiers. The reproduction test with the predatory mite *Hypoaspis aculeifer* (OECD 226) is currently being evaluated 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 oral, direct, and indirect dietary food. Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites *Trophaphagus 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 pesticides (Benzocarb 1519, 5126 mg kg⁻¹). Cheese mites were used as food in both tests but, while in one test cheese mites obtained from normal laboratory breeding cultures (clean preys) were added, in the other test, cheese mites previously exposed to Cu (pre-exposed preys) were used. Results showed that *H. aculeifer* fed with pre-exposed preys were more sensitive to Cu than mites fed with clean cheese mites. These data support that the route of exposure is important for the evaluation of contaminant toxicity. Therefore, lipids and -C₇₄-normalized BSAF should be used for the assessment of terrestrial BAF. Kinetic BSAF from both experimental 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 for bioaccumulation in terrestrial organisms. The objective of this project is to provide a suitable data base which will help to clarify how to address terrestrial bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the BvB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following 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-terphenyl 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 correlations were observed between assessment factors derived from both bioaccumulation in terrestrial organisms and bioaccumulation in aquatic organisms. Other aspects like non-depurred residues at the end of the elimination phase are discussed.

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 test is available to simulate biodegradation and its influence on soil organisms (EFSA 2017). One available approach for filling this gap is proposed by combining experimentally determined residue data from earthworms and data from degradation studies in the field. Earthworms were sampled at different seasons from eight fields in Croatia and analysed for 26 active ingredients. The concentrations of 26 analysed active ingredients were 0.000-0.247 mg/kg worm fresh weight with a mean of 0.005 mg/kg. The percentage of samples with values below the limit of detection (LOD), values below the limit of quantification (LOQ) = 0.001 mg/kg and values above LOQ was 29, 42 and 29 %, respectively. Based on publicly available draft assessment reports from EC and EFSA, degradation parameters (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 imidacloprid, the analysed residue levels in earthworm samples from the fields tended to increase with time whereas the calculated concentrations in soil decreased with time as expected, resulting in a supposed increasing bioaccumulation potential of imidacloprid under field conditions. The procedure proposed here – in the absence of analysed soil data – is a simple estimation which combines field history data with data from publicly available draft assessment reports. This approach may be useful for the assessment of the bioaccumulation potential of an active ingredient from a plant protection product under realistic field conditions.


Assessment and regulation of PBTr (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 in terrestrial organisms. The objective is to provide a suitable data base which will help to clarify how to address terrestrial bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the BvB criteria in the scope of the PBTr guidance revision. For this aim, the study comprised the following 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-terphenyl 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 correlations were observed between assessment factors derived from both bioaccumulation in terrestrial organisms and bioaccumulation in aquatic organisms. Other aspects like non-depurred residues at the end of the elimination phase are discussed.

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

562 Developments and recommendations on the practical use of Social LCA - S. Di Cesare, CRAD / Department of Economic Studies; A. Zamagni, Econoinvazione / LCA and Ecodesign Laboratory; J. García, SCORE LCA; F. Silveri, University of Chieti-Pescara / Department of Economic Studies; A. Lanfranconi, Ecoact; L. Petiti, University of Chieti-Pescara / Department of Economic Studies

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

Globalization and especially leather industries facing constant discussions on social compliance mostly in relation to bad working environments and thus cause severe social impacts for different stakeholder groups along the supply chain due to e.g. unhealthy working conditions. In order to determine social impacts occurring during the leather production processes, social cycle assessment’s (S-LCA) implementation is of major importance. Practical implementatations 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 a combination of contextual discussions, social hotspots along the supply chain, e.g. existence of labor laws. Relevant social hotspots are identified. Depending on the indicator direction, social consequences (e.g. benefits in societal health resulting from non-exhausting work hours) can be determined for the stakeholder groups. The inclusion of positive impacts may function as an incentive for improvement and guide the way towards future developments within the European leather industry. The results may also be transferred to further product groups in the global textile and leather industry.

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

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

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

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

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We present a social footprint assessment of implementing a deposit-refund system (DRS) applied to beverage packaging waste in Spain. In a DRS consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. The social footprint developed by Weidema et al. (2012) is an example of how the summation 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 internalized. The social footprint of an activity can be defined as $SF = IR + PG$. We compared two scenarios, namely the current situation for household packaging waste in Spain in 2014 (system A), and a hypothetical scenario (system B) where a 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 current study is an example of how the summation of social footprint, together with a powerful tool like Exiobase, can pave the way for an operational approach to social LCA, avoiding excessive data requirements and the long lists of impact indicators currently proposed for bottom-up approaches.

567 Poster spotlight: TH226, TH227, TH228

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

568 Application of Equilibrium and Toxicokinetic Models to Understand the Behaviour of Organic Chemicals in In Vitro Toxicity Tests

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Toxicology 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 numerical 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 (EOP) 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 EOP model. The toxicokinetic model was applied to a set of hypothetical organic chemicals under different scenarios (e.g., biotransformation half-life) and then the results compared with a previously developed in vitro mass balance modeling tool based solely on equilibrium partitioning. We also applied the
EQP model to a specific ToxCast assay (ACEA_T47D_80hr_negative assay; cytotoxicity) to illustrate the value of the modelling approaches for QIVIVE and hazard/risk assessment. For relatively persistent chemicals (or in cells/tissue with limited metabolic competency), the simulated mass distribution using the toxicokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable for predicting exposure to static conditions in reliable toxicity metrics for QIVIVE (e.g., membrane concentrations). Of the 306 chemicals included in the ACEA_T47D_80hr_negative assay simulations, approximately 2/3rds had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/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

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Improved assessment of exposure in in vitro toxicity assays is essential for the application of in vitro data for chemical risk assessment. Equilibrium mass balance models have been developed to convert the reported nominal effect concentrations of chemicals to the in vitro exposure concentrations (CEFs), which are considered more meaningful dose metrics than nominal concentrations. In vitro exposure assessment might be challenging for pesticides and pharmaceuticals that are acidic 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 carbonyl group of the thioether bridge in the disulfide bond allows reliable models are available to calculate the binding of neutral chemicals to lipid, protein, medium and cells, the binding of organic acids to biological materials cannot be easily predicted. Here we applied a 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., CEF). Because polymers like polydimethylsiloxane that are typically used for solid phase microextraction (SPME) are not suitable for charged chemicals, C18-coated SPME fibres were used in this study, that have been previously reported to have high sorption capacities for charged chemicals. Eight organic acids were chosen for the experiments: diclofenac, 2,4-D, ibuprofen, naproxen, warfarin, trichloroacetic acid, and gentamicin. The concentration range (CCEF) was determined for each compound and 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 CEF in cell culture media. At low chemical concentrations the results from the binding experiments agree with the predictions from a mass balance modelling approach. However, saturation of the medium was observed at high chemical concentrations and further experiments will be necessary to investigate for which chemicals and at which concentration levels saturation occurs and if it is required to incorporate non-linear binding into existing exposure models for in vitro bioassays.

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

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

571 An intestinal fish cell barrier model to assess absorption of poorly soluble organic chemicals in vitro

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Permeation of organic chemicals from the aquatic environment across cellular barriers is a critical step for accumulation in organisms, such as fish. To better understand the underlying processes, we aim to study the role of the fish intestine as barrier for hydrophobic and volatile chemicals. The function of the intestine in these processes is experimentally impractical to assess on a routine basis. Additionally, hydrophobic and volatile chemicals are difficult to work with, due to their low water solubility and high volatility. Therefore, we here combine a recently developed in vitro epithelial barrier model using the rainbow trout (Oncorhynchus mykiss) intestinal cell line, RTG-GC, and a newly constructed chamber that enables stable chemical exposure concentrations. In this setup, we measured the permeation of 10 fragrance compounds with a range of volatility (logHLC = 5.8 to -2.2) and hydrophobicity (logKow = 3.6 to 5.7). The RTGutGC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer comprised diffusion controlled permeation and intestinal biotransformation. The involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of the model, which correlated with the logKow. The chamber enabled stable exposure concentrations and close to full recovery at the apical compartment in the apical to basolateral direction. The cell monolayer had a unique design, which enabled stable chemical exposure concentrations. This setup makes it easier to assess the permeation of fragrance compounds with different volatility and hydrophobicity, which is an important step to understand the barrier function of the fish intestine and the processes involved in chemical absorption. It will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the pipetting robot can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has makes automation technology accessible to a much higher number of laboratories around the world.

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

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In vivo and in vitro bioassays (effect-based methods, EBM) are increasingly used for the water quality monitoring to complement chemical analysis. In a holistic point of view, sampling is the starting point and an integrated part of the whole analysis workflow. However, sampling for effect analysis is more challenging than for chemical analysis. Thus, the aim of this paper is to discuss (1) the requirements and challenges of sampling for EBM and (2) to present the recently developed large-volume solid phase extraction approach and apparatus (LVSPLE) as a...
promising technology to overcome the disadvantages of traditional sampling techniques with respect to EBM. The first challenge is the demand of water to be enriched which is dependent from the number and extracts consumption of the bioassays used for the assessment. The second challenge is the recovery and carry-over of the potential toxicity from the water sample to the vessels or wells of the bioassay. The third challenge is the representativeness of the sample. The successful implementation of EBM strategies requires the availability of automated sampling devices which allow the sampling of larger water volumes, guarantee the sampling integrity and makes it possible to take representative samples over a longer period or during events such as heavy rain- and flood-events. A solution to overcome the disadvantages of classical sampling methods and devices is the recently released LVSEP approach and apparatus. It brings the SPE onshore, allows further automation of processing and avoids the transport of larger water volumes to laboratory for filtration and extraction. LVSEP was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LVSEP is applicable in monitoring and survey programs, to assess surface water and wastewater with effect-based tools and to unravel one of the causes of mutagenicity in the river Rhine using effect-directed analysis. Thus, LVSEP is a promising technology for the implementation of EBM for water quality monitoring in European and worldwide water quality monitoring. LVSEP 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 exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for a in-depth risk assessment based on all available toxicity data, for introduction in monitoring programs or for further risk management measures. Standardization of prioritization schemes for suspect screening approaches may be needed for further introduction of these techniques in water quality regulations. Funded by the Joint Research Program of the Dutch water companies (BTO, project 400554-214).

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

574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils

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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 cannot be compensated through simple dilution or the lack of matching internal standards. If consistent and reliable method recovery results cannot be ensured in a set of environmental samples of variable physicochemical characteristics, any comparison drawn between samples (e.g., inter-site differences) could be questionable. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., AFF non-target partitioning coefficients, dissolved surfactin bioaccumulation factor). Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs from AFFF-effluent and 28 soil samples were investigated in-house with AFFSs and aged. The optimized method presented quantitative or near-quantitative PFAS recoveries from diverse soils and limited matrix effects were noted. The method was applied to a limited survey of firefighting training areas in eastern Canada, showing the prevalence of betaine-based (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFbHxSm) PFASs at such sites.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination

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Perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their bioaccumulation and toxicity, PFASs are suitable for a variety of applications and possess a lot of possible entry pathways that were identified in prior studies. Although, advertisement and material safety data sheets indicate a rather extensive use of PFASs in building materials and industrial textiles, only few studies deal with investigation of these materials. A total of 23 samples from products used in building industry and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C4 to C14, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalkylic acids were up to 430 µg/kg for highly contaminated samples. FTOHs were even detected in samples with concentrations up to several mg/kg. However, FTOHs need to be further investigated since they may be false positives resulting from the low selectivity of utilized transition for FTOH quantification. In addition to performed investigations, rinse of samples of e.g. buildings should be performed to prove suggested entrance pathways. Furthermore, additional method development has to be performed in order to better illustrate entrance pathways.

576 The growing role of seafood consumption for exposures to legacy PFASs

Evident in Longitudinal Birth Cohorts from the Faroe Islands

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Rapid declines in legacy poly- and perfluoroalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and thus important for mitigating current and future risks. We report on the blood concentrations of 19 PFASs (SPFAS) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faroe Islands) where pilot whale is part of the traditional diet. Median SPFAS concentrations in children (ages 5 to 13 years) peaked in 2000 (47.7 ng mL⁻¹) and declined significantly by 14.4% yr⁻¹ to 8.7 ng mL⁻¹ in 2012. Perfluoroarboxyclic acids (PFCAs) with nine or more carbons (C₉₋₄₉) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUdNA, r = 0.72). Toxickogenic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a decline in whale consumption in recent years. A previous study reports PFASs in Faroese drinking water were below detection. We thus infer that even in a major seafood consuming population, declines in SPFAS exposure after 2000 were achieved by the rapid phase out of PFOS and its precursors in consumer products.
Membrane-water partition coefficients to aid PFAS risk assessment.

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Widely varying structures of fluorinated compounds have been detected ubiquitously in humans and the environment. Due to the limited understanding of basic physical-chemical properties of any of these PFASs, risk assessment (RA) models still provide highly uncertain outcomes. Most PFASs are ionogenic, and act as surfactants. As a result, octanol-water partition coefficients ($K_{ow}$) cannot be determined experimentally. Due to the lack of experimental data, QSARs to predict $K_{ow}$ are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant (pK_a) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of a $K_{ow}$ value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements of sorption data to (phospho)lipid, for which assays are readily available and that lack all the concerns about experiments with octanol. Phospholipids are in general the key tissue component to sorbs ionogenic surfactants, and relate directly to baseline toxicity levels and bioaccumulation. The current study evaluates the results of two experimental tools to measure sorption of standard PFAS structures to artificial phospholipids: retention on immobilized phospholipid chromatographic column and solid supported lipid membranes. The current study also evaluated to what extent quantum-chemical software COSMOtherm, which does not require experimental data but simply takes 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning ($K_{ow}$) of the ionic perfluor species, and the predictions on pK_a. Whereas COSMOtherm accurately predicts $K_{ow}$ for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_a of alternative PFASs, e.g. General trend is negative and values are larger compared to the gas to electron on ions of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

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

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Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctane sulfonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS residues because they require a high concentration of particles or premises to take 3D molecular charge densities into account. PFOS emissions from Europe and North America are, for example, 20 times higher than those from the rest of the world. Ocean transport has been demonstrated to be a significant pathway for the global distribution of PFOS. In the past 15 years, several oceanic transport studies have supported the hypothesis that oceanic transport plays an important role in the global transport of PFOS. This has led to a point source input of pollution of soils, waters and biota in close proximity to these areas. The use of PFAS containing substances by the textile and paper making industries, as well as their presence in waste sent to landfills represent several diffuse source pollution pathways. The case studies presented encompass all of these inputs, and methods used to monitor the behavior of PFAS in soil, ground water, surface water and biota (including the use of passive samplers) will be discussed. It is highlighted that understanding the partitioning and leaching behavior of these compounds allows more informed regulatory decision making. It is made and given that the regulation of PFAS is currently under the spotlight this is of great importance. Perfluorooctane sulfonate were recently included on the list of Substances of Very High Concern in REACH. PFOS is included in the water framework directive and an environmental quality standard is often used in order to set clean up targets. The remediation of PFAS impacted sites presents unique challenges and current remediation of water often relies on pump and treat using activated carbon filters to sorb PFAS. There are fewer suitable remediation methods for soils. Through the case studies presented, different remediation methods that are currently being used in the field and lab (pump and treat and sorbent amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS leaching up to 99 %.

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

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

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Environment fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and limitations of the methodologies available in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the past 25 years and many aspects were refined: the inclusion of nanomaterials among the modelled substances, the development of models at different spatial and temporal scales, the estimation of chemical properties and emission data, the incorporation of additional environmental media and processes, the integration of sensitivity and uncertainty analysis in the simulations, etc. However, some issues are still challenging and require research efforts and attention: the need of methods to estimate partition coefficients for polar and ionizable chemical in the environment, a better description of bioavailability in different environments as well as the requirement of injecting more ecological realism in exposure predictions to account for the diversity of ecosystem structures and functions in risk assessment. Finally, to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for risk assessment.

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 2016) that has undergone the assessments practices for these three policy areas at that time. EUSES last relevant update was in 2004, so that the tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function efficiently, both for applicants/registrants, MSCAs and ECHA. EUSES has several modules (release estimation and distribution), different environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of a $K_{ow}$ value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. At a (partitioning) of these compounds in relation to their presence in soil, ground water, surface water and biota (including the use of passive samplers) will be discussed. It is highlighted that understanding the partitioning and leaching behavior of these compounds allows more informed regulatory decision making. It is made and given that the regulation of PFAS is currently under the spot light this is of great importance. Perfluorooctane sulfonate were recently included on the list of Substances of Very High Concern in REACH. PFOS is included in the water framework directive and an environmental quality standard is often used in order to set clean up targets. The remediation of PFAS impacted sites presents unique challenges and current remediation of water often relies on pump and treat using activated carbon filters to sorb PFAS. There are fewer suitable remediation methods for soils. Through the case studies presented, different remediation methods that are currently being used in the field and lab (pump and treat and sorbent amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS leaching up to 99 %. The tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function efficiently, both for applicants/registrants, MSCAs and ECHA. EUSES has several modules (release estimation and distribution) as well as the importance of precursors. This work will provide insights into future risks associated with shifting source regions and PFOS precursor releases.
As the main form in which grease thickeners are manufactured and used, is grease thickeners by conducting leaching studies based on a Water Available Thickeners Consortium (ERGTC) have characterised the bioaccessibility of their 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 industrial consortium and the FARM REACH consortium, the fertilizers sector has developed a fertilizer sector uses map. In addition, four sector specific ERCS 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 leaching of hydrolysed substances under agricultural fields to surface water are not taken into account. In addition, important output pathways for fertilizers via crop uptake and harvest are generally not considered in these tools. Quantitative exposure scenarios, resulting in the calculation of realistic worst-case local Predicted Environmental Concentrations (PEC local) for fertilizers constitutes in the various environmental compartments (soil, water, sediment) were established. The main focus of the FEE tool is on micronutrients such as manganese, copper and zinc, which are identified as hazardous for the aquatic environment; but the tool allows for assessment of other inorganic and organic substances in fertilizers as well. Conceptually, the tool has been based upon existing REACH exposure modelling, but is adapted for fertilizer use by applying the system from other chemicals legislations. In order to improve harmonization and communication within the supply chain, generic exposure scenarios have been developed for a number of micronutrient and SPERCs combinations. Collectively, the development of SPERCs, the fertilizers environmental exposure tool and generic exposure scenarios, allow for a systematic review of environmental exposure assessment of fertilizers under the REACH regulation. Further information on the project, including downloads of the FEE tool and SPERC factsheets can be found via www.fertilizers.eu.

Bioaccessibility of grease thickeners and the implications for REACH registration

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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 polyarboxylic acid. 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 beyond the base oil manufacturing process, unique physical characteristics (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 thicker 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 (FSSIF – Biorelevant, Switzerland) to assess exposure route via the gut (human health). Data is presented for different types of thickener substance which shows that most thickeners will not be bioaccessible and therefore, there will be minimal exposure to these substances. As the main form in which grease thickeners are manufactured and used, is entrained in a grease base, it is proposed that a lack of exposure based on low-solubilities and/or bioaccessibility is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed “limits for leaching”. This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil

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

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A process has been initiated by ECHA with stakeholders to assess the need for update of EU REACH. The kick off for this update process is a workshop with stakeholders which will take place in ECHA, in April 2018. The expected outcome of the workshop is the identification and prioritisation of emerging or existing methods related to the EU REACH submission process (scientifically and IT support/setting). Workshop outcomes planned to be available before May 2018 and will be presented to the wider audience of the SETAC conference.

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 industrial consortium and the FARM REACH consortium, the fertilizers sector has developed a fertilizer sector uses map. In addition, four sector specific ERCS 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 leaching (on hydrolysed hydrogen) was considered to test and the framework progressed upon exposure assessment. The scheme serves as a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. Kah M, Hofmann T. 2014. Environ. Int. 63:224–235. 2. Kookana RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

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

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One of the grand challenges of environmental chemistry is to be able to predict human exposure to toxic 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
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

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

A. Kapanen, European Chemicals Agency - ECHA; L. Deydier Stephan, European Chemicals Agency / Evaluation Directorate; V. Rodriguez Unamuno, A. Karjalainen, J. Holmquist, European Chemicals Agency ECHA European Chemicals Agency (ECHA) implements the REACH Regulation (EC No 1907/2006 (Registration, Evaluation and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC No 1272/2008)). Industry and authorities need to fulfil their obligations regarding these regulations also for nanoforms as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH would benefit from nano-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(e). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 4). ECHA currently performs three types of activities to implement REACH, CLP and BPR regulations and to support these processes aiming at ensuring safe use of nanomaterials (NM): REGULATE: formal processes under regulatory frameworks, whereby ECHA uses the legal instruments available under REACH (substance/dossier evaluation, authorisation and restriction), CLP and BPR; SUPPORT: helpdesk, meetings with stakeholders and with Registrars, 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 as to potential environmental and/or human health risks as a result of environmental exposure to nanomaterials. Canada regulates chemical substances, including nanomaterials, under various regulatory mechanisms. The Canadian Environmental Protection Act, 1999 (CEPA) and the Chemical Management Plan (CMP) are key in safeguarding Canadians and the Canadian environment from potentially harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.

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

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The EC4SafeNano initiative, founded by Horizon 2020 is an ongoing effort to build a European Centre for Risk Management and Safe Innovation in Nanomaterials and Nanotechnologies. EC4SafeNano aims to bridge the gap between scientific knowledge on hazard and risk, and ‘fit-for-purpose’ risk management tools and strategies supported by measurement and control methods. The Centre of European organisations will offer services for Risk Management and Safe Innovation for Nanomaterials & Nanotechnologies. One of the first actions of the project was developed an inventory of available resources related to nanosafety issues. Indeed, until now, many tools and studies which aim to improve human and environmental nanosafety have been developed by research organisations and EU funded projects. Therefore this inventory have the aim to give a useful overview on tools, methods, trainings, standards, standard operating procedures (SOPs), guidance documents and best practices in nanosafety. quality criteria are included to give users the possibility to select or sort resources based on your own example (an 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. Moreover 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 ecotoxicity, 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 be useful to promote the understanding of environmental risk and generate 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 ecotoxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated.
nanomaterials contained in the sunscreen can be released into rivers, lakes, sea shores, and/or sewage treatment plants. Their fate and impact in these different systems is largely determined by the surface properties, i.e. the coating type and lifetime. This project aims to develop the eco-design of sunscreens through the minimization of risks associated with nanomaterials incorporated into the formulation. All stages of the cream life cycle must be considered in this light, from its manufacture to its end of life, through its use by the consumer and its impact on the environment. By considering each development stage of the sunscreen, from the choice of UV-blocker and its integration into a cosmetic formulation, to the knowledge of the risk involved in this choice all along the product lifecycle, an eco-design approach can be achieved and risk can be minimized. The present work combines industrial companies specializing in cosmetic formulation with academic research experts in the fields of exposure, toxicity and lifecycle assessment. Sunscreen fabrication, risk for the consumer by dermal exposure, risk for the direct aquatic environment and risk related to the end of life of the product are as many key steps of the sunscreen lifecycle that were investigated in this project.

591 Environmental risk assessment of engineered nano-SiO2, nano iron oxides, nano-CeO2, nano-Al2O3, and quantum dots

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Many research studies have aimed to investigate the ecotoxicological hazards of engineered nanomaterials (ENMs). However, little is known regarding the actual environmental risks of ENMs, combining both hazard and exposure data. The aim of this study is to quantify the environmental risks for nano-Al2O3, nano-SiO2, nano iron oxides, nano-CeO2, and quantum dots by comparing the predicted environmental concentrations (PEC) with the predicted no effect concentrations (PNEC). The PEC values of these five ENMs in fresh waters in 2020 for northern Europe and southeastern Europe were taken from a published dynamic probabilistic material flow analysis model. PNEC values were calculated using probabilistic species sensitivity distribution (SSD). 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-Al2O3 > 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 SSDS approach makes it possible to include all available data to estimate hazards of ENMs by considering the whole range of variability between studies and material types. The risk assessment approach is therefore able to handle the uncertainty and variability associated with the collected data. The results of the current study are able to provide a scientific foundation for risk-based regulatory decisions of the investigated ENMs.

592 Occurrence of cyanotoxins in Greek lakes

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Cyanotoxins (CTs) are produced from cyanobacteria in surface water during harmful algal blooms can pose significant threat to human health and the environment. Their occurrence has been monitored using the main classes of CTs, i.e. cyclic peptides (microcystins, MCs and nodularins, NODs) and alkaloids (cylindrospermopsin, CYN, anatoxin a, STX and neoSTX) were identified in Greek lakes for the first time. Acknowledgement: The authors thank CYANOCOST – COST Action ES 1105 www.cyanocost.net

593 Interactions between cyanobacteria and daphnia

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Thanks to their adaptation cyanobacteria colonized aquatic, marine and terrestrial environments. Eutrophication of waters has promoted and will increase cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither has the question, if the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 and M. viridis PCC7820 were cultivated as the question, if D. magna were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 µm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10⁷ cells/mL, reduced feeding and survival, moreover altered detoxification and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy- are currently in progress. Vice versa, M. viridis PCC7820 reacted to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.

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

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The occurrence of teratogenic retinoid-like compounds produced by cyanobacteria into surface water for the first time. Thanks to their adaptation cyanobacteria colonized aquatic, marine and terrestrial environments. Eutrophication of waters has promoted and will increase cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither has the question, if the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 and M. viridis PCC7820 were cultivated as the question, if D. magna were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 µm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10⁷ cells/mL, reduced feeding and survival, moreover altered detoxification and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy- are currently in progress. Vice versa, M. viridis PCC7820 reacted to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.
developmental effects in zebrafish (Danio rerio) and frog (Xenopus laevis) embryos. Both the phenotypes and effective concentrations of exudates corresponded to all-trans retinoic acid (ATRA) equivalents, supporting the hypothesis that the teratogenic effects of cyanobacterial exudates are likely to be associated with retinoid-like activity. Non-target analyses and comparison of the spectra of compounds present in exudates with different retinoid-like activities pointed to structural features of compounds contributing to the retinoid-like activity. In the approach of a “virtual EDA” we have characterized in detail retinoid-like activity of 53 samples of extracts from 4 algae species and 15 cyanobacteria species/strains. Only several species of cyanobacteria showed detectable activity, while there was no activity in any algal exudates. We have identified a set of compounds that contribute to the total retinoid-like activity in both laboratory and field samples, including ATRA, 9/13cis retinoic acid, but also several novel cyanobacterial metabolites, such as 5,6epoxy-RA or 4keto-ATRA with high retinoid-like potency. In general, retinoid-like activity has been shown to be associated with cyanobacterial water blooms dominated by 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 FF7 SOLUTIONS project No. 603437.

595 (Co-)Production Dynamics of Cyanobacterial Peptides
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Cyanobacterial algal blooms are expanding temporally and spatially, which is promoted by eutrophication and likely climate change. Cyanobacteria can produce a wide range of bioactive compounds with different modes of action, including a variety of toxic and non-toxic compounds. Information on the formation dynamics of the majority of novel cyanopeptides is mostly unknown even for common cyanobacterial strains. Such information is crucial to assess the risk of these emerging natural toxins for human health in evaluating their potential to reach drinking water supply plants. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides other than microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides from common cyanobacterial species including Microcystis aeruginosa and Anabaena flos-aquae strains. Batch culturing was done under varied environmental conditions and the cell abundance was followed by optical density, cell counts and biomass without simultaneous, the cyanopeptide production was followed. Therefore, biomass extracts were purified and measured by liquid chromatography, high resolution mass spectrometry with refined analytical protocols. Comprehensive data analysis was performed to identify cyanopeptides and follow their abundance. These new insights of co-production dynamics are critical to better understand which peptides and peptide mixtures are present during cyanobacterial bloom events.

596 Development of methods for Measuring Total Microcystins in Fish Tissue using the 2-methoxy-3-methyl-4-phenylbutyric acid (MMPB) procedure
There are limited methods for the analyses of multiple algic 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 produce experimentally and cell culturing homogenates with 3 congener of microcystins (LR, LA and RR) individually and as mixtures, and to develop a method for their recovery and measurement using the MMPB derivatization method. The second phase of the project is to field-test this method on fish collected from water bodies experiencing algal blooms and compare results with individual congener measurements. Extraction methods and analytical methods being developed for this research will be utilized for developing procedures for plankton, periphyton, and macroinvertebrates. Ten and 100 mg of fish homogenates from fish containing 1, 4 and 14% lipids were spiked with 4 and 40 ng of each of the microcystin congeners, LR, LA and RR. Various extraction techniques and conditions were tested to optimize recovery and simplify the procedure. Overall toxin recoveries were found to range from 30 to 50%. The lipid content was found to not interfere with generation of MMPB; however, it did impact the workup/extraction procedure in ways which were accountable through the use of a surrogate standard. The MMPB technique can be reliably employed for microcystin quantification in fish tissue. Detectors in non-spiked samples (10-20 ug/kg) are comparable to literature precedent. For tissue quantification the MMPB method provides considerable improvements over extraction of individual toxin congeners and is consistent even with very polar or hydrophobic MCs.

597 Saponins in the aquatic environment: hydrolisys and toxicity
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Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopesticides in crop protection. They may lead also into the aquatic environment due to their low-octanol/water partition coefficient and poor binding to organic matter. They may therefore pose a risk to the aquatic organisms. However, their fate and toxicity in the environment are not fully understood. Hence, we aim to investigate the pH and temperature dependence of saponin hydrolisys together with their dissipation in sampled lake waters and to determine the aquatic toxicity of saponins from quillaja bark, tea seed coat, and quinoa seed coat towards different aquatic organisms. The hydrolisys of saponin (quillaja saponin) showed to be a highly pH dependent base-catalysed reaction. The half-life was around 330 ±220 days at pH 5.1 and 26., while decreased to 0.06 ±0.01 at pH 10.0. The hydrolisys was also influenced by temperature with an activation energy of 56.9 ±14.2 kJ/mol at pH 7.2. Lake waters with pH varying between 6.4 and 8.2 showed completely different hydrolisys patterns, with a fast initial dissipation of up to 60% of the initial saponin concentration, followed by an extremely slow to nil reaction, making saponin partially persistent in lake waters. The maximal concentrations protecting 95% of the aquatic species (HCs) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinoa seed coat were 2.91 ±0.00, 0.22 ±0.11 and 22.9 ±5.84 mg/L respectively. The 100-fold difference in toxicity between the saponin-rich extracts from different plant species indicate that saponin toxicity depends on the species where it originates from, making “read-across” between saponins a dubious exercise. In addition, the predicted environmental concentrations of different saponins are close to or higher than their water quality standard, which means that the saponins might pose a risk to the aquatic environment if not used cautiously. Therefore, we recommend not using surrogate or expected data/conclusion in the regulation of saponin-rich plant extracts and pay more attention to the potential risk of saponins to the aquatic environment.

Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach
598 Setting the Stage to Advance the Adverse Outcome Pathway Framework through Horizon Scanning
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Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self-identified as 35% academia, 35% government, 20% industrial, 10% non-profits, 5% research organizations. During question solicitation, questions were separated into broad topic areas including, AOP networks, quantitative AOPs, collaboration and communication on AOPs, AOP discovery and development, extrapolation, exposure/toxicokinetics considerations, and AOP application. An expert-ranking exercise was then conducted to identify high-priority questions for each category and from this, four key themes emerged including further AOP research and regulatory initiatives. These themes were used as workgroup topics for a Pelliston™ 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 report and expert-factor exercise and questions to 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

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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. The development of AOPs is generally iterative. 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 initial expert-factor exercise and answers to FAQs, but also on related topics such as mixture toxicity assessment and the implementation of feedback loops within the AOP framework. This presentation briefly outlines critical concepts concerning the development of AOP networks, how they may be analyzed, and illustrates how information derived from them can be applied. First, derivation of AOP networks is considered in the context of how it differs from traditional development of individual AOPs. Next, the application of filters and layers is discussed, which can be used to refine and enrich developed AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application-case studies is used to illustrate concepts underlying development and analysis of AOP networks, and how those concepts tie in with ultimate application. The contents of this presentation represent the personal opinions of the authors and neither constitute, nor necessarily reflect the policies or viewpoints of their employers or institutions.

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

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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.

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

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An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway (AOP) Concept – An International Horizon Scanning Approach,” in April 2017. The workshop addressed key challenges or limitations of AOP constructs as tools for informing research and regulatory decisions that were identified by responses to a global Horizon Scanning survey. This presentation will summarize the findings of Pellston Workshop 3, which was tasked with the explication of practical considerations for this use of AOP constructs in regulatory decision making. The use of AOPs and related concepts have increased in scientific and regulatory sectors over the past decade, coinciding with pressures to find innovative solutions to evaluate chemical safety in a more efficient and effective manner that better directs resource utilization. This workshop focused on how AOPs can be a useful tool for chemical decision makers in the government and private sector. At 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 AOPs 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.
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) Pellan™ 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 Pellan 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 parameter specialists and more. Furthermore, when considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

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

604 Monitoring of POPs in the Swedish aquatic ecosystem and in human milk

E. Nyberg, A. Biggert, S. Danielsson, Swedish Museum of Natural History; C. Ek, Department of Applied Environmental Science / Department of applied environmental science.

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


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 the environment over time and their potential to accumulate over the last decades. The data collected going back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves and roe deer will be used to illustrate time trends for regulated flame retardants and their substitutes. Recommendations will be given to European and international chemical management.

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


The National Institute of Standards and Technology (NIST) has been involved in the long-term archival of biological and environmental specimens for over 40 years. Specimens originally intended for monitoring geographic and temporal trends in emerging contaminants as well as changes in transport and accumulation of legacy contaminants have added value today. Tissue and fluid specimens from marine animals, including mammals, seabirds, sea turtles, bivalves, fish, coral and coral ecosystems, collected through various projects are archived at the Marine Environmental Specimen Bank (MBS) at the National Institute of Standards and Technology, in Charleston, South Carolina, USA, using standardized protocols for collecting, processing, and cryogenic storage. The protocols ensure a high quality sample is provided for downstream analysis that is fit-for-purpose and that homogeneous aliquots are uniform, reproducible, and stable over time. New investigations exploring if the standardized protocols, 1) affect the quality and suitability of RNA for downstream expression studies, 2) are feasible in determining trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well- barcoded genome, and 2) the discovery of using total mercury as an alternate method to genetic species identification, have also been conducted and will be discussed.

607 Monitoring of the indoor environment of ESB laboratories with selected target and non-target screening methods

P. Bohlin Nizzetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkowski, NILU Norwegian Institute for Air Research

The environmental specimen banks (ESBs) handles and store a wide range of high-quality samples with a main objective to perform retrospective analyses of newly identified contaminants (chemicals of emerging concern, CECs). It is of highest importance that the ESBs provides high quality samples in the 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 release of contaminants to the indoor environment. To evaluate trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, a) detailed proteome profiling of tissues used to evaluate a new high-coverage well- barcoded genome, and b) the discovery of using total mercury as an alternate method to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Astrin, Zoological Research Museum Alexander Koenig

Within their genomes, the organisms on our planet contain an immense wealth of information about the diversity of life. These genomes conserve the code to identify organisms, comprehend population structures, etc. Fast progress in molecular technologies dramatically speeds up research on genetic biodiversity and increases the demand for professionally preserved and managed genome-quality samples in many disciplines, e.g. in ecology, conservation biology, etc. Biodiversity biobanks cater specifically to these demands, and in a standardized way. Environmental samples collected periodically by ESBs following defined routines constitute a very valuable source of DNA for biodiversity research, as they keep open a window that allows the parallel, correlative analysis of the chemical and of the species community composition of a given environment over time. Through species
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 ESBS samples should be deposited in dedicated DNA banks in order to make this resource available to the scientific community and the ever-developing 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 ESBS samples, making these more valuable.

609 Discussion on environmental specimen banking in research and regulation

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.

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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

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Assessing health risks associated with organic micropolllutants 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 source, from the osmosis- and reverse osmosis water, and from mining water. 2 generations of mice (10 males, 10 females for each type of water) were fed with concentrated water and food during a 1 year period, in order to reproduce in the animals, the exposure as a man drinking the water for 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 distributions. In vitro bioassays were used to evaluate endocrine disrupting effects (ER and AR receptor), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropolllutants. The presentation will show the detailed protocol.

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?

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 in the mixture), non-interaction (toxicity equal to that expected from the sum of the individual contaminants), interactive and synergistic toxicity (greater toxicity than expected from the sum of 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 Chelex-100 resin) to assess the toxicity of Cd, Cu, Ni, Pb, and Zn in mixtures, to two common Antarctic marine microalgae, Phaeocystis antarctica and Cryothecomonas armoricana - the major food source for penguins and other seabirds. The application of DGT to assess the risk of metal mixtures in polar environments

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

M. S. Adams, CSIRO; C. K. King, Australian Antarctic Division; D. F. Jolley, University of Wollongong / School of Chemistry; C. R. Janssen, Ghent University / Applied Ecology and Environmental Chemistry; S. Huysman, Ghent University; K. Demeestere, Ghent University / Sustainable Organic Chemistry and Technology; 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

In vitro bioassays were used to evaluate endocrine disrupting effects (ER and AR receptor), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropolllutants. The presentation will show the detailed protocol.
615 Marine Diatom Exposure to a Complex Mixtures of Fourteen Chemical Pollutants at Environmental Concentrations. What did we learn?
D. Napierkowska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; R. Carvalho, European Commission Joint Research Centre / Seawater Sediment Laboratory; D. Napierska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; I. Sanseverino, European Commission Joint Research Centre; S. Balzamo, M. Patalivo, ISPIRA 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 gene expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Duron and Isporoturon. Signatures induced by the Cadmium or Nickel partially overlapped with the mixture signature. The exposure to the other compounds did in general not induce relevant signatures, although a weak overall consistent signature is present for some of them. In conclusion the effects of the mixtures could be explained mainly by the exposure to the two herbicides.

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

616 How protective is the current risk assessment for soil invertebrates?
P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roembke, ECT Oekotoxikologie Gmbh; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Lage, Environment & Safety – INVICTA, University of Coimbra; S. Cheлинko, 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 standard (re)登记evaluation on terrestrial ecoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the current risk assessment (lab to field extrapolation) might lead to both an underestimation and an overestimation of the toxicity of test chemicals for organisms in natural soils. A screening project has been initiated in spring 2016, comprising a literature review aiming to investigate the effects of soil properties on the impact of PPP´s on soil organisms. The practical part of the project included laboratory studies on Eisenia sp. and Folsomia sp. on 4 PPP in 5 different soils. The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6. The highest deviations were detected for Folsomia sp. exposed to the active substance Pendimethalin in OECD10% and Lufa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species Eisenia sp. as well as Folsomia sp. is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be set on the identification of key parameters influencing toxicity in different groups of species in order to create conceptual models allowing the extrapolation from the lab towards the field situation.

617 Risk assessment of soil organisms in field: dealing with earthworm community Y. Bayona, F. Brulle, ANSES / U3EIV; A. Bovin, ANSES
Fourier Transform Infrared Reflectance Spectroscopy (FTIR) is an alternative risk assessment for soil organisms followed the Tiered Approach procedure. It covers worst-case situations (i.e conservative estimates and toxicity laboratory studies) to the most realistic assessment (i.e. Field studies). The recent EFSA opinion proposed a framework for risk assessment of soil organisms and definition of protection goals. Still, no statistical tool was proposed when dealing with field studies as higher tier. The aim of this communication is to test tools routinely used for regulatory risk assessment of communities. The tools for the ecological communities were mostly developed for aquatic organisms risk assessment. The multivariate analysis (PRC) is used for the community comparison. Individual populations are compared date-by-date varying using statistical analysis commonly including Dunnett test and Wilcoxon test. The main weakness pointed out is that the number of replicates which could lead to false negative or false positive. The recently improved Minimum Detectable Difference is used to assess the robustness of the data used in these statistical tests. Then, through the analysis of results, we propose some lead and improvements for the soil community risk assessment, from the experimental design to the sampling choice and statistical analysis in the context of higher tier regulatory risk assessment of chemicals for earthworm and soil communities.

618 Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals K. Leach, REACH; 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 legislation on chemical management (REACH) and the data were therefore primarily used to derive protection goals for non-registered substances (PRR) for respective risk assessment. To facilitate a more flexible derivation of ecological quality standards for metals in soil for different protection goals (e.g. remediation thresholds), jurisdictions, regions or sites, while still making maximal use of the wealth of data and models already available, a metal soil threshold calculator tool has been developed. This freely available spreadsheet reports almost 1200 reliable toxicity data for the direct effects of the metals Cd, Co, Cu, Pb, Mo, Ni and Zn to soil organisms (plants, invertebrates and microbial processes) and calculates ecotoxicological threshold concentrations expressed as (pseudo-)total (i.e. aqua-regia extractable) metal concentrations in soil (mg/kg dry weight). All metals covered have sufficient chronic toxicity data allowing the derivation of an SSD. The soils used for ecotoxicity testing cover for each metal a wide range of soil properties, making the results representative for most regions in the world. Several options are included to allow calculation of metal soil threshold concentrations for various goals (e.g. risk assessment or setting of remediation thresholds for different land uses): selection of organism groups or species to be considered, selection of
effect levels from the original dose-response curves (ECs), selection of protection level (probability level in SSD), bioavailability models to be included etc. The advantages of this approach are the maximal use of available toxicity data and bioavailability corrections and the enhanced transparency in the derivation of ecological quality standards for metals in soil for different goals and different scenarios.

619 Assessment of pesticides on a landscape level - What is basically needed? A. Toschki, Research Institute gaiac; M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research

It is recently discussed and is widely accepted that species diversity and habitat quality dramatically decreased in the last decades due to the increasing intensity of agricultural land use. The decline was proved for various species groups, such as soil arthropods, insects, butterflies, birds etc. With the loss of species also a variety of benefits and ecosystem services that were provided by the species dropped away. The impact of that can be quoted as a decisive factor, but the all explaining reason for this unacceptable loss of biodiversity cannot be assigned easily to a single factor and is more due to a multifactorial complex of influences which is responsible as a whole. In current risk assessment procedures, single pesticides were authorized individually independent of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally, there is no transparent or quantification of the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thus risk for the future operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

620 Potential new soil test requirements for the risk assessment of pesticides in the European Union: do we have the right methods? J. Roembke, ECT Ökokontroll GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

In February 2011 the European Food Safety Authority (EFSA) published a Scientific Opinion entitled “Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms”. This document summarizes various scientific issues relevant for the risk assessment of plant protection products (PPPs) for in-soil organisms, i.e. micro-organisms and invertebrates (plants are covered in another EFSA document). The aim of this document is to temper the discussion on quantification of the use of pesticides in soil ecotoxicology, but – more importantly – it also summarizes the scientific background for a new approach. In the future, soil risk assessment should be based on the ecosystem service approach, meaning that important services at agricultural landscapes (e.g. nutrient cycling, soil structure maintenance, just to name a few) have to be protected. In consequence, protection goals for soil organism communities, i.e. their biodiversity and functions relevant for providing these services, have to be defined. This contribution will focus on one important question, assuming that the new risk assessment approach is put in practice: Do we have the appropriate (e.g., scientifically sound, robust, standardized) methods to cover the new data requirements? In this contribution we focus on four aspects of the new methodology: Organism groups, endpoints, soils, regions (i.e. agricultural practices are not covered). In fact, there are various research needs which have to be addressed asap, i.e. before the new requirements will be put in practice. We focus our discussion on those test systems which are already standardized (or which are in the process of being standardized in the foreseeable future). Besides OECD also methods published by ISO or national organisations such as Environment Canada are considered, knowing that the latter often have to be adapted in order to cover the specific needs of PPP environmental risk assessment schemes. In addition, the same criteria as in other comparable approaches will be used and examples of suitable methods will be given. Most important is whether they can be modified in a way that they are useful under the upcoming EFSA regulations.

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

Nowaday bio-composite materials have increased automotive market penetration, which intend is to produce environmental friendly products while maintaining their competitive edge [1]. In particular wood-fibers is considered a more environmental friendly alternative to the synthetic reinforcements as t alcum, glass and carbon fibers. The reason behind is due to their less impact on production issues (sharp reduction of toxic and fossil materials as well as for the energy expenditure, light-weight profile and more energy credit through their incineration [2-4]). This study presents the application of a newly engineered wood-based product, called Woodforce®, for the production of an automotive PedalBox Support (PBS); in particular, the environmental advantages/disadvantages are presented and discussed when such material is thought to substitute the glass fibres. At this scope, a comparative environmental analysis has been performed between two materials - a standard material (with glass-fibres content) and an innovative (with woodchip content) - which perform the same function. 1. References 1) Humans A., Curus M. 2016. Wood and natural fiber composites current trend in consumer goods and automotive parts. Reinforced Plastics 60: (3) 170-173. 2) Joshi S.V., Drzal L.T., Mohanty A.K., Arora S. 2003. Are natural fiber composites environmentally superior to glass fiber reinforced composites? Composites: Part A 35 (2004) 371–376. 3) Boland S. Claire, De Kleine R., Keoleian G.A., Lee E.C., Kim H.C. 2010. Wood–fiber composites for Automotive Applications. Effects of Renewable Energy Content and Lightweighting. Journal of Industrial Ecology 20: (1) 179-189. 4) Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture.

623 Resource depletion of a Lithium ion battery cell technology M. Cusenza, Università degli Studi di Palermo; S. Bobba, G.A. Blengini, Politecnico di Torino; M. Cellura, M. Mistrutta, University of Palermo Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode materials, are available in the market, such as LiMnO2, Li(Ni0.5Co0.5Mn0.5)O2. The cathodes contain a wide range of raw materials (RMs), among which e.g. cobalt is in the 2017 list of CRMs for the Europe Union (EU). CRMs are both of high economic importance for the EU, and vulnerable to supply security. In the last years, the increasing demand of LIBs has triggered a growing interest in the need to ensure the security and the sustainability of the lithium cycle [1]. In order to be able to assess the impact of a Lithium ion battery cell technology on resource depletion, a life cycle assessment based on the benchmark of the NMC battery is selected, with NiCoMn ternary cathodes (NMC). In this context, the authors carried out a Life Cycle Assessment of an 11.4 kWh LMO-NMC battery cells usine in plug-in EVs with the following goals: to assess the impact on the mineral, fossil and renewable resources depletion (MFRRD); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRRD; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRRD and CRMs requirement. The LMO-NMC battery cell technology is modelled as 0.5LiMnO2 – 0.5(Ni0.5Co0.5Mn0.5)O2, using both primary and secondary data. The cells of the 11.4 kWh LMO-NMC battery are selected as functional unit. The system boundaries include RMs supply, manufacturing, transports and infrastructures. The results show that the LMO-NMC cells have an impact on MFRRD of 0.34 kg Sb equiv. The relevant share of MFRRD (34%) is caused by the cobalt sulphate production used in the cathode. Of the 27 CRMs for the EU, the analysis shows the relevance of only two of them: cobalt and barite. From the comparison with the NMC cell, carried out with reference to 1 kWh of nominal capacity, results that the MFRRD impact and the cobalt requirement of the LMO-NMC technology is lower, respectively, of a percentage equal to -4.4% and -29% than those of the NMC. The results indicate that the LMO-NMC cell could be a suitable technology to meet the demand of the EV market as it involves a lower impact on MFRRD and a lower consume of CRMs compared to the NMC cell.

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

The transport sector causes the environmental impacts that are mainly connected to the passenger car activities. In this context, strategies for reducing the environmental impacts related to the transport sector are required moving from cars to alternative transport vehicles, such as electric bicycles. Although many studies have been focused on the application of the Life Cycle Assessment (LCA) method for assessing the environmental impacts of electric vehicles (EVs), there are...
few information regarding the environmental impacts connected to the life cycle of the charging infrastructures to operate the EVs, and, in particular, regarding the environmental performance of charging station for e-bicycles This study aims to evaluate, through the application of the LCA method, the environmental burdens of a stand-alone charging station for electric bicycles manufactured in Italy, assuming its installation and utilisation in Italy with a lifetime of 15 years. The investigated station is characterised by four recharge points 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 electric bicycles, envisaged as the potential avoided production of conventional electricity which may be replaced by the electricity surplus produced by the wind-solar system. The functional unit (FU) adopted to perform the analysis is one charging station installed in Italy and used for a lifetime of 15 years. System boundaries follows a cradle-to-grave approach and include four main phases: 1) production phase, 2) installation phase, 3) use and maintenance phase, and 4) end of life phase. The results are presented 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. Cutai, C. Chiesari, P. Porta, ENEA; M. La Monica, C. Scaglirano, CINGeo

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

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

A. Albers, P. Collet, D. Lorne, IFPEN / Economics & Technology Intelligence; A. Benoist, CIRAD / UPR BioWooEB ELSA research group; A. Hélias, Montpellier SupAgro / LBE ELSA

Energy production and consumption is the main driver for anthropogenic GHG emissions, and in the French context, the transportation sector is the principal emitter accounting for almost one third of these emissions. The growing need to reduce GHG emissions and mitigate climate change demands tapping alternative energy resources, as currently enforced by energy policies (e.g. the French Transition Plan for Growth Act). LCA scholars increasingly assess the environmental performance of the advance biofuels, but mainly from a static perspective. Results are therefore limited to linear simplifications, whereby long-term impacts might be neglected or underestimated. New dynamic LCA approaches have been suggested, however no consensus is available on how to treat Climate sequestration dynamics over different timeframes. This study further addresses the temporal shortcomings of bioenergy systems while considering future outlooks and consequences on the market dynamics. The approach consists of a hybrid-approach combining the MIRET energy systems model with dynamic Chio accounting models towards dynamic LCA. The former—a prospective techno-economic partial-equilibrium model covering the French energy-transport sectors—is a reference for scenario-dependent outputs over a long timeframes (2007 to 2050), exploring optimisation options under no-policy and policy-driven constraints. The latter assesses biomass growth and allometric relations representing the Chio fixation of a vegetation species per hectare on an annual basis, and thus the time-dynamic Chio flows between the atmosphere and the technosphere. The assessed Chio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Chio inventories are then combined with both dynamic and static LCA characterisation factors, towards a comparison of both approaches. The results show that the time factor is an essential component to properly assess long-term Chio sequestration potentials and climate benefits of lignocellulosic biofuels. The combination of technological innovation and market dynamics in a transitioning energy system expands the assessment boundaries providing insights into least cost (economic optimisation) and low carbon (Chio sequestration) options influenced by policy and decision constraints. Future refinements addressing other bioenergy paths are envisaged.

627 Poster spotlight: TH304, TH309, TH314

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

628 SIMONI: Smart integrated monitoring of the water quality

R. van der Oost, Waternet / Onderzoeken & Advies; G. Sileno, Waternet / Research and Development; M. Thao Nguyen, Waterproof, L. Moria, Waternet / Water Systems

At present, regular water quality assessment is almost exclusively performed by target chemical analysis of substances. Scientific research over the last decades, however, demonstrated that water quality assessment with only chemical analyses is not reliable. Since over 100,000 harmful substances may be present in the aquatic environment, a paradigm shift from ‘substances’ to ‘effects’ has to be encouraged in order to implement a more holistic approach in regular monitoring. Therefore, an alternative Smart Integrated Monitoring (SIMONI) strategy has been developed by Dutch water research institutes. The purpose of this 2-tiered strategy is to obtain more reliable information on the chemical water cycle quality without increasing the monitoring costs. Key factors for generating this model were the selection of the most relevant bioassays and the design of effect-based trigger values (EBT). Tier 1 of the strategy combines micropollutant concentration by passive sampling with testing of 15 bioanalytical endpoints. This hazard identification makes the distinction between low, acceptable and increased ecological risks. Only at sites where tier 1 indicates increased ecological risks, a customized tier 2 research is performed to identify the chemicals that cause the bioanalytical effects and to evaluate if observed in vivo 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 found that those hot-spots are generally located at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wwp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for msPfA determination (potentially affected fraction of water organisms due to multiple exposures). At most sites with increased ecological risks due to micropollutants, similar classifications were obtained with bioanalytical and extensive chemical analyses. The tier 2 research at agricultural greenhouse areas identified eight pesticides contributing most to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedick passive sampler extracts

M. de Baat, University of Amsterdam / IBED-FAME; M. Thao Nguyen, Waterproof; R. van der Oost, Waternet / Onderzoeken en Advies; W. van den Berg, Waterproof Laboratory, Research and Validation; P. de Voogt, University of Amsterdam / IBED; M. Kraak, University of Amsterdam / IBED-FAME

A large portion of the toxic effects observed in surface waters cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make up of a water body. Effects observed in surface water cannot be explained by compounds that water authors
samples, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced Speedisk, POCIS and Speedisk passive samplers were simultaneously deployed at sites likely to be contaminated with polar compounds, including agricultural greenhouse sites and wastewater treatment plant (WWTP) impacted locations. The extracts of the passive samplers were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERu, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKILT WaterSCAN for antibiotics activity. In addition, the Microtox test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger values exceeding the toxicity threshold and therefore to the detection of ecotoxicological risks. Hence, POCIS outperformed Speedisk in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzenophene, 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 to bioaccumulate to cause toxic effects in the accumulated organisms. Benzophenone-3 (B3), benzophenone-1 (B1), benzophenone-4 (B4), benzophenone-5 (B5), benzophenone-6 (B6), benzophenone-3 methyl (B3M), benzophenone-3 methylethyl (B3ME), benzophenone-4 methyl (B4M), benzophenone-4 methylethyl (B4ME), benzophenone-5 methyl (B5M), benzophenone-5 methylethyl (B5ME), benzophenone-6 methyl (B6M), benzophenone-6 methylethyl (B6ME), octocrylene (OC) are four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larvae and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BPs and OC and their transformation products to the overall biological or toxic activity of a sample. In this study, we applied a systematic approach combining effect-directed analysis (EDA) for hormones used in high volumes in pharmacy were applied. In addition, a novel high throughput Effect-directed Analysis (HT-EQA) 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 activity in WW was reduced significantly, and the estrogenic activity remained. The anti-androgenic and anti-estrogenic activities in WW are attributed to the presence of a metabolite of androstenedione and testosterone. Application of the HT-EQA-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-EQA platform can help to characterize and ultimately identify the responsible compounds.

631 Current status of in vitro bioassay approach in environmental risk assessment of emerging biotic environmental mixtures and individual organic contaminants

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Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays combined with a detailed chromatographic analysis, and in some cases the effect-directed analysis, in order to identify principle modes of action of contaminants bound to river sediment, airborne or diesel exhaust particles. Toxicity profiling of selected individual contaminants was used as a complementary approach, which aimed to identify major toxic modes of action and principle contributors to specific toxicity effects. The AhR-mediated activity has been recognized to play a key role in toxicity of organic extracts of abiotic environmental mixtures. Using the DR-CALUX assay, we established relative effective potencies (REPs) of large (up to 2 kg) of polyphenolic aromatic compounds, including PAHs, methyl- and ox-PAHs, triphenylethene, bisphenol A and bisphenol F, and the glendiloxams, dibenzo-p-dioxins and dibenzo-furans. Recently, we have also developed REP values in human AhR-dependent reporter gene assay, in order to compare the potencies in rodent and human models. Using a set of various CALUX assays, receptors and selected individual classes of organic contaminants. The general outline of those studies will be illustrated using an example of a detailed in vitro toxicological evaluation of standard reference material of diesel exhaust particles (SRM 2975), with an aim to document both the complexity of the observed effects and the difficulties faced when applying these data in risk assessment of complex mixture. [This study was supported by the Czech Science Foundation, grant no. P503-12-G147.]

632 Hormone-like activities in waste water characterized by CALUX bioassays, ecotoxicological analysis and Effect-directed Analysis

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Emission of compounds with biological activities from waste water treatment plant (WWTP) is a topic of concern for ecology and drinking water companies. We investigated the occurrence of hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC-MS target analysis method for hormones used in high volumes in pharmacy were applied. In addition, a novel high throughput Effect-directed Analysis (HT-EQA) 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 activity in WW was reduced significantly, and the estrogenic activity remained. The anti-androgenic activity was attributed to the presence of androstenedione and testosterone. Application of the HT-EQA-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-EQA platform can help to characterize and ultimately identify the responsible compounds.

633 Non-target screening and identification of emerging pharmaceuticals and their transformation products in wastewaters

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Wastewaters represent a major pathway of introduction of EDCs into the aquatic environment. Considering the University of Bordeaux in the framework of the pollution of marine and terrestrial environments by pharmaceuticals and their transformation products, many EDCs are currently unknown. Therefore, characterization of the presence and identification of EDCs in wastewaters are major issues in order to assess their occurrence in natural waters and the associated risks for wildlife. To date, in vitro assays based on luciferase reporter gene expression, are available to assess the biological activities of samples in a quantitative, sensitive, specific and fast way. The comparison of concentrations derived from bioassays and from chemical analyses allows assessing the contribution of micropollutants to the overall biological or toxic activity of a sample. In this study, a systematic approach combining effect-directed analysis (EDA) and high resolution spectrometry was applied to several urban WWTPs to establish an overall contamination diagnostic and to identify major contaminant that could be released in environment. For this purpose, crude extract from influent and effluent of an urban WWTP were analyzed by LC-QTOF and tested on estrogens, androgens and glucocorticoids 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 water were produced by the transformation process suggesting the formation of transformation products. Concerning the strategy implemented to identify compounds of interest, we was decided to use effect-directed analyses methodology to have a tool to target active compounds in relation with selected biological activity. To this end, the crude extracts were fractionated by HPLC and biologically active fractions were isolated for further chemical identification. Biological fractionation profile of samples indicated the presence of estrogenic and glucocorticoid activities at all studied sites with very similar fractionation patterns between sites, highlighting major and recurrent individual fractions. The identification of active compounds was performed using LC-QTOF and several drugs and their transformation
products (e.g. O-desmethyl venlafaxine, O-desmethyl tramadol) were recurrent found. This approach combined to LC-QTOF has allowed establishing a list of systematic detected non-target compounds in several wastewaters.

Indigeneity and Science: A collaborative work in progress

634 The Nechako White Sturgeon Recovery Initiative: A discussion of species at risk conservation, scientific outreach, community and First Nations support

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Nechako white sturgeon (Acipenser transmontanus) is 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 actions acting on the Status of Endangered Wildlife in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional governments, industry, and public volunteers. The CWG plays a dual 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

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The NSERC CREATE H2O program is the first science-engineering research training program in Canada that combines technical water and wastewater management training with Indigenous theory, law and methodological skills training. Since its inaugural year in 2013, the program has trained 86 students who have collectively worked with 30 First Nations communities in the provinces of Manitoba, Ontario and Saskatchewan, Canada. 33% of the university students and postdocs enrolled in the program self-identify as Indigenous. This presentation provides an overview of the approaches the program is using for: engaging communities and students in research training activities, Indigenousizing science and engineering curricula, and designing advocacy strategies to support clean drinking water as a human right in First Nations communities in Canada. Case studies are presented to demonstrate the community-based monitoring programs implemented to examine drinking water quality in First Nations homes. First Nations communities participating in the research have 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

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Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and socio-economic activities on the health and wellbeing of Indigenous communities. 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 (K-W) and Kangiqsujujuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We present results from inuit perspectives on REEs community engagement: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern fish? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key species important for both biomonitoring and country food. Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

637 Te Ohu Mo Papatānūku: A Collective Response to Healing

T. Godfrey, H. Hirieme, Te Whare Whananga O Awauniarangi / School of Undergraduate Studies

The use of pentachlorophenol (PCP) as an anti-sapotoxin in timber treatment, with subsequent disposal of chemically treated wood waste in the Whakatane District of New Zealand has resulted in a legacy of contamination. There are 36 identified wood waste sites located on private and public lands, as well as the customary lands and waters of the indigenous Ngati Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formation of two collaborative groups in the west coast of New Zealand that are comprised by indigenous members of Ngati Awa, whilst being strongly supported by scientists, local government agencies, and industry. As a consequence of ongoing research, the use of a rather unique approach utilising combined myco- and phytoremediation to remediad dioξin-contaminated land has been adopted. Whilst implementation of the approach is underpinned by science, the use of “nature to heal nature” is an approach that resonates with the indigenous community. Contemporary environmental problems resulting from anthropogenic activities often require the use of scientific based solutions. Hence, even when indigenous participation is encouraged by the scientific community as part of the problem solving process, the contribution of indigenous knowledge may be considered of less value than scientific knowledge. Of vital importance to ongoing environmental monitoring however, is the role of indigenous knowledge – indigenous relationships informed by binding and enduring familial links with lands, waters, and people. This presentation builds upon previous presentations detailing the journey of the Te Ohu Mo Papatānūku research collaboration – using a synchronistic approach –
Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (II)

Tap water intake of poly- and perfluoroalkyl substances (PFASs) in relation to serum concentrations in a nationwide prospective cohort of U.S. women X. Hu, F. Laden, Q. Sun, P. Grandjean, Harvard University; L.W. Yeung, University of Oerbro / 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-pollutant 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=210) of matched 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 from 1% to 94% by up to a factor of 2-3. We will investigate how this ratio varies geospatially and whether it is associated with distance to well-known point sources. The spatial analysis results will also be discussed in the presentation. By comparing PFAS concentrations in archived tap water sample with recent tap water samples matched on the township, we found the fraction of quantifiable PFASs (i.e. known PFASs) has decreased in most towns and unknown extractable organic fluorides (EOF) has increased. Our analysis suggests tap water may be a significant exposure source for five PFASs among a group of U.S. women from diverse geographical areas. Increases in unquantified EOF in recent tap water suggest additional quantification would be worthwhile. Other exposure sources such as consumer products are suspected to dominate overall exposure of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.
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 Biology, University of Vermont / Department of Environmental Health Sciences; O. Jolliet, University of Michigan

When interpreting biomonitoring data, we are limited by the cross-sectional nature of biomonitoring data and incomplete longitudinal data. It is important to differentiate between the potential influential of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product usage. In addition, an overarching systematic approach to studying exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistency of chemical biomarkers from 16 different classes of chemicals from databases, literature 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 aim of the present study were to verify the suitability of biochemical responses of estuarine fish (Microgisons formarum), copepod (Acartia tonsa) and crabs (Callinectes sp) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments in northeastern Brazil. Thus, based on field sampling of fish, crabs, and shellfish from northeastern Brazil, we explored the influence of fish species, age/size class, and trend monitoring. To this end, a dedicated sampling campaign was designed which covered six different freshwater sites. Fish were caught at sampling sites in the rivers Weser, Havel, Elbe and Moselle, in Lake Starnberg and a lagoon at the Baltic Sea. At each site three of the fish species were sampled that are listed in a German guidance document (RAKON IV.3): bream, chub, perch, roach and whitefish. During each sampling campaign it was tried to obtain twenty fish per species from two different age classes allowing multiple comparisons. Fish were dissected into fillets and carcasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by examining scales, which covered six different freshwater sites. Fish were caught at sampling sites in the rivers Weser, Havel, Elbe and Moselle, in Lake Starnberg and a lagoon at the Baltic Sea. At each site three of the fish species were sampled that are listed in a German guidance document (RAKON IV.3): bream, chub, perch, roach and whitefish. During each sampling campaign it was tried to obtain twenty fish per species from two different age classes allowing multiple comparisons. Fish were dissected into fillets and carcasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by examining scales.
646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms

S. Kumar, CSIRO / Center for Environmental Contaminants Research; L. Rintoul, Queensland University of Technology; F.D. Leusch, Griffith University / Australian Rivers Institute

Plastic particles within the microns range (microplastics, MP) are increasingly of 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 koreanus) on particle size was investigated by studying the ingestion and egestion processes in response to microplastics in the size range of 1-5000 µm. Results showed that microplastics could cause more serious impacts on aquatic organisms. To further explore the defense mechanism in response to different sizes of microplastics, 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 multienzyme-resistant (MXR), resulting increase of sensitivity of rotifers to environmental pollutants. Our study provides a better understanding of molecular responses in the rotifer B. koreanus in response to microplastics and their potential impacts on the aquatic ecosystem.

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

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

The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e., additives and side products, attracting less understood. In this study, we identified microplastics in the wastewater effluent, which possibly originate from synthetic clothing and cosmetic products, respectively. This suggests that WWTPs can act as a significant pathway to release microplastics to the aquatic environment, given the large volume of treated wastewater being discharged on daily basis. The effects associated with wastewater-based microplastics (e.g. fibres and beads) were thus investigated by exposing two freshwater organisms, a water flea (Daphnia magna) and a midge larva (Chironomus tepperi), to microplastics in water and sediment, respectively, at concentrations within the range of environmentally realistic concentrations. A dose-dependent effect was observed after acute and chronic exposure of D. magna to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than reported environmental levels. Further, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tepperi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 µm showing more pronounced effects. Our study demonstrates that microplastics are released into the environment by WWTPs and can have effects on freshwater organisms at concentrations within an order of magnitude of environmentally relevant levels.

648 Microplastic size-dependent toxicity, oxidative stress induction, and multienzyme-resistant (MXR) inhibition in the monogonont rotifer (Brachionus koreanus)

C. Jeong, J. Lee, Sungkyunkwan University

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

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

B. Cormier, EPOC University of Bordeaux; M. Larsson, Orebro University / MTM Technology-Environment research centre (MTM); P. Guégan, UCD; C. Clérendeau, EPOC University of Bordeaux; A. Karman, Orebro University / MTM Research centre; B. Morin, University of Bordeaux; EPOC; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Béguin, O. Rouyer, IFREMER / Laboratoire de Recherches Halieutiques de La Rochelle; J. Cacheot, University of Bordeaux / EPOC; S. Keiter, Orebro University / MTM Research centre

The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 µm. MPs can result from runoff and degradation (biodegradation or weathering breakdown) of macroplastics or from microplastics and their size is between 1-5000 µm. Their concentration in aquatic environments is growing in 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, the objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microplastics for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larva. 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 deaccreased. 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, photoinduction response (PR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or composted MPs. Results showed that MPs can be vectors of pollutants which sorbed at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h of exposure to LDPE microparticles. Experiments are currently being done to test the toxicity of MPs.
habitats is that they might act as vectors of pollutants to marine organisms, since hydrophobic organic contaminants with low water solubility tend to concentrate on the surface of these particles. In this study we have compared the role of polyethylene MPs and microalga (MA) of similar size, as vectors of the organophosphorous insecticide chlorpyrifos (CPF) to Mytilus galloprovincialis man. With that aim, CPF pre-exposed MP and MA were offered to the mussels in a batch experiment in order to determine the extent to which it was transferred to the mussels and measured. AChE activity in digestive gland and gills was significantly inhibited at all CPF treatments, disregarding exposure time. Levels of GST activity in the digestive gland in the three CPF treatments (CPF, MA+CPF and MP+CPF) after 7 days exposure were significantly higher than levels in treatments without CPF. However, after 21 days exposure, GST activity in the controls significantly increased, and differences with controls disappeared. For GST in gills, a significant increase in activity was observed in the MP, CPF and MA-CFP treatments after 7 days, compared to the MA control. When the nine biomarkers recorded are combined using the Integrated Biomarker Response (IBR) index a similar response in the three CPF treatments is initially observed (7 d), but after 21 d an enhanced response in observed in the MA+CPF and MP+CPF treatments only. In conclusion, AChE inhibition was similar in all CPF treatments disregarding the presence of particles. However, both MP and MA particles in CPF-exposed mussels produced in the long term an increase in biomarker response compared to waterborne exposure. Therefore MP seem to play a similar role than natural organic particles as vectors of organics to marine organisms.

651 Poster spotlight: TH001, TH002, TH003

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

652 Dissipation of the carcinogenic patuioide in water resources

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Patuioide (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 1%). 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 = k[H+] + kneutral + kalkaline[H+].

The rate constants are: kneutral = 25.7±1.0 M-1 h-1; kalkaline = 9.5±6.0·10-1 M-1 h-1 and kneutral = 4.8±6.0·10-4 M-1 h-1. The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol-1. Hence, hydrolysis is a function of both pH and temperature. The purpose of this investigation was to study the degradation of PTA under near natural conditions using 10 different surface and groundwater samples from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. Sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e. no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline samples followed the existing model for hydrolysis. Winter samples exhibited slower degradation (half-lives in alkaline samples followed the existing model for hydrolysis.

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 compulsive protocols. In particular, the determination of marine biotoxins, released as a consequence of toxic algal blooms, is performed offline on fish or 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 an integrated direct Enzyme–Linked Immuno–Magnetic Capture microplate assay for the detection of Domoic Acid, Saxitoxin and Okadaic Acid in seawater. The assay is based on the fact, that in the presence of the target toxin, competition occurs and consequently the color production decreases proportionally to the toxin concentration. This analytical approach allows to combine antibody selectivity, convenience of a separation step through the use of magnetic beads and simplicity of the protocol. Next, the immunoassays were 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 Peltier refrigerated compartment was designed and incorporated in the instrument. Laboratory measurements were executed to validate the prototype efficiency to detect sub-ppb 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 data-logger for real-time data analysis.

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 exposure to bloom mats were observed together with death of marine invertebrates. When first toxic outbreaks related to O. cf. ovata occurred in 2005 along the Ligurian coasts (Italy), little was known on several aspects of the phenomenon. Although some Ostreopsis spp. were known to produce congeners of palytoxin (PLTX), O. cf. ovata was not known as a toxic species and its metabolic profile had never been investigated. Secondly, although PLTX itself was reported as one of the most potent marine toxins known, the role of PLTX congeners 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, strain-related differences, in vitro detected toxicity 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 occurrence of harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)
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

S. Barmaz, EFSA - European Food Safety Authority / Pesticides Unit; M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

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 sub-drivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.
plasma and liver cells exhibited toxic stress response. Canonical correspondence analyses revealed that concurrent with indicators of toxic stress, biomarkers of reproductive potential declined. To further examine the population level consequences, fathead minnows (Pimephales promelas) were exposed in the laboratory for three generations to the empirically derived urban CEC mixture at three environmentally relevant concentrations. Mixtures at environmentally 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 K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment; M. Cronin, Liverpool John Moores University; J. Veneseth, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iguchi, Yokohama City University / Molecular Environmental Endocrinology; C. LaLone, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Norwegian Institute for Water Research; C. Metzen, Leuphana University / School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers; ERDC, T. Rundberget, Norwegian Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Environmental Research and Development Center; Y. Song, NIVA / Ecotoxicology and Risk Management

A number of exogenous compounds have the potential to interfere with the endocrine system of animals and may perturb vital endocrine processes to a degree causing an adverse effect (outcome) on ecologically relevant endpoints such as growth, development and reproduction. These endocrine disrupting (ED) effects have been well characterised in aquatic vertebrates and mammals due to a well-defined endocrine system and substantial research effort in the last decades, but knowledge on ED effects in a larger range of species are still poorly characterized. Lack of knowledge on ED effects in invertebrates is currently a major limiting factor to properly perform risk assessment of endocrine disrupting chemicals (EDCs) across taxa. The present project has focussed on developing Adverse Outcome Pathways (AOPs) for EDs in aquatic crustaceans, and applying these to assess the hazard and risk of ecologically relevant complex mixtures of pollutants. Although several ED mechanisms have been proposed to be of relevance for crustaceans, perturbations of endocrine processes related to chemical interactions with the ecdysone receptor (EcR) and the Juvenile Hormone (methyl farnesyl) receptor (MfR) have been identified in both model organisms. 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 risk assessment.

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

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

662 Interference of hepatotoxicity with endocrine activity in zebrafish (Danio rerio) L.A. Baumann, University of Heidelberg / Aquatic Ecology and Toxicology; H. Holhech, University of Southern Denmark / Biology; L. Weltje, BASF SE / Crop Protection; Ecotoxicology; H. Schmidt-Posthaus, University of Bern / Institute of Animal Pathology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; T. Brauneck, University of Heidelberg / Centre for Organismal Studies Vitellogenin (VTG), a well-established biomarker for the diagnosis of endocrine activity in fish, is used in the OECD test guidelines 229, 230 and 234. A reduction of VTG production (mainly in males) and an endocrine 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 hepatotoxicity in a screening assay would unnecessarily trigger very labor-, animal- and cost-intensive higher-tier testing (e.g. a fish life cycle test). Therefore, an intuitive 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 / test or fish. Thus, we investigated the effects of two well-known hepatotoxicants, acetaminophen (APAP) and isoniazid (INZ), on zebrafish (Danio rerio) in a 21-day flow-through exposure test according to OECD guideline 230. Various hepatotoxicity- and endocrine system-related endpoints were recorded: - mRNA expression of different endocrine-related (vtg1, vtg3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoai, cyp2k19 and cyp1a1); - 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 hepatic 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.


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 (D. rerio) has been performed to examine if a pulse exposure to an ED might initiate - distinguishing effects and the establishment of a dose-response relationship is possible. The results will be used for a comparison with available data originating from a flow-through study with TC in zebrafish. A water-sediment system has been set up to expose different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints include early-life stage (hatching), growth, reproduction in adults and adult growth, sex ratio, vitellogenin levels and F0-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 (spacings 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 going through non-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.
664 A Tiered Approach for Screening Chemicals for Biomagnification Potential in Humans
A. Sangion, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnott, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology, P. Gramatica, E. Kuster, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

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

665 Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals
K.L. Foster, J.A. Arnott Research and Consulting Inc / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); A. Loomy, J.A. Arnott Research and Consulting Inc.; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; M. Embry, Illinois State University / Microbiology; G. Legault, Trent University / Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Despite the fundamental value of gut biotransformation rate information, relatively few measured in vitro data are available for humans compared to the thousands of chemicals requiring evaluation. Reliable models, laboratory measured in vitro biotransformation data and, in vitro-in vivo extrapolation (IVIVE) methods can be applied to address in vivo biotransformation rate data gaps and, coupled with data confidence assessment methods, uncertainty and data utility. We have developed a new database of 11,000 human in vitro biotransformation rate estimates (half-lives, clearance rates and rate constants) derived from liver microsomal, S9 homogenate, and hepatocyte-based assays for 8,500 organic chemicals from the literature and publicly available databases (i.e., ChemBL). The database is comprised primarily of pharmaceuticals and pharmaceutical candidates from various experimental sources. The organic chemicals in the database represent a broad range of physical-chemical properties (Log Kow=-4 to 13, Log Koa=0.01 to 47, Kow=10-4-4×106, k in vitro=10-3-4×105 mL h^-1 kg^-1) span about 8 orders of magnitude. We developed and applied novel data quality assessment methods based on proposed standardized testing guidance to address variability and uncertainty in the database. The data quality assessment methods included compiling physical-chemical property data (e.g., Kow, pKa, water solubility) for all of the chemicals and applying a mass balance in vitro model. The measured data quality scores (e.g., high or low confidence) may help identify datasets that are most appropriate for QSR development and for other potential applications (e.g., bioaccumulation screening, prioritization). The score results are further examined in a case study of seven chemicals and the utility of high and low confidence biotransformation rate data, its merits and limitations for various use contexts, are discussed and overall key findings of the critical review of existing human in vitro biotransformation rate data are summarized.

666 Sediment-associated cyclic volatile methylsiloxanes: Biotransformation in a freshwater oligochaete and an estuarine polychaete
H. Selk, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC

Chemical regulatory legislation of organic contaminants is generally based on an assessment of the chemical potential to persist (P) in the environment, bioaccumulation (B) in biota, and possess potential toxicity. Applying standardized exposure setups (i.e., water-only exposure) as historically has been employed in environmental risk assessment may underestimate bioaccumulation of hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms because: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, the bioavailable fraction may be able to metabolize organic contaminants (i.e., biotransform), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella tetuca and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.

667 Toxicokinetics and biotransformation products of diuron and 3,4-DCA in the developing zebrafish embryo (Danio rerio)
E. Jarnag, UFZ Leipzig / Bioanalytical Ecotoxicology; M. Krauss, Helmholtz centre for Environmental Research, UFZ / Mass Spectrometry; E. Küster, Helmholtz Centre for Environmental Research, UFZ / Mass Spectrometry; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Bioanalytical Ecotoxicology

Bioanalytical Ecotoxicology; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Bioanalytical Ecotoxicology

Diuron is a commonly used phenylamide herbicide which acts by interrupting the photosynthetic electron transport chain. Like other phenylamide herbicides diuron is bio-transformed to 3,4-dichloroaniline (3,4-DCA) which occurs in plants, the liver of vertebrates and in soil. Fish embryos do not possess the same metabolic potential as adult fish. It was not determined so far if different embryo stages differ regarding toxicokinetics and 3,4-DCA conversion. Here we conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella tetuca and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.

668 Application of a generic fish PBTK model for binary mixtures of chemicals
P. Salem, NERIS / METO; R. Beaudouin, A. Grech, C. Brochot, INERIS / Models for Ecotoxicology 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, may underestimate bioaccumulation of hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms because: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, the bioavailable fraction may be able to metabolize organic contaminants (i.e., biotransform), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella tetuca and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.

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assessment of single chemicals. (iii) Development of PBTK models for environmental risk assessment of multiple chemicals. Generic PBTK models for single compounds in rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), stickleback (*Gasterosteus aculeatus*) and zebrafish (*Danio rerio*) have been developed. Physiological description and parameters proposed by Nichols et al. [1] were updated by an extensive literature search. New mathematical functions were proposed to integrate the main factors influencing the toxicokinetics (water temperature, growth dilution, reproduction cycle, …). Default values for compound-specific parameters were estimated by QSAR models based on hydrophobicity [2, 3]. An optional interaction term was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

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

F. Gobas, Simon Fraser University / Resource & Environmental Management; M. Dimauro, K. Compton, Simon Fraser University; Y. Lee, Simon Fraser University / Resource and Environmental Management; V. Otton, Simon Fraser University / Resource and Env Management; J.C. Lo, Simon Fraser University / Biological Sciences; G. Allard, Simon Fraser University / Faculty of Environment

Bioaccumulation assessment is quickly evolving to respond to the need to conduct bioaccumulation assessment faster, better, cheaper while reducing animal use. In this presentation, we present novel methods for conducting both aqueous and dietary bioaccumulation tests that provide more information on bioaccumulation than currently used methods while also reducing animal use, effort and costs. Stream-lined aqueous bioconcentration test designs and dietary bioaccumulation studies following OECD 305 test guidelines are shown and discussed. A key element of the novel methods is the use of reference chemicals. In addition to experimental methods, we also present computational methods for deriving biotransformation rate constants, elimination rate constants and other bioaccumulation metrics with their associated error from the results of bioaccumulation tests. This involves an Excel worksheet, referred to as ADME calculator, that is specifically developed to interpret the results from aqueous and dietary bioaccumulation tests in terms of Absorption, Distribution, Metabolism and Excretion (ADME) rates including somatic and intestinal biotransformation rate constants, elimination rate constants, BCF and other bioaccumulation metrics. We further demonstrate that the application of reference chemicals can help to develop a full mass balance of the internal distribution of test chemicals in fish in the test and in the field under environment-specific exposure conditions. The application of the test results for determining exposure pathways of the test chemical under field conditions is illustrated. We conclude that bioaccumulation tests can become more effective in developing bioaccumulation profiles of chemicals when including reference chemicals.
Advances in environmental risk assessment of oil spills and offshore oil & gas operations (P)

MO001
An in-situ amphibian assay to evaluate oil spill-related toxicity in receiving freshwater systems
R. Krohn, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; J. Muscaltello, Lorax Environmental Services Ltd; J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine Divided dibutylm (dibutyl) transported from the oil sands in northern Alberta, consists of a mixture of chemicals, such as aromatic hydrocarbons, metals and other compounds, which may pose risks to wildlife and human health, if spilled into the environment. There is a major knowledge gap regarding remediating 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 (ISID-ELA). Ontario, Canada. Tadpoles were fed and monitored every other day and were euthanized when >50% reached their metamorphic climax (the day of forelimb emergence), to perform gross anatomical examinations, sample collection and relevant biochemical analyses. Major outcomes: 1. Time to metamorphosis (an established, sensitive biomarker) 2. Mortality rate 3. Morphometrics (total body mass, length and hepatic mass) Analyses: 1. Hepatic detoxification effort (ethoxyresorufin-O-deethylation (EROD) enzyme activity); 2. Thyroid hormones levels (serum biomarkers of thyroid dysfunction); 3. Triglyceride levels (reflecting body condition & energy stores). 4. Tissue contaminant levels (metals, PAHs) Baseline data for Wood frog development in Lake #260 were acquired in 2017, and potential pitfalls and solutions for the metamorphosis assay were identified. This assay will be used in the 2018 field season with the experimental shoreline oil spill and remediation strategies planned in Lake #260 at the ISID-ELA. In keywords: oil spill, endocrine disruptors, metamorphosis, Wood frogs

MO002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF PRODUCED WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
M.G. Smit, Shell International; O. Anako, SPDC Nigeria Ltd
The pursuit of excellence in managing risks associated with produced water discharges has led to continuous innovation of internationally acceptable risks assessment tools for determining the risks associated with produced water discharges. This study utilized a structured hazard and operability (HAZOP) assessment 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 the potential discharge processes and associated risks like SPME-GC and Microtox. In addition higher tier tools were applied like two way GCxGC, PETROTOX 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 at water levels above 25mg/L or oil concentrations above 500 mg/L in produced water would pose a significant risk to the ecosystem. The results of this study indicate that oil in produced water is likely to cause significant adverse effects at the discharge point and that the concentration of oil in produced water should be monitored. This will lead to an improved understanding of the environmental risk of hydrocarbons in the PW discharge. Phenols and BTX, coming 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 single screening tools (Tier-1) for frequent BPT monitoring to address variability and for tuning and focusing the larger Tier-2 and 3 assessments.

MO003
Assessment of the biological impact of using chemical dispersants to remediate oil spills in different environmental conditions using zebrafish embryos
Oil spills are a global concern due to their capacity to affect wide areas of the ocean and the 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 proposed to be toxic chemicals. The impact of crude oil on a specific ecosystem and its recovery potential are determined by the biotic and abiotic elements of the ecosystem such as species composition, temperature, oxygen level and salinity. At low temperatures the persistence of hydrocarbons in the environment increases. Based on the standard OECD test with zebrafish embryos, we have tested the toxicity of the chemical dispersant FINASOL OSR52 and of the water accommodated fraction of a naphthenic North Sea crude oil produced with dispersant (WAF<sub>OIL+D</sub>) or without dispersant (WAF<sub>OIL</sub>) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAF<sub>OIL+D</sub> and then used as passive dossers. Exposure to the dispersant caused 100% of mortality at concentrations ≥50 mg/L. Increased prevalence of malformations of a comparative analysis of predicted environmental concentrations (PECs) of chemicals present in the oil and WAF<sub>OIL+D</sub> resulted in a greater embryo mortality than the exposure through PDMS sheets. Significant differences were observed in hatching rate and in the prevalence of malformations of embryos exposed to WAF<sub>OIL+D</sub> in different conditions. Although no clear differences were observed in relation with the temperature production of WAF<sub>OIL+D</sub> in general greater survival rates were observed in embryos exposed to WAF<sub>OIL</sub> than to WAF<sub>OIL+D</sub>. Zebrafish embryos appeared as a good model to study the toxicity of WAF depending on the temperature and on the addition of chemical dispersants. Funded by the EU H2020-BG-2005-2 project GRACE (grant agreement #679266), Spanish MINECO (NACE project CTM2016-81130-R) and MECED (FFP grant to A.E.), the Basque Government (consolidated research group IT10-13) and the University of the Basque Country (UII 11/37).

MO004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea
R. Turja, Finnish Environment Institute, SYKE / Oil Research Centre; A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Kankaanpää, A. Reunamo, K.K. Lehtonen, K.S. Jørgensen, Finnish Environment Institute / Marine Research Centre
Marine diesel oil is produced and transported in large volumes in the Gulf of Finland and also used extensively as fuel in marine traffic in the Baltic Sea area. The heavily intensifying marine traffic in the area increases the occurrence of smaller spills and leads to higher risk of major oil spills, which would certainly have drastic consequences to the local ecosystem. Chemical composition, mainly the polycyclic aromatic hydrocarbons (PAHs), can be more variable between the different diesel fuels, affecting the toxicity of the diesel to exposed marine organisms. The aim of this study was to determine the changes in the concentration of PAHs in water, tissue, and biotransformation effect of PAHs in mussel tissues (Mytilus spp.) exposed to a common type of low-sulfur marine diesel oil produced by Neste Oil’s Porvoo refinery in Finland. The diesel oil was applied to mussels aquaria as a water accommodated fraction (WAF). The exposure set-up consisted two replicate aquaria in each treatment; control, WAF-high and WAF-low, each with 200 mussels in 20 liters of artificial seawater (10°C). Water and WAF treatments were renewed every two days. Changes in PAH concentrations in water were constantly quantified using a Tri05 EnvironO HSC-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 experimental groups after a one week recovery period in clean water. Water and mussel tissue samples were also taken to chemical analysis of PAHs. Based on the sensor fluorescence data the initial PAH concentrations were ca. 30ng/L in WAF-high and 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 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 Eucorae brasiliensis along four tropical estuaries in the Brazilian Northeast
J.S. Silva, R.N. Alves, UFPE / Universidade Federal de Pernambuco / Zoology;
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 productive chain. This study aimed to evaluate PAH biliary bioconcentration and biochemical effects in the fish *Eugenes brasiliensis* sampled along four estuaries in the state of Pernambuco, northeastern Brazilian coast. Fish were sampled in Aquirindá river, Formoso River Estuary System (ARFRES), Massangana river, inside Suape Estuary Complex (MA-SEC), Barra de Jangada Estuarine System (BJES) and Bacia do Pina Estuarine Complex (BPEC). Fish bile 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 biomagnification enzymes. Test compounds *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. Suape Estuary Complex includes a developing industrial port complex, while Rio Formoso Estuary System is within a low population density area focused mostly on tourism. Fish sampled in the two other estuarine systems near Recife metropolitan area, BJES and BPEC, showed chrysene equivalent bile concentrations between 13 x and 19 x higher than AR-FRES, respectively. EROD, GST and CAT activities were also increased in BJES and BPEC being 2 to 4 and 0.1 to 0.9 of CAT and GR compared to AR-FRES. Higher PAH bioconcentration and enzymatic induction of *E. brasiliensis* fish from BJES and BPEC indicate that these fish are spending energy to biotransform and excrete these contaminants, which may have consequences to their growth and survival in such regions. The results indicate that BJES and BPEC receive a greater input of PAHs, associated with the higher population density and anthropogenic activities in these regions. These results will be used as reference of monitoring these estuarine systems, especially Suape Estuary Complex, which is under a rapid urbanization and industrialization process.

**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 range of EROD and GST activities from 0.1 to 0.9 CAT and 0.1 respectively. Given the limited information available on the bioaccumulation potential of these substance classes, a dietary bioaccumulation study with rainbow trout was performed. Representative compounds with log *K*ₐ > 4.2 from five classes (sulfides, thiols, thiophenes, carbazoles and acridines) were investigated along with a positive control (hexachlorobenzene). Test compounds were administered via diet on three different experimental setups: (a) contaminated sediments; waterborne metal (Cd) and (c) waterborne organic pollutant (Benz(o)xypore). A battery of biochemical biomarkers was analysed in samples of liver and brain: Catalase, glutathione S-transferase, acetylcholinesterase and superoxide dismutase. Exposure to contaminated sediments led to reduction of catalase, glutathione S-transferase and superoxide dismutase activities and induction of acetylcholinesterase activities. Exposure to waterborne toxics 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. The present laboratory experiments helped characterizing the impact of pollution in sole at different levels of biological organization and different time scales. Work funded by ExxonMobil.

**MO007 Biochemical biomarkers and histopathology in juvenile *Solea senegalensis* for early warning assessment of marine ecosystem health**

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Human originated contaminants can appear diluted in estuarine and marine waters or accumulate in sediments. Chemical analysis provides key data on toxicant levels but gives limited inputs on their potential biological effects. The combination of biological responses with chemical data is essential to improve the assessment of environmental pollution. In this context, the use of benthic species for the assessment of biological effects of marine pollution is crucial for marine environment monitoring. In the Bay of Biscay, the common flatfish Solea solea, is commonly used as sentinel species in pollution monitoring programmes. The present study uses juvenile *Solea* sp. (23.24 ± 1.22cm standard length) exposed to conditions to better understand toxicity processes involved in biochemical biomarkers and histopathology. *Solea senegalensis* was exposed to three different experimental set ups: (a) contaminated sediments; waterborne metal (Cd) and (c) waterborne organic pollutant (Benz(o)xypore). A battery of biochemical biomarkers was analysed in samples of liver and brain: Catalase, glutathione S-transferase, acetylcholinesterase and superoxide dismutase. Exposure to contaminated sediments led to reduction of catalase, glutathione S-transferase and superoxide dismutase activities and induction of acetylcholinesterase activities. Exposure to waterborne toxics 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. The present laboratory experiments helped characterizing the impact of pollution in sole at different levels of biological organization and different time scales. Work funded by ExxonMobil.

**MO008 BIALKER CAR AND GENE TRANSCRIPTION VARIABILITY IN PERCH IN REFERENCE SITES USED FOR BIOMONITORING STUDIES**

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Perch (*Perca fluviatilis*) has been used in biological effect monitoring of point sources in Sweden for many years, for example in studies of effects of industrial effluents. Since 1988, perch has also annually been included in a program for integrated coastal fish monitoring in three reference sites along the Swedish east coast, sites characterized by no or minor local anthropogenic influences. Long term studies on reference sites may be necessary for future evaluation of baseline pollution. The data sets also show relatively large variations between years. To further investigate these time trends and to identify additional temporal variation in biological parameters, global gene transcription studies using RNA sequencing was performed. Perch collected in 2010 and 2014 were selected as they showed variation in several biomarkers such as the activity of the detoxification enzyme CYP1A (EROD), plasma levels of vitellogenin, markers for oxidative stress, white blood cells count and gonad sizes. The RNA sequencing analyses were performed on the five sexually mature female perch collected in 2010 compared to the five individuals from 2014. Also principal component analysis (PCA) using all sequenced transcripts identified large differences in gene transcription as perch collected during the separate time periods were clearly divided into two groups. Gene Ontology enrichment analysis showed that the differentially expressed genes were involved in biological processes such as innate immune responses, response to toxic substance, response to hypoxia and cholesterol biosynthetic process. In conclusion, differences in immune system parameters and responses to exposure of toxic substances have now been verified on two different biological levels (mRNA and protein) in perch collected in 2010 as well as 2014. Additional biological processes having temporal variation have been identified compared to the previous measurements of biomarkers.

**MO009 Cellular and tissue-level biomarkers in mussels (Mytilus edulis) sampled in two different study areas in the Northern Atlantic**

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Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to know it has not been commonly used in high latitude study areas. In order to establish reference values of cellular- and tissue-level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm; large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromsø (69° 40’ N) and Trondheim (63° 26’ N) were sampled in autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvBAS) in digestive gland epithelium, structural changes of digestive alveoli (MLR/MET), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation (high MLR/MET values) and retraction of digestive diverticula resulting in apparently higher relative intestestinal connective tissue (high CTD ratio) were observed in mussels from polluted sites. Parasitization burden 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. Lysosomal and apoplastic responses to xenobiotics were not evident in response to the exposure to oil spills. Biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT810-13) and UPV/EHU (UIF 11/37).

MO010
Cytotoxicity of the WAF of naphthenic North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mytilus galloprovincialis (L.)
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Oil pollution coming from accidental oil spills and from activities related to oil productions is a major threat to marine ecosystems. The presence of dispersed oil in the water column can affect marine organisms. In this study, the cytotoxicity of the dispersed oil (w/o dispersant) and of the oil dispersed with dispersant was investigated in the marine mussel Mytilus galloprovincialis (L.) as a model to evaluate the toxicity of the water accommodated fraction (WAF) of naphthenic North Sea crude oil produced at different temperatures (10, 15 and 20°C) with and without the dispersant Finasol OSR 52. In order to evaluate the contribution of the dispersant on the toxicity of the WAF plus dispersant, the cytotoxicity of the dispersant alone was also tested. Primary cultures of hemocytes were exposed in glass covered microplates to different dilutions of WAF (0.25, 0.25, 2.5, 50 and 100%) with and without the dispersant and to the dispersant alone at the same concentrations present in the WAF dilutions of oil plus dispersant (1.25, 12.5, 125, 250 and 500 mg/L). After 24 h exposure, cytotoxicity (MTT test) and ROS production were measured. WAF was moderately cytotoxic to mussel hemocytes. WAF produced at different temperatures showed similar cytotoxicity to hemocytes. A slight but significant decrease in cell viability occurred at 25, 50 and 100% WAF (p-value < 0.05) Regarding cytotoxicity, ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consoldiated research group IT810-13) and UPV/EHU (UIF 11/37).

MO011
Determination of inorganic cations and amines in wastewater, surface water, and neutralizing amine solutions by IC coupled with a single quadrupole MS
T. Christison, Thermo Fisher Scientific / Strategic Ion Chromatography Applications; G. Ellison, ThermoFisher Scientific / Chromatography and mass spectrometry division; T. Cross, Thermo Fisher Scientific; J. Rohrer, Thermo Fisher Scientific / Chromatography and mass spectrometry division. Inorganic cation and amine determinations are important to assess salt build-up in oil and gas production, and to assess marine neutralizing solutions, or to meet regulatory discharge compliance from petroleum and municipal treatment plants wastewater. Additionally, municipal water plants require cation determinations to monitor secondary water characteristics. In the petroleum industry, alkanolamines (monoethanolamine, diethanolamine, and methyldiethanolamine) are used routinely to prevent corrosion during transportation to the refinery or to remove sour gases during the refining process. Processing plants require accurate monitoring of structural changes in the endo-lysosomal system (LSC) of digestive cells were also determined. Higher VvBAS values were recorded in polluted sites than in mussels from reference sites in both study areas. Moreover, mussels from impacted sites exhibited enhanced atrophy of the digestive alveoli (high MLR/MET values) and retraction of digestive diverticula resulting in apparently higher relative intestestinal connective tissue (high CTD ratio). Cytotoxicity testing approach in mussel hemocytes could be used as an ideal and economical way to determine and confirm cations and amines. Here we demonstrate cation, alkylation, and alkanolamine determinations in amine neutralizing solutions, amine waste water, municipal wastewater samples, drinking, and surface water samples by cation-exchange separation followed by suppressed conductivity and mass spectrometry detections in a serial configuration. Cations, alkylamines, and alkanolamines were determined in full scan from m/z 18 to 250 and individual SIMs as bare ions and when further sensitivity is needed, as their desolvation. Unlike earlier IC-MS methods for cation determinations, the new single quadrupole MS setup satisfies the use of multiple lipids, and the no of analytes, desolvation. Limit of Detections were single digit or double digit µg/L for most analytes. The experiments showed that typically sodium, ammonia, and primary amines were the primary contaminants in the scrubbing amines.

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
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On 3 August 2017, two container vessels collided in the Pearl River Estuary, southwest of Hong Kong, leading to release over 1,000 tonnes of palm stearin into adjacent waters. About 200 tonnes of palm stearin reached south coasts of Hong Kong after two days. However, toxicity of palm stearin to marine organisms is unknown. This study, therefore, aimed to examine its contamination levels in seawater, sediment and animal samples collected from seven locations along the south coast of Hong Kong; determine its toxicities to selected marine organisms including microalgae (Isochrysis galbana and Chaetoceros gracilis), the copepod (Tigripus japonicus), the snail (Pila rufa), the surf clam (Spisula solidissima), and the fish (Oryzias melastigma), and derive interim water quality guidelines (WQG) of the palm stearin and thereby assess its ecological risks to local marine ecosystems. Samples of the palm stearin, surface seawater, sediment and three intertidal gastropods were collected twice (within seven days and four months after the incident) in six locations along the south coast of Hong Kong. Fatty acids in these samples were detected using gas chromatography-mass spectrometry and identified using standard solutions. These results suggest that relevance of temperature of WAF production on its cytotoxicity is limited. WAF caused a significant induction of ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consolided research group IT810-13) and UPV/EHU (UIF 11/37).
environment due to rainfall and surface runoff, and thus it may affect marine organisms. However, its toxicity and ecological risk to marine organisms remain largely unknown. Therefore, this study aims at investigating the environmental fate of larvicidal oil in the marine environment and its toxicities towards marine organisms at different trophic levels along the food chain. The composition of larvicidal oil was characterized by gas chromatography-mass spectrometry. It was found to consist mainly of aliphatic petroleum hydrocarbons (C8–C25) ranging from n-octane to n-pentadecane. The concentrations of larvicidal oil were determined with the range from 6.92 mg/L to 53.89 mg/L, by analyzing water samples collected along coastal areas in Hong Kong. Standard acute toxicity tests were conducted to investigate their toxic effects to the marine microalga Isochrysis galbana and Chaetoceros gracilis (primary producers), the intertidal copepod Tigriopus japonicas (a primary consumer), the brine shrimp Artemia franciscana and fish embryos of the marine medaka Oryzias melastigma. Our results showed that although all test marine species were not very sensitive to larvicidal oil with the ranking of their acute median lethal concentrations (LC50) that were all above the estimated hazardous concentration for 5% of species (HC5), the results of a probabilistic risk assessment showed that the local marine ecosystem had 65.7% address to be at risk (i.e., the neurotoxicity > 1) from exposure to larvicidal oil using Monte Carlo simulation, indicating that the current risk was uncont acceptably high. Hence, monitoring and control on the use of larvicidal oil as mosquito control pesticide would be urgently needed to mitigate its ecological risks.

MO014 Effects of a coastal oil spill on marine invertebrates and their potential to recover
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There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and environmental health. The main route of communication by poly cyclic 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 of stress and recovery were evaluated. The results showed that the recovery of the selected species was different depending on the oil exposure. Also, organism’s ability to recover over time was also addressed and these tools and species potential for costal monitoring pollution scenarios discussed.

MO015 Effects of oil exposure on visual function in early life stage fishes
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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, impacting 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 larva’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).

MO016 Effects of oil spill on coastal seaweed in the Arctic
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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. Water accommodated fractions (WAF) were used to measure the effects on the origin of crude oil and refinery process, and hence may have different effects due to their physical and chemical characterizations. Photosynthetic activity was measured as proxy for effect on growth and the self-cleaning potential was tested by wash in sea for oil smothered tips of F. distichus over a period of 2 weeks. The removal of the oils from the seaweed surface was considered as relatively fast (T1/2 3 3 days). Depending of oil type, the oil inhibited or stimulated photosynthetic activity. Marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated 1) that oil smothering was relatively fast washed off in the sea water; 2) that, depending on the oil type, photosynthetic activity were stimulated or inhibited; and 3) that the photosynthetic activity was still affected (stimulated or inhibited) even after 14 days, although oil on the surface was removed in 2 weeks. The work was funded by the European Commission Horizon 2020 programme and the Government of Greenland.

MO017 Effects of water accommodated fractions of crude oil on the Baltic Sea blue mussel Mytilus trossulus at different salinities
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In the Baltic Sea accidental oil spills are mainly combated using mechanical collection. However, this method is insufficient in harsh weather conditions such as high waves or in the presence of ice. The use of dispersants is an alternative counteractive method but in the Baltic Sea their use is restricted by HELCOM recommendations since the chemically dispersed oil may cause severe toxic effects on marine biota. In addition, the control of dispersants is difficult at sea, especially in water conditions is not well studied. In the present study, impacts of a crude oil and the dispersant Finsal 51 on marine biota were investigated under cold conditions (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-static aquarium experiment. Concentration of WAF or WAF-D in the aquaria was 5%. The mussels were sampled after 0, 1, 7 and 21 days of exposure, and analyzed for accumulation of polycyclic aromatic hydrocarbons (PAHs), and biological effects including acetylcholinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial community composition extracted from the gills and digestive gland tissues of the mussels were investigated by sequencing of 16S rDNA genes and quantitative PCR targeted to bacterial PAH-degradation genes. Water samples from the exposure aquaria were taken for oil and PAH analysis. Dispersant augmented the amount oil in the exposure water with 0.13 mg/L in 5.6 WAF compared to 44 mg/L in 5.6 WAF-D (GC-FID, petroleum hydrocarbons C17–C40). A significantly higher oil concentration was observed at the lower salinity WAF-D water with 44 mg/L oil at 5.6 and 1.82 mg/L 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 on the biodegradation of oil concentrations in water as well as be ecological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

MO018 Multiple biomarkers on the estuarine guppy Poecilia vivipara to monitor two Integrated tropical estuaries
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Integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuaries with ecologically relevant tools. The guppy Poecilia vivipara, native species with a broad tropical distribution, was utilized in such an approach, using in situ field exposures in cages...
migration of petroleum pollutants, and the relationship of this migration with the
and keto compounds (Fraction III), while the saturated hydrocarbons were least represented (Fraction I). This trend is almost unchanged in samples from different microlocations 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, which is of great concern for the environment. References: Miletic S., Ilic M., Avdalic J., Soletic Kudsten T., Belkoski V.P., Branimir Jovanviccevic 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, EMEC16, Book of Abstracts. November 30 – December 03. 2015. Torino, Italy.

MO019 NEW METHOD TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD
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Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are contaminants of functional base case sensitive impacts on the environment and human health. At fuel stations whose storage tanks are leaking, these substances may in contact with the soil and even reach the groundwater. In order to detect the concentration of these compounds in contaminated soils, gas chromatography (GC) is the most commonly used technique. However, in the present work it is proposed the use of high performance liquid chromatography coupled to diode array detection (HPLC-DAD) for the determination of BTEX in soil samples. A methodology was developed using as mobile phase methanol and H2O acidified with 250μL of H3PO4 (70:30, v/v), Eclipse XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 ml min⁻¹, λ = 205nm and T = 50 ° C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector. Data was acquired using the OpenLAB DAD 2.0.105 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. Reproducibility tests were performed with two solutions obtained from the standard solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for analyses of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in the next step.

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) up to depths of 15m. The sampled material was organized in the layers, and for all microlocations was made a lithological profile. Most of the samples have had a clayey-sand structure with low content of organic matter. Extraction of petroleum pollutants from soil samples were done using the Soxhlet apparatus with dichloromethane. After extraction, the dichloromethane extracts were then fractioned by column chromatography into fractions of: saturated hydrocarbons (Fraction I), aromatic hydrocarbons (Fraction II), and polycyclic aromatic hydrocarbons (Fraction III) [1]. For monitoring changes in the vertical migration of petroleum pollutants, and the relationship of this migration with the soil characteristics, the group composition was determined for each borehole of all microlocations, taking into account their lithological profiles. Results of our research showed that in all samples the most represented were polycyclic hydrocarbons (Fraction III), while the saturated hydrocarbons were least represented (Fraction I).
MO023
Risk-based assessment of produced water discharges - need for alignment
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Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water re-injection (PWRI), discharge of treated produced water is a commonly used disposal route applied in line with ALARP principles (As Low As Practically Achievable). 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. Theonus is on the industry to comply with regulations in the country of operation, to properly manage the risk of produced water discharges and to relieve any concerns over the potential environmental effects in the receiving marine environment. For this purpose the industry is applying a diversity of tools and methods within the framework of risk-based assessment (RBA). Tools and methods range from simple (tier 1) screening tools to comprehensive (tier 3) field verification programs and include among others; chemical analysis, determination of PBT characteristics through whole effluent toxicity (WET) studies 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 be 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 might apply 100m (US-EPA). This hampers straightforward comparison of results of risk-based assessments across industry and regulatory frameworks. Different objectives of the assessment undertaken might, however, be a reason for existing differences in methods. It is, therefore, crucial that for each assessment method a corresponding assessment objective is formulated and communicated. This presentation will provide an overview of RBA practices commonly applied by the industry to offshore produced water disposal, showing main assumptions, input requirements, risk endpoints applied and corresponding assessment objectives. Examples will be used to highlight the need for further harmonization of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

MO024
Spatial and temporal analysis of the risks posed by total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait
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Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb, V and Zn, and total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait were analysed from water samples collected from 23 stations since 1984 from Kuwaiti coastal waters. Here it was investigated whether concentrations of these determinants are at levels above Kuwaiti and internationally established assessment criteria (AC). The results indicate that Cu and Cd had the most Kuwaiti AC breaches over time. Comparing the data of the last sampled year to the least stringent international AC, then Cu and Cd showed breaches at all stations. The trends for trace metals are significantly downwards, especially for Cd and Hg. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

MO025
Temperature-dependent toxicity of Naphthenic Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
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Maritime traffic and oil platforms in the North and Baltic Sea have been growing during the last year, and the risk of spill is constantly increasing, mainly driven by changes in water temperature could modify the potential toxicity of spill products including chemical dispersants. The impact of crude oil water accommodation fraction (WAF) and dispersants have been widely studied but their potential toxic effects at different given range of temperature have not been deeply explored yet, to our knowledge. Thus, as a part of a European project called GIBUS the aim of this project was to assess the temperature-dependent toxicity of WAF produced from: Naphthenic North Sea crude oil (NNS), Finmos OSR52 dispersant (Total Fluids) and their mixture (NNS+Finmos 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 larvae and embryos of the sea urchin Paracentrotus lividus (Lamark) were performed. After the exposure period, EC50s were calculated and length of larvae were measured to assess the inhibition of larvae growth. Additionally, larvae abnormalities were determined to calculate a general index of toxicity (IT). In the present study, at 25°C NNS WAF provoked a lower inhibition of larvae length than the other studied temperatures. Accordingly, oil toxicity seems to be influenced by temperature. Indeed, temperature is known to affect hydrocarbon solubility and evaporation, and dispersant effectiveness. The same trend was found for Finmos OSR52 WAF. However, high temperature seems not to follow the same pattern in the case of the mixture. EC50s and IT values were in accordance showing that dispersion increases WAF toxicity. Overall, results showed that temperature affects oil, oil-dispersant and chemical dispersant toxicity. In the studied, larvae abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in dispersant WAF, with their mixture in between, for all the temperatures tested. Acknowledgement – This work has been funded by the EU H2020-BG-2005-2 project GRACE (grant agreement number 679266), Spanish Ministry of Education, Culture and Sport (PhD fellowship L.D.M FPUE01/505371 grant) and the Basque Government (Consorciated 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
L. Mariani, CEFAS-IRSA / RSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Virdo Lamberti, ISPRA Institute for Environmental Protection and Research and The Higher Institute for Environmental Protection and Research (ISPRA) is responsible for the evaluation of the potential environmental impact on marine ecosystem caused by the Produced Formation Water (PFW) discharged from Italian gas offshore platforms. A multidisciplinary approach has been applied through the monitoring of chemical-physical characteristics of water and sediment, matched with biological investigations, such as ecotoxicological bioassays on bacteria, algae, rotifers, crustaceans, echinoderms and fishes. The PFW is an effluent containing complex mixtures of contaminants, the composition of which may change with time. It is therefore necessary to analyse a large number of samples taken over a long period of time in order to adequately assess the toxicity of this effluent. The present paper discusses how specific toxicants within the whole study; the variability of the acute toxicity responses of fish to PFW collected on two offshore gas platforms in three years (2003-2005). More sensitive life stages (post larve 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: 6.25-12.50-25.00-50.00-100.00 % PFW were used. The LC50 and LC90 on post larve ranged from 17.67 % to 37.42 % PFW. The LC50 on post larve ranged from 6.68 % to 16.51 % PFW. The PFW acute toxicity responses showed a temporal variability of PFW as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.02% 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 polycyclic aromatic hydrocarbons in biota
Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francisco, I. Idowu, 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 (PAHs) of which 16 have been identified as common tiered framework for RBA is suggested as a first step to achieve this. The present paper reports on a specific to the need for alignment of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

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. Pampinan, International Research Institute of Stavanger / Environment
An approach to integrate biomarkers into probabilistic risk assessment has recently been developed and published regarding oil based discharges offshore. The main purpose has been to enable the use of monitored biomarker responses offshore as Risk Indicators in the procedures for Environmental Risk Assessment of produced water (PW) discharges. The principles of the approach and experiences obtained in applying it to existing oil field monitoring data will be presented. The approach was tested using a database of 798 data from the latest surveys in the biomarker based oil monitoring program Column Monitoring (WCM) program on the Norwegian Continental Shelf for assessment of PW effects. Cases including both a typical PW discharge and an alternative discharge make the data set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the surveys, the contamination by drill cuttings were the sources of contamination. The experiences gained are discussed in relation to contaminant sources, use of the approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

MO029

Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil

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The brackish Baltic Sea is a fragile ecosystem potentially sensitive to oil spills. Chemical dispersants are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on biota. The Baltic Sea blue mussel (Mytilus trossulus) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and acclimated at the experimental temperature of 5ºC to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersed Finasol OSR 51) (mixtures WAF-D) and sampled at 0, 1, 7 and 21 d. Tissue level biomarkers were investigated to determine the following biological responses: cell type composition (volume density of basophilic cells, VBAAS) of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MLT), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/ diverticular ratio (CTD), gonadal development and other histopathological alterations in digestive gland, gonad and gills. VBAAS significantly decreased after 1 d in mussels exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MLR/MDT changed markedly with exposure time at 15.0 whereas MET/MDTR showed no response. High CTD values in mussels observed at the salinity of 5.6 indicate a poorer condition of the digestive gland at low salinities than at the artificial increased salinity 15.0 psu. Pathological responses (atrophy, necrosis, vacuolization, haemocytic infiltration, granulocytomas) were assessed, being more evident in mussels exposed to WAF and WAF-D (21d). Salinity is a major factor controlling the biology of mussels in the Baltic Sea. The results obtained here indicate that during the early winter the health of native mussels in the very low salinity central-northern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first to investigate tissue level biomarkers in Mytilus trossulus in the Baltic Sea and provides preliminary reference values for future biomonitoring programmes in the area. Acknowledgements: Funded GRACE project (EU H2020 grant N°679266) and a Basque Gov. fellowship to EGU

MO030

Toxicity of diluted bitumen to freshwater fish and invertebrates

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This study investigated toxicity and chronic toxicity of two blends of diluted bitumen ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to vidiferent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically dispersed (chemically-enhanced WAF; CEEWAF). Toxicity of weathered, unweathered and dispersed Access Western Blend (AWB) dilbit was evaluated on fathead minnow (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 (LC50-96 h = 2.06 g/L). Chronic toxicity tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7 d = 1.31 g/L) whereas larval growth toxicity was lower for AWB (IC25-7 d = 0.312 g/L) compared to the weathered dilbit (IC25-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96 h = 5.66 g/L) compared to the weathered CLB (LC50-96 h = 0.05 g/L). Larval growth toxicity was lower for unweathered CLB (LC50-7 d = 0.64 g/L) whereas larval growth toxicity was lower for CLB WAF with no mortality was observed with the weathered CLB. The reproductive effects on ceriodaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC50 = 1.99 g/L). Volatile organic compounds (VOC), polymeric aliphatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

MO031

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

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Regulation of produced water (PW) discharges on the Norwegian continental shelf is based on a maximum oil contamination at 0.05% (API gravity more than 10°API, gravity unit of oil density). However, the PW may contain a wide range of conventional oil quantification methods based on traditional GC is limited when it comes to polar compounds that originate from produced crude oils. Furthermore, the use of treatment or production chemicals might also contribute to the overall PW toxicity. As a result, there may be discrepancies between measured concentrations of organic compounds and the total PW components that contribute to the toxicity. This paper presents a “collection of reference data” from four oil platforms on the Norwegian continental shelf. PWs were selected from oil fields of different operational ages, which produce oils exhibiting different physical and chemical properties. Samples were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions using solid phase extraction, recovering 80% of the total GC amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC-MS, GC/MS–GC–MS, LC–Orbitrap-MS, and by direct infusion FT-ICR-MS. The total PW extract, as well as the apolar and polar fractions were subject to acute toxicity tests using nauplii of the marine copepod Acartia tonsa. LC50 values for the total PW extracts ranged between 0.05–0.98 mg L−1 (based on total GC amenable fraction analysis). For the apolar fraction, the toxicity was mainly attributed to the polar fraction, with the LC50 values ranging between 1.07–5.75 mg L−1. Interestingly, toxicity was mainly attributed to the polar fraction of the fourth PW, with an LC50 of 0.05 mg L−1. For the PWs where toxicity mostly related to the polar fraction, this fraction spanned from 16−55% of the total PW (GC amenable fraction analysis). For the PW where toxicity mostly related to the apolar fraction this was 35%. This study therefore demonstrates that the apolar fraction is more critical, with covering methods that are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that contribute to the GC–based quantification of oil in water. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

MO032

Toxicokinetics of oil components in Arctic copepods

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To comprehend the implications of large oil spills in the Arctic marine environment, we need a better understanding of the toxicokinetics of oil in true Arctic species. The central Arctic copepod Calanus hyperboreus forms the top of the food chain, as well as its life history strategies and Arctic adaptation, makes it a relevant species for testing the bioaccumulation potential of the lipid-rich stage. The higher lipid volume fractions may explain the higher BCFs, although other factors like body size and activity levels may have contributed as well. The BCFs are well predicted by the octanol-water partitioning coefficient (logKow). The slope of the relationship, however, differed between the lipid-poor CIIIs and the lipid-rich CVs. For the...
MO033 Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples

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Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two-dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and quantification of alkyl PACs (dimer to tetramer) from environmental samples and Standards using 2DGC were demonstrated. The method was used successfully for the analysis of samples containing PACs and alkyl PACs in the presence of other coeluting compounds.

MO034 Using the hogfish (Myxine glutinosa) to study biological effects of a wreck filled with chemical munitions

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The sea bottom of the Skagerrak Strait (North Sea) contains ca. 45,000 tonnes of chemical warfare agents (CWA) dumped after the Second World War. Entire ships loaded with CWAs were intentionally sunk and are still laying on the deep bottoms. CWAs are highly toxic and have a long half-life in the marine environment. The aim of this study was to investigate the potential biological effects of these CWAs using the hogfish (Myxine glutinosa), a bottom-living fish species, as a biological indicator species.
of south polar skua during the breeding season. Keywords: Antarctic, south polar skua, stable isotopes, temporal variation, OHC

MO037 Evaluation of malformations induced by a hospital effluent of Toluca (Estado de México) in Lithobates catesbeianus

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Hospital effluents are important from the eco-toxicological point of view and are an important source of pollutants emission, among which are pharmaceutical products, chemical residues, radioelements, disinfectants and heavy metals, among others, which are waste of daily activities and has reported that they can reach concentrations between 4 and 150 times higher than those detected in municipal effluents. In addition to this, they usually do not have adequate pre-treatment before their emission, so they can be mixed with other effluents from homes, industries and municipal wastewater, which can subsequently generate interactions, enhance effects and create synergies, which lead to induce adverse effects on the environment, so it is important to study. The Estado de Mexico is located in the center of the country and is considered the entity with the largest population and according to data reported in 2015, it has 1835 medical units of different levels of care. On the other hand, Lithobates catesbeianus is a species considered native of the state and has been proposed by the government as an alternative to food supplement (due to its protein content). Due to the aforementioned, the objective of this work was to evaluate the malformations generated by a hospital effluent of Toluca (Estado de México) in this species and compare with Xenopus laevis, a species that is used as a preferred bioindicator, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blastula transition were exposed for 96 h to six different concentrations of the effluent (0.1, 0.3, 0.5, 0.7, 0.9 and 1%), subsequently, the mean lethal concentration (LC50) effective concentration inducing 50% malformation (EC50), and the teratogenic index (TI) was obtained. Results indicates that lower concentrations of the hospital effluent induced slightly higher malformations and lethal effects in X. laevis (EC50=0.132%, LC50=0.508%; TI=3.8) and in L. catesbeianus (EC50=0.351%, LC50=1.431%, TI=4.0), the main alterations being microcephaly, cardiac and facial edema, malformations in the eye, notochord, tail, fin and intestine. However, the lightest alterations of 0.1% concentration were indicative of mortality only in X. laevis exposed to this hospital effluent will be malformed in the absence of mortality compared to X. laevis, and therefore, can be considered as a sensitive and useful species to evaluate toxic effects of contaminants with the FETAX assay.

MO038 Monitoring fish health in a densely populated catchment in Central Germany

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In the frame of the joint project NiddaMain 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 soil parameters, for the first, second and third generation, respectively. Results show that the river system – from a biological point of view – is not in a good (as demanded by the EU Water Framework Directive) but rather in a moderate to unsatisfactory condition throughout most of its stretch, whereas upstream areas mainly perform worse than sampling sites downstream. This is noticeable in results obtained by the Dar-T, in particular. However, histopathology of the liver from monitored fish upstream and downstream in general showed vacuolations, 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

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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 collembolan Folsomia candida), which plays important roles in the maintenance of soil quality. The main objective of this study was to evaluate the ecotoxicological effects on the reproduction of three generations of the Folsomia candida species when exposed to fipronil for a period of 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 Migullos fyrumus in sugarcane crops (RD = 1.3 mg of the commercial product / kg² of dw soil), which means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (± 0.01) mg / kg of soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities

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Fipronil is a widely used broad-spectrum phenylpyrazole insecticide, effective against insects resistant to other agents as pyrethroids, organophosphates or carbamates. Accordingly, it has gained popularity worldwide as a pesticide in both agricultural and urban environments. Its wide use, resulted in the presence of fipronil in soil, surface and ground waters involving a risk to the environment and humans. In addition, humans and animals are also exposed to fipronil, by ingestion of products containing residues. Previous studies showed the toxicity of fipronil to aquatic freshwater organisms using model species, but there is scarce information about its impact on wild organisms. This study assesses, for the first time, the impact of fipronil on the photosynthesis of natural freshwater algal benthic community. This community – periphyton- is a key element of aquatic trophic chains, and is routinely used as indicators of water quality. Results show LC50 values of 0.74 mg/l (0.63-0.89) (p> 0.001), exposing periphyton to fipronil under standard medium. However, toxicity was almost nonexistent 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!

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Due to the human population increase and the consequent high demand for food, each day a larger area of the planet is dedicated to the practice of agriculture. Crops favor the reproduction of various organisms (invertebrates and vertebrates) that are combated with large amounts of pesticides, it 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 environmental fate that is made of them is of great concern. The use of organophosphorus insecticides, especially the spectrum phenylpyrazole insecticide, effectiv...
relationships (Pearson, R² >0.11) between the ChE and the weight or sex of the birds. The weight of the birds decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrows showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

MO042 Implementation of a worst-case landscape scenario for population modelling of a fungicide applied in cereals

M. Wang, WSC Scientific Group / Dept Efate Modelling; T. Preuss, Bayer AG / Environmental Safety; M. Elbing, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team

In many cases EU member states prefer the use of country specific scenarios for the exposure or risk assessment of pesticides. This is sometimes requested due to specific geographical features or agricultural practice. In the present example, we demonstrate how the specific agricultural situation of the Netherlands was taken into account for the selection of landscape scenarios for use in population modelling. It is first shown how a country specific landscape scenario is developed. Then, the dose response obtained in a rat reproduction study with an azole fungicide is employed in a population-level risk assessment on small herbivorous mammals (Common vole, Microtus arvalis). The margins of safety obtained in that assessment were found between these two non-leaf effects would be expected under realistic worst-case field conditions.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in freshwater turtles

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The mobilization of metals in 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 (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 correlations were found between these biomarkers and blood Pb levels. Similarly, the highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.83±8.44 μg/dl (dw). These individuals showed no evidences of oxidative stress, but presented increased activity of glutathione peroxidase and reduced glutathione levels relative to the rest of populations, which would indicate that antioxidant system is preventing from oxidative damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sub-lethal effects in reptiles for the vast majority of 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/dl). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R ˃ 0.765, P ˂ 0.001), but not for Hg (R ˂ 0.362, P ˃ 0.127). Thus, these samples could be used as non-invasive methods for the analysis of Pb bioavailability in M. leprosa, and by extension in reptiles, which will contribute to the development of ecotoxicology in reptiles, a group very little studied in this regard.

MO044 An analysis of important life stages, exposure routes and test endpoints in amphibians and coverage by existing risk assessment regulatory requirements for plant protection products, part 1

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

MO045 European common frog (Rana temporaria) larvae show subcellular responses upon field-relevant Bacillus thuringiensis var. israelensis (Bti) exposure levels used in mosquito control

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Bacillus thuringiensis var. israelensis (Bti) is presumed to be an environmental friendly agent for use in either health-related mosquito control or the reduction of nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bti products several times during their breeding season. Up until now, information regarding effects on the non-targeted group of amphibians has to be regarded rather inconsistent. On this account, we evaluated how repeated exposures to frequently used Bti formulations (VectoBac®2AS, VectoBac®WG) in field-relevant rates affect European common frog (Rana temporaria) larvae. In a laboratory approach, tadpoles experienced exposure conditions similar to realistic mosquito control in the Upper Rhine Valley (Germany). We assessed potential effects with regard to enzymatic biomarkers (glutathione-S-transferase, glutathione reductase, acetylcholine esterase), development, body condition and survival until the end of metamorphosis. Regardless of the formulation, delivery form or application rate, tadpole survival rates and time to metamorphosis were slightly reduced after repeated Bti exposures, while body condition was similar throughout the treatments. Furthermore, Bti induced significant increases of all enzymatic activities irrespectively of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti applications, especially acting on early developmental stages, seem to increase the risk for adverse effects. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of Bti for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

MO046 Influence of salinity and temperature on tadpoles of Xenopus laevis

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Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to sea water intrusion. Climate change projections for the International Panel for Climate Changes regarding the increase of mean temperatures, until 2100, and consequent sea level rise, is foreseen an increase in the number of coastal ecosystems suffering from 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 organisms holds the highest number of endangered species and is considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the influence of temperature on the adverse effects that increase of salinity may cause to tadpoles of the amphibian species Xenopus laevis. To address this objective, X. laevis tadpoles (Gosner 25) were exposed to a range of 5 NaCl concentrations under three temperatures: 20, 23 and 26ºC. The following parameters were monitored at the end of the test: feeding rate, body weight and growth rates. The differences reported for size between control and NaCl treatments seem to increase with temperature and with the NaCl concentration. As well, body weight decreased linearly with increasing NaCl concentration. As well, body weight decreased...
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 Dendroaspis
columbianus (ANURA: HYLIIDAE) TO WATERS CONTAMINATED
by ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE
COLOMBIAN ANDES
V. Romero-Castellanos, Universidad de Caldas; B. Toro, Universidad de Caldas / Biological Sciences
The pollution generated by agriculture, livestock and mining have impacted the watersheds in the Colombian Andes. Amphibians have been used to evaluate this contamination due their biphasic lifecycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of D. columbianus exposed to contaminants of agricultural, livestock and mining (with mercury: Hg, and with mercury and cyanide: Hg:CN) varied in the snout-vent length (SVL), tail length (TL), head width (HW), and body weight, and 2) to evaluate the effect of exposure on metamorphosis and behavior of the larvae. The AMPHITOX protocol was followed using ten larvae in each of the treatments and in the control, which were exposed from the moment of hatching to complete metamorphosis. Significant differences were found in the LRC between the larvae of the control and the Hg:CN mining treatment (Z = -28.92, p = 0.000) and between Hg:CN mining and agriculture treatments (Z = 25.325, p = 0.001) after 50 days of exposure. Differences in LC were found between the larvae of the control and the Hg:CN mining treatment (Z = -25.57, p = 0.001), and between Hg:CN mining and Hg mining treatments (Z = 21.525, p = 0.009) in the same time. The weight did not show differences. The majority of larvae of the control and the agriculture treatment showed similar development rates, reaching stage 46 between days 60 and 75 of exposure. While tadpoles exposed to Hg:CN mining did not complete the metamorphosis and reached stage 42 between days 50 and 55. Surface floation was the activity that was most stable at the time of exposure, presenting percentages of individuals greater than 60% in the control (81%), and in the agriculture (70%) and Hg mining treatments (65%), between the last days of exposure evaluated: 22 to 28. It is shown that 1) the effects on growth of anuran larvae due to agricultural, livestock and mining contamination are similar. However, samples contaminated by mining produce smaller tadpoles than agriculture and livestock, and 2) tadpoles exposed to agricultural and livestock contamination, unlike other studies which recorded stages 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. Adriana, Alterra Wageningen University and Research Centre; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece
Amphibian and reptilian species are found in agricultural landscapes. Some inhabit water bodies either permanently or during some time of their life cycle. Others use predominantly terrestrial environments. Some of these species migrate long distances through fields and some reside in fields and field margins where they can be exposed to pesticide residues in food items, water, soil and plant surfaces. A number of studies indicate that pesticide exposure can lead to severe impacts with up to 100% mortality from overspray at field rates for some pesticides. Dermal exposure was identified as an important exposure route in the EFSA opinion. The aim of the current study was to investigate different options to address the risk from dermal exposure by overspray and contact to soil and plant surfaces. Existing exposure models were reviewed with regard to their suitability for amphibian and reptilian risk assessment. This included comparison of parameters used in model calculations, comparison of sensitivity to dermal exposure and worst case exposure calculated to the most sensitive groups of amphibians and reptiles with greatest dermal exposure from overspray and to compare it with exposure from contact to soil and plant surfaces. In addition a novel approach was developed to estimate the uptake from soil and plant surfaces. Mammalian dermal toxicity related to local effects and dermal adsorption data may be used as surrogates for reptiles but not for amphibians. The development of a test method investigating local effects on amphibians is still the subject of current investigation. If the body burden following exposure via the dermal route is needed. Comparison of body burden by overspray to body burden by exposure to treated soil or foliage showed that the maximal body burden by overspray was lower than the maximal body burden by passive or active dermal exposure from soil or by contact to foliage. An approach was suggested which can combine oral and all dermal exposure routes in one overall body burden which could form the basis for a realistic risk assessment.

MO049 Evaluating the Role of Fish as Surrogates for Amphibians in Ecological Risk Assessment
S. Glaberman, University of South Alabama / Biology; J. Kwiet, University of South Alabama; C. Aube, US Environmental Protection Agency / Risk Assessment Division Office of Pollution Prevention and Toxics
Ecological risk of chemical exposure to freshwater- and amphibian ecotoxicology is of interest for both groups are similarly sensitive to a range of chemicals. However, these analyses are limited because the amphibian data reported in the peer-reviewed literature are variable both with respect to experimental design and test species. In 2010, the U.S. Environmental Protection Agency began receiving ecotoxicity data for a standard amphibian test species (Xenopus laevis) as part of the Endocrine Disruptor Screening Program. All test results were intended to inform a determination of potential thyroid interaction within the context of other endocrine screening studies, they also contain valuable data on survival and growth that can be compared to existing fish data for a given chemical. We used this dataset to compare no observed adverse effect concentration (NOAEC) values for survival, body weight, and length data between fish and amphibians for 45 different pesticide active ingredients. Overall, the results indicate that fish are a reasonably good predictor of amphibian toxicity as there were no statistically significant differences in NOAEC values between the two groups for the endpoints examined. However, toxicity endpoints were lower in amphibians as compared to fish approximately half the time across chemicals, challenging the notion that fish are consistently more sensitive than amphibians. Disclaimer: 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 Blankenstein, KU Luebeck, 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 before or during 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. 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, 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 Santamaria, Institute for Game and Wildlife Research (IREC) / UCLM-CSIC-JCCM; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Biology Concerns have been raised that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion 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 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 spawn into 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 around the world. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecology (e.g., aquatic early-stage life-stages) as well as natural microhabitats (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 data gap on terrestrial life-stages of European anurans with focus on moving patterns and microhabitat selection in agricultural landscapes. At two study sites individuals of common toads (Bufo bufo) and common frogs (Rana temporaria) were caught at and around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.

MO053
A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles
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Differences in sensitivities to chemicals among species and taxa is a major challenge for accurate ecological risk assessments. Most toxicity information is collected for a few model species and little is known about the relationship between the sensitivity of the model species compare to non-model species. Quantitative adverse outcome pathways (qAOPs) are quantitative, biologically-based models which describe key event relationships that link a molecular initiating event to an adverse outcome. qAOPs can serve as a useful tool to determine the relationship between the sensitivity of chemicals with a molecular initiating event and an adverse outcome among species. Previously, a qAOP had been described for the indirect relationship between activation of the aryl hydrocarbon receptor (AHR) by diorganochlorinated compounds (DLCs) and embryo-mortality in birds and fishes. It was hypothesized that this qAOP was also applicable to amphibians and reptiles. However, little is known about whether the sensitivity to activation of AHR is predictive of sensitivity to DLCs of embryos of any amphibians or reptiles. Therefore, in order to test the hypothesis of applicability to amphibians and reptiles, this study investigated sensitivities to activation of AHRs in an in vitro transactivation assay and in vivo embryo sensitivities for an amphibian, the African clawed frog (Xenopus laevis), and a reptile, the common snapping turtle (Chelydra serpentina). Embryo-mortality was assessed in African clawed frog embryos exposed to serial concentrations of one of two DLCs: 2,3,7,8-tetrachlorodibenzo-furan (TCDF) or 2,3,4,7,8-pentachlorodibenzo-furan (PCDF). Embryo-mortality was assessed in common snapping turtle embryos exposed to serial concentrations of one of four DLCs: TCDF, PCDF, 3,3',4,4',5-pentachlorobiphenyl (PCB 126), and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Further, in vitro AHR transactivation assays were used to determine sensitivity to activation of the AHR1 isoform of African clawed frog and common snapping turtle to these selected DLCs. It is anticipated that this research will result in a single qAOP linking in vitro activation of the AHR to embryo-mortality with toxicodynamic 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?
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The aims of this work were to 1) determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and 2) assess if tadpoles from impacted sites have increased tolerance to metals relative to tadpoles from reference sites. Metal body burden, oxidative stress biomarkers and metallothioneins (MT) were measured in Pelophylax perezi tadpoles from reference and metal contaminated sites. Additional tadpoles (20 per site) were collected and exposed in lab conditions during 24h to Hg or Pb levels above the median lethal concentrations reported for amphibians (1.5 and 10.5 mg/l, respectively). The parameters mentioned above plus mortality were monitored at the end of the assay. Field-collected tadpoles from Pb and Hg polluted sites had higher metal body burden than those from reference sites (median per site as d.w. 540.4-708.1 vs 2.6-9.5 ng Pb/g, 768.2-3103.5 vs 0.01 ng Hg/g; all p<0.01). Levels of MT (median, µg/g tissue) were significantly higher in tadpoles from Hg polluted sites than in the rest of locations (248.5-307.7 vs. 63.9±13.6: p<0.01), suggesting that MT could be induced in natural populations, by the sum of environmental factors. Exposure to Hg caused mortality of all individuals, while Pb did not result lethal to tadpoles. Laboratory exposure revealed that experimental treatment rather than pollution at the origin site determined Pb body burden (controls: from reference site 96.7-120.4 ng/g, from Pb site 118-491.6 ng/g; Pb-exposed: from reference site 369.79-9476.0 ng/g from Pb site: 9043.5-78452.4 ng/g), showing that Pb was readily bioavailable for exposed tadpoles. Lab exposure to Pb increased MT levels in tadpoles from reference sites (exposed vs. non-exposed: 116.3 vs. 41.70 µg/g; p<0.01), but not in those from Pb-polluted areas. Oxidative stress biomarkers did not differ either between origin sites or because of experimental exposure to Pb. MT levels in tadpoles from reference populations that were taken to the laboratory and kept in common tanks for two week did not show any difference from 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
São Tomé Island harbors important sea turtle nesting and feeding sites. However, insufficient enforcement of environmental laws to avoid illegal take of nesting females and eggs, associated with a great lack of knowledge about how these species interact with their environment and how human activities impact their survival in the region, constitute significant challenges for sea turtle conservation. Through current local conservation projects, some information on genetics and nutrition of sea turtle populations is being unveiled but very little is known about how heavy metal pollution is impacting these populations. The main objective of this study was to assess the metal contamination levels, metal accumulation, and stress responses of two species of São 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
eggs and its success. Results showed significant correlations between expression of some genes and metal contaminant levels, pinpointing some candidate genes to be used as biomarkers of interest for biomonitoring campaigns, which worrying function highlights the need for a close follow-up of these organisms. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these turtle species nesting in S. Tomé which, given their classification as endangered species (IUCN red list), is of paramount importance to contribute for conservation measures and management.

**MO056**

Ecotoxicology of Africa's three largest reptiles: POPs, metals, eggs, and eggshells.

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The Nile Crocodile (Crocodylus niloticus), Loggerhead Turtle (Caretta caretta) and Leatherbacked Turtle (Dermochelys coriacea) are the largest reptiles in Africa. The bioaccumulation and effects of metals and metalloids on large-bodied reptiles are less well known compared with birds and mammals, especially those from Sub-Saharan Africa. Globally, reptiles are experiencing declines, and pollution is one of the hypothesized reasons for the decline. The Nile Crocodile and Loggerhead Turtle are at relatively high trophic levels, with the Nile Crocodile also being the largest predator in Africa. We sampled eggs from these three species (27 crocodile, and 10 each from the two turtle species) and analysed the shells and contents separately for metallic elements using ICP-MS. Trophic level, body size, and migratory patterns influenced the concentrations in shells and egg contents, but crocodiles generally seem to have lower concentrations than the sea turtles. Compared with data from elsewhere, sea turtle eggs had lower concentrations, but crocodile eggs had higher copper and mercury concentrations. Comparisons between eggshells and egg content elemental compositions for each species clearly showed that eggshells cannot be used as proxy for egg contents. Sampling therefore, requires the collection and analyses of unhatched eggs. Relative elemental composition patterns indicated overlaps for the respective egg contents and eggshells of the sea turtles, but not for the crocodiles. We found that thicker eggshells significantly associated with higher iron concentrations in the crocodiles. The implications may be that hatchlings may spend more energy to break through the leathery shells, and may therefore affect reproduction. Copper had concentrations that raised concern in all three species. The strontium concentration in the eggshells of the Leatherback Turtle was high. Mercury, copper, and selenium had higher concentrations in the eggshells than in the crocodile eggs. In general, the following endpoints were monitored: hatching success, growth, and effects feeding inhibition. The lethality was compared with that of seawater (EC50 = 1) to derive such DT50 = 11.89 mScm⁻¹. These results highlight that eggshell material is more toxic than seawater (EC50 = 11.89 mScm⁻¹) for Crocodile eggs, and suggest that eggshell material may act as a barrier to metal bioavailability and uptake. Eggshell material is also a potential indicator of metal contamination in crocodile eggs, and the Nile Crocodile eggshell material may present a proxy for metal concentrations in the environment.

**MO057**

Increasing salinisation effects on Pelophylax perezi populations - Could historical exposure drive the future?

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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 A5 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 increasing levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of *P. perezi* originated from reference and salinized natural populations. Embryos (Gosner stage 8–10) were exposed for 96h, and lethality was recorded. We collected several parcels 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 mScm⁻¹ for seawater and NaCl, respectively). As well, for the sublethal monitored endpoints (growth, weight and feeding NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater salinity.

**MO058**

Wildfires effects on aquatic invertebrates organisms with in situ bioassays

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In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attentions. Particularly in the input of potentially toxic elements and hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of *in situ* bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Aguarda, central Portugal) and occurred after the first severe wildfire event in the region in 2017. The study was composed by four sites, using dedicated test chambers. After two days of field exposition, the water collected in the upstream area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that the sub-lethal post-exposure feeding inhibition, revealed a decrease in the feeding rate of organisms from the sites impacted by wildfire (RDS and SDS). Unlike, the sites outside the burnt area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that *in situ* bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.

**MO059**

Estrigic effects of an Organophosphorous Flame Retardant (TCP) on Edible Sea Urchin "Paracentrotus lividus"

P.C. Lopes, 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)

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attentions. Particularly in the input of potentially toxic elements and hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of *in situ* bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Aguarda, central Portugal) and occurred after the first severe wildfire event in the region in 2017. The study was composed by four sites, using dedicated test chambers. After two days of field exposition, the water collected in the upstream area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that *in situ* bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.
Abstracts

New synthetic chemical compounds, like Organophosphorous Flame Retardants (OPFRs), are widely used by the industry as plastic additives in common life objects, or overlaying woods, fabrics, etc. They pose environmental risk due to their effects as androgenic or estrogenic endocrine 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 (TCPP), are a typical flame retardant in plastics, being the most detected chemical in the aquatic system. Possible toxic effect of this chemical has not been deeply evaluated yet. This study aims to explore the possible effect of TCPP as an endocrine disruptor on the edible sea urchin Paracentrotus lividus. 392 individuals (male: female = 1:1) were exposed to normal saline (control) and TCPP exposed (1 and 10 mg/L), they were maintained in controlled conditions and analyzed at 7 and 28 days. TCPP exposure did not cause histological damages in the gonads, and the bioaccumulation in the tissues was moderate (mean BCF=28 L/Kg WW). However, the results of the GI in this study, support the idea of an endocrine disruption action of TCPP in females exposed to the compound, thus the compound could be catalogued as estrogenic for this marine biological model. Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO061

Short-term effects of fluoxetine exposure on biomarker and behavioural responses of an estuarine fish.

L.A. Duarte, M.P. Pais, P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE Marine and Environmental Sciences Centre Pharmaceutical compounds are routinely discharged into the aquatic environment. There is growing concern whether they elicit deleterious effects on aquatic organisms, following point source acute exposure as well as chronic exposure. Acute stressors (e.g. H-MPC, B. Hista) 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 Pomatochistus 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, lipoperoxidation, 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.

MO062

Assessment of PCDD/Fs, dioxin-like PCBs and PBDEs in Mediterranean striped dolphins

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Marine mammals are exposed to a variety of persistent organic pollutants (POPs) 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 levels in blubber of 2100 g in a dolphin population from the western Mediterranean Sea from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs 13C-labeled standards prior to Soxhlet extraction, and then cleaned-up by using the automated sample preparation system. Samples were analyzed for seventeen PCDD/Fs, twelve DL-PCBs and twenty-seven PBDEs. Quantification was carried out by the isotope dilution technique by GC-HRMS on a Trace GC Ultra coupled with a Q-TOF chromatograph coupled to a high-resolution mass spectrometer. Samples’ lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs>PBDEs>PCDD/Fs. The mean concentration values obtained were 6420 ng g⁻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⁻³ (45.8-83.5 pg g⁻³) for PCDD/Fs. Our results are in the same order of magnitude that those reported for the same species in the same area by a recent study from other authors save for PCDD/Fs which were found in an order of magnitude lower. Yet, they were generally much higher that those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower that those reported for sperm whales from North Atlantic. The PCDF congener profile (hexa>hepta>octa) was related to those reported for striped whales from Australia and to those reported in blubber of striped dolphin (Stenella coeruleoaalba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa>hepta>octa>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 l. w. and surpass the WHO threshold of 2100 µg g⁻¹ L. w., in both the Mediterranean basin and the North Atlantic as starting point of immunosuppression in harbour seals. This high level of contamination is not considered to be the cause of death of these animals, but may have contributed to lowering the defense of their immune system.

MO064

Biochemical and molecular responses to organic contaminants in bottlenose dolphins (Tursiops truncatus georquius) from southern Brazil.

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the transcript levels of all studied genes were higher in winter when compared to summer, potentially due to enhanced metabolism over colder months. mRNA transcript levels of AHR, GR, IL1 and MT2 genes correlated positively with increasing levels of blubber 2PCBs, supporting the occurrence of biological response to this class of contaminants. GLMs for MT2 indicated that the transcript levels of this gene are higher in dolphins from LES, possibly due to greater metal inputs in this area. GR activity was higher in dolphins with higher Zn levels. Overall, the results indicate that the skin of bottlenose dolphins is altered due to exposure to 2PCBs and 2PDBEs, which co-varied with 2PCBs and Mirex. Absence of influence of other contaminant classes over biomarker response might be due to low contaminant levels in sampled dolphins. This influence might also have been overshadowed by the effects sampling season. Nonetheless, results indicate a sufficiently high exposure to PCBs in PCB-positive dolphins and Mirex to trigger a biological response in dolphins from these small resident coastal populations, particularly susceptible to the negative effects associated to contaminants.

MO065 Monitoring Eleonora’s falcon conservation status both at its breeding and non-breeding grounds, using biological (stress indices) and environmental data
V. Tsarpali, University of Patras / Department of Biology; C. Barboutis, Hellenic Ornithological Society / Antikythera Bird Observatory; C. Kassara, University of Patras / Department of Biology; M. Papadimitraki, S. Giokas, University of Patras / Biology; S. Dalioussis, University of Patras / Patras Forensic Medicine Laboratory.

The present study investigated a battery of stress indices in blood and liver of Eleonora’s falcon (Falco eleonorae Géne, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, as well as cellular abnormalities (MN assay) were measured in blood samples collected from wild individuals, captured on the island of Antikythera (Greece), in May (N=13) and September 2017 (N=19). The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of F. eleonorae, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.730±0.433 - 11.343±0.829 nmol m⁻¹ min⁻¹ in May and 1.444±0.079 - 9.314±0.618 nmol m⁻¹ min⁻¹ in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cyttoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals measured were within limits, which could be considered relatively safe. Its biological half-life was approximately 6 hours, and their body mass and food intake were monitored. The results of the present study showed for the first time that the assessment of a battery of stress indices in tissues of F. eleonorae, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the quality of its foraging grounds and, hence, the impact of land use on the species’ conservation status.

MO066 Optimising design and analysis of acute effect field studies
R. Dittrich, Tier3 Solutions GmbH / Wildlife Ecology; I.S. Hotopp, Tier3 Solutions GmbH

Vertebrate risk assessments of a plant protection product (PPP) may indicate an acute risk to wild birds and mammals or predict effects on population development. This might be driven by (too) conservative assumptions on the exposure side of the equation for the risk evaluation, due to the lack of better data. It is therefore worthy to study deeply the presence of effects in the field in order to obtain a proper risk assessment. We highlight three complementary ways to improve the quality of such field studies. An acute design concept is the ‘extensive approach’, by using a great area or number of agricultural fields in different study sites, with the ‘intensive approach’ by using radio-tracking techniques in a control/treatment design. This double approach covers the natural variation in parameter estimates and enables the identification of possible treatment effects. The radio-tracking technique is sensible enough to monitor the fate of individuals in a treated area over a long period of time, and to finally conclude on their survival. However, in most cases the critical point is the disappearance of individuals; an increase in their number can indicate a greater vulnerability to other stressors. In the context of a good study design, we also propose an improved statistical evaluation to increase the detectability of effects in comparison to earlier studies. The Kaplan-Meier survival curve and the Cox proportional hazards model are recommended as methods for the analysis of survival information. The Cox model is a well-known statistical technique used in medical tests. It provides an estimate of the treatment effect on survival adjusted for other explanatory variables. Moreover, as it isolates the effects of treatment from the effects of other covariates, the assessment of results of such field studies is facilitated. Additionally, an essential part of every statistical evaluation is to know the minimum number of individuals needed in order to perceive actual treatment effects in the statistical output. Using data from generic radio telemetry studies on real untreated populations of wood mouse and several bird species, we run simulations of acute effects for different scenarios. The results show that minimum sample size is highly dependent on, first, the species, and second, the action mode and persistence of residues of each specific PPP.

MO067 Assessing impacts of legacy pollutants on wildlife of the Trinity River (Texas, USA) using Neotropical Cormorants as indicator species
M.A. Mogi, Texas A&M University / Wildlife and Fisheries Sciences; C. Sandoval, Texas A&M University / Psychiatry.

The Trinity River (Texas, USA) has been historically known as a polluted river because of its proximity to the Dallas-Fort Worth area and also because of known discharges of sewage and agricultural irrigation waters to the river. Surprisingly, there are no studies regarding the presence of legacy contaminants in the river and their impacts to wildlife. The objectives of this study were to determine accumulation and potential impacts of persistent organic pollutants such as organochlorine pesticides, PCBs, and PBDEs on nesting aquatic birds of the Trinity River, using Neotropical cormorants (Phalacrocorax brasiliensis) as indicator species. Adult and first year cormorants were collected from two sites on the Trinity River watershed during 2014 and 2015. Tissue sections from liver, spleen, kidneys, and gonads, were used for histopathology analysis, and a portion of the liver was analyzed for OC pesticides, PCBs, and PBDEs. An immunohistochemical assessment of the present study showed for the first time that the assessment of a battery of metals levels measured in liver samples were found to be relatively low. The results of the present study showed for the first time that the assessment of a battery of stress indices in tissues of F. eleonorae, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the quality of its foraging grounds and, hence, the impact of land use on the species’ conservation status.

MO068 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 vulnerable to the negative effects of neonicotinoids. Effects of refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory activity 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 exhibited reduced survival and stopover durations as compared to 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 radio-tagged 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 total dose of 1.12 μg/kg body mass 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 experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northerly orientation. To further analyze the 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.

MO069 A synthesis of the interactions between anticoagulant rodenticides and wildlife
R. Shore, Centre for Ecology & Hydrology (NERC); N. van den Brink, Wageningen University / Dept of Toxicology; J.E. Elliott, Environment Canada / SciComm Technology Braintrust; B.A. Rattner, USGS-Patuxent Wildlife Research Ctr / Patuxent Wildlife Research Center

Anticoagulant rodenticides (ARs) are the mainstay of rodent control throughout the world. Regulatory risk assessments indicate ARs pose a significant risk to non-target wildlife but AR use remains widely authorised because the benefits (particularly to human health) are deemed to outweigh the environmental risks. Recently, an authoritative reference text, prepared by 24 international scientists, reviewed the main issues related to ARs and wildlife, specifically: AR use, regulation, exposure pathways, toxicity, mechanism of action, pathology, pharmacokinetics, genetic resistance, non-target risk and its mitigation, alternatives
to ARs and integrated pest management (IPM). Broad concepts that emerged were: there is high conservation of the blood clotting process and so ARs can affect a wide range of non-target species; development of genetic resistance in target species led to global use of the more acutely toxic and persistent second-generation ARs (SGARs); vitamin K1 can be an effective antidote (unlike for many rodenticides); variation in non-target sensitivity may be due to pharmacokinetic, ecological and behavioural processes; >50% of predatory species contain AR residues; AR residues in food exposure or diet; evidence of AR-induced mortality requires additional evidence (e.g., clinical signs, haemorrhagic lesions); probability of death in relation to AR residues may help assess extent of mortality in populations; tissue residues are informative of exposure but dietary AR concentrations are more suited to assess risk; and primary AR exposure associated with ingestion of prey containing ARs is the principal risk to wildlife populations; knowledge of exposure and effects in invertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

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

Second generation anticoagulant rodenticides (SGARs) can be toxic to all mammals and birds. Studies have shown that, in Britain, there is widespread exposure to SGARs in a diverse range of predatory mammals and birds, including red kites (Milvus milvus). This species may be particularly at risk as it scavenges dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites is essential to build a body of information in an independent case may cause localized poisoning and effects in vertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO071 Environmental determinants of the exposure to anticoagulant rodenticides in non-target species
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Anticoagulant rodenticides have some similarities with other bioaccumulative persistent organic compounds, because of their frequent presence in many predatory species. In addition, the fact of being highly toxic substances makes this biaccumulation particularly harmful for these predators. Considering that the use of rodenticides occurs mainly in areas with high density of rodents that are in turn prey to multiple predators, we can also expect an ecological trap scenario. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. The analysis included liver samples of wild animals (n=244) found dead between 2007 and 2016 (in the region of Aragon, NE Spain). The sampling included 776 individuals (11 reptile, 16 mammals and 32 birds). Liver samples were analysed by LC-MS and the presence of SGARs was statistically analysed with generalized linear models with a binary logistic response to study the effect of environmental or habitat characteristics including human population and livestock density and types and surface of crops. SGARs residues were detected in 83 (34%) of the analysed animals. Ten species (25.51%) were found with detectable SGAR residues, corresponding to four mammals and six birds, had residues >200 ng/g, which is threshold associated with adverse effects: these included common raven (67%), red fox (50%), red kite (38%), eagle owl (25%), stone martens (23%), common buzzard (17%), Western marsh-harrier (17%) and Eurasian badger (14%). The spatial analysis at the municipality level has allowed to identify the percentage of human density in the study area. The presence of SGARs in animals shows that SGARs residues are dangerous for all species, and not only for the most sensitive, thus, the use of SGARs should be reduced or avoided in areas with high human population density and livestock density or types, and surface of crops.
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. Faecal sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an avian study with wild caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 μg d-1) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC-MS/MS for fluoxetine and its major active metabolite norfluoxetine. Our preliminary results indicate that fluoxetine is detectable in the feathers and we will present information on the concentrations present and whether they are correlated with levels in other tissues such as liver and brain. We discuss the extent to which feathers have potential as tools for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

MO074
Field-effect studies as a suitable method to assess effects of plant protection products on free-living common voles (Microtus arvalis): A case study with the fungicide iprodione
O. Fuelling, C. Miersch, Tier3 Solutions; S. Steiger, BASF SE, Agrarzentrum Limburgerhof.

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

MO075
Monitoring NSAIAs in carrion and avian scavengers form Spain: preliminary results after diclofenac registration for veterinary use
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The serious impact of diclofenac on Asian vultures raised the alarm of the deficient environmental risk assessment of some veterinary drugs. In the case of diclofenac, there was an evident gap in the knowledge of the high toxicity that this non-steroidal anti-inflammatory drug (NSAID) has in Old-World vultures that can feed on treated livestock (LD50 in Gyps bengalensis of 98-225 μg/kg body mass). Avian scavengers (vultures and others) are the vulture populations that are threatened with the collapse of the vultures populations in Asia, in 2013 this drug was authorized for use in veterinary medicine in Spain and other countries in the European Union with the consequent risk of repeating the situation generated in Asia. In this work, we have studied the presence of NSAIAs in carrion animals (kidney, liver and muscle of pig, n=125) supplied in “muladarres” to feed vultures. We have also studied the presence of NSAIAs residues in tissues of avian scavengers, n=27) found dead with suspicion of being intoxicated. NSAIAs were detected in tissues of four pigs (3.2%). Low levels of fluixin in the muscle of another pig (170.5 ng/g). This level of diclofenac was relatively high, but kidney and liver of the same animal were negative for diclofenac presence. An examination of this muscle sample showed a pale area adjacent to a congestive portion that may correspond to the injection point of the diclofenac in the pig. Fluixin was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffons (Gyps fulvus) analysed had 330 and 23 ng/g of fluixin in liver. Two cinereous vultures (Aegypius monachus) had 2.83 μg/g of fluixin in liver, but it was diagnosed as an intrageneric poisoning at the wildlife rehabilitation center. Lesions in the kidney and visceral gout have not been observed macroscopically or microscopically in 15 Eurasian griffons analysed. Residue levels in carrion and scavengers indicate a limited risk of poisoning, possibly because treated livestock died several hours after NSAID injection. However, veterinary use of NSAIAs can still be a threat for scavengers if veterinarians and farmers ignore the associated risk when treated livestock is used to feed vultures.

MO076
Different approaches comparison for evaluation of hypopharyngeal glands (HPG) toxicity in honeybees (Apis mellifera L.)

Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in nature but also in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypopharyngeal glands (HPG) which produce proteinic substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypopharyngeal glands development evaluation, in order to select the Method that combines the highest reliability (the smallest technical error), the optimal cost, the least effort and time-consumption. The study was conducted on Honeybees subjected to chronic toxicity studies performed according to the EFSAs guidelines (EFSA Journal 2013;117(3):3295). Insects were treated with four different chemicals in 3 to 5 concentrations. The HPG were obtained from 3 bees per test item (in the highest concentration, which did not cause mortality below 50%) and the negative control. Six different approaches for HPG evaluation were tested: - histopathology (HP) of isolated glands (linear and quantitative measurements, imaging); - histopathology (HP) of whole heads (linear and quantitative measurements, imaging); - whole mount (WM) method on isolated gland (linear and quantitative measurements, imaging); - protein absorbance (PA) from isolated glands (quantitative measurements); - protein absorbance (PA) from whole heads (histopathological assessment); - scanning electron microscopy (SEM) (linear and quantitative measurements, imaging). The linear measurements (small and big axis of symmetry) were taken from ten acini from left and right HPG, however for SEM only left HPG were included. The quantitative measurements (number of acini per 1 mm²) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from left and right HPG. The analysis of the results showed decreases and increases of acini and protein absorbance depending on the test item. However, observed deviations did not show any statistical significance. According to the performed studies for evaluation of hypopharyngeal glands development the linear measurement combined with imaging should be used.

MO077
Bird and mammal focal species for pesticide risk assessment in rice
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Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through food chains. Potentially contaminated diet items. To ensure a realistic and reliable risk assessment, bird and mammal focal species should be used that are representative for the species actually occurring in the crop of concern. However, in the relevant guidance document on bird and mammal risk assessment by the European Food Safety Authority (EFSA), rice is to date pooled with other cereals such as wheat and barley, despite the obvious peculiarity of rice cultivation. The generic focal species species provided for rice are thus those known from the dry environments of cereal fields. To address this issue, we conducted a comprehensive literature review on bird and mammal species regularly occurring in rice paddies at the relevant time periods of potential pesticide exposure to identify appropriate focal species candidates for risk assessment. Our results show that the relevant species occurring in the wet environments of rice paddies indeed clearly differ from the focal species suggested for risk assessment for wildlife in cereals and thus provide a baseline for more realistic and rice-specific risk assessment for birds and mammals.

MO078

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SETAC Europe 28th Annual Meeting Abstract Book
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 survival of nestlings and one of those is exposure to lead from the ammunition used for hunting. An exposure to lead, even at sub-lethal levels, can be a stressful situation that implies an increase in circulating corticosterone levels. In birds that are rare and difficult to capture, blood sampling for both lead and corticosterone analysis can be a difficult task and with some risk for birds. For this reason, we developed an innovative non-invasive methodology to study exposure to pollutants and their respective biomarkers is being directed towards the analysis of easy-to-collect samples, such as feathers mounted 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 moulded 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 rachis), and that the annual incidence of such exposure was 30% (a feather with an abnormal exposure during its development of approximately two months). The contours of the segments of rachis feathers of key biotransformation enzymes (glutathione-S-transferase, GST and 7-ethoxyresorufin-O-deethylase, EROD) in the liver of kelp gull Larus dominicanus for periods up to 24 hours. Liver tissue of two euthanized animals was sectioned into several 1-cm² cubes and stored in individual closed tubes at 25 °C for 0, 1, 2, 3, 6, 12, 18 and 24 hours before liquid nitrogen freezing. Cytosolic and microsomal fractions were obtained from 5 mg of each sample individually and used for GST and EROD measurements, respectively. GST activity proved to be stable after 24 h (85-90% of initial activity). EROD activity decreased abruptly after the first hour post mortem for both animals. After 3 hours EROD activity presented 65 to 71 % of initial activity and 28 to 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 post mortem samples. GST seemed to be more resistant to degradation over time, and it thus appears possible to make valid GST activity measurement in post mortem samples. Results show higher OHC concentrations in Steigen [median and range; ΣPCBs: 5.1 ng/ml (1.5 – 59.1 ng/ml), ΣOCPs: 4.2 ng/ml (1.3 – 52.2 ng/ml), ΣPBDEs: 0.3 (< 0.1 – 2.6 ng/ml) and ΣPFASs: 20.8 ng (7.2 – 52.9 ng/ml)], than Smøla [median and range; ΣPCBs: 3.9 ng/ml (0.8-34.7 ng/ml), ΣOCPs: 2.4 ng/ml (0.9 – 15.3 ng/ml), ΣPBDEs:0.2 (1.1 – 1.5 mg/ml) and ΣPFASs: 52.9 ng/ml (4.6 – 46.7 ng/ml)]. The analyses of thyroid hormones have been carried out and the OHCs results will be presented at the conference.

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

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The measurement of biomarker responses to chemical contaminants in wild organisms represents a powerful tool in environmental monitoring programs. However, getting biological samples suitable for biomarker analysis may be challenging, since some programs rely on samples collected from carcasses. Shorter periods from death to analysis of biochemical biomarkers provides more accurate results, but how these parameters change at longer post mortem intervals remains unclear. Our study was focused on the post mortem period of key biotransformation enzymes (glutathione S-transferase, GST and 7-ethoxyresorufin-O-deethylase, EROD) in the liver of kelp gull Larus dominicanus for periods up to 24 hours. Liver tissue of two euthanized animals was sectioned into several 1-cm² cubes and stored in individual closed tubes at 25 °C for 0, 1, 2, 3, 6, 12, 18 and 24 hours before liquid nitrogen freezing. Cytosolic and microsomal fractions were obtained from 5 mg of each sample individually and used for GST and EROD measurements, respectively. GST activity proved to be stable after 24 h (85-90% of initial activity). EROD activity decreased abruptly after the first hour post mortem for both animals. After 3 hours EROD activity presented 65 to 71 % of initial activity and 28 to 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 post mortem samples. GST seemed to be more resistant to degradation over time, and it thus appears possible to make valid GST activity measurement in post mortem samples. Results show higher OHC concentrations in Steigen [median and range; ΣPCBs: 5.1 ng/ml (1.5 – 59.1 ng/ml), ΣOCPs: 4.2 ng/ml (1.3 – 52.2 ng/ml), ΣPBDEs: 0.3 (< 0.1 – 2.6 ng/ml) and ΣPFASs: 20.8 ng (7.2 – 52.9 ng/ml)], than Smøla [median and range; ΣPCBs: 3.9 ng/ml (0.8-34.7 ng/ml), ΣOCPs: 2.4 ng/ml (0.9 – 15.3 ng/ml), ΣPBDEs:0.2 (1.1 – 1.5 mg/ml) and ΣPFASs: 52.9 ng/ml (4.6 – 46.7 ng/ml)]. The analyses of thyroid hormones have been carried out and the OHCs results will be presented at the conference.

MO081
Assessment of exposure and effects of Hg levels in feathers of White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) nestlings from Norway

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Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its biaccumulative properties, Hg has caused detrimental effects in birds such as haematoxicity, 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 post mortem in two avian species: White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) from Norway. Samples were obtained in 2014 from nestling WTE (n=14) and NG (n=11) in northern Norway (Nordland-N 68.30 – 68.47; E 24.54 – 25.27° and Trøms-N 68.87 – 67.39°; E 20.39 – 23.47°, respectively). Total Hg in feathers, total and free plasma corticosterone levels were analysed, along with following blood chemical parameters (BCPs): albumin, calcium, cholesterol, phosphorus, triglycerides, creatine kinase, amylase, glucose, uric acid, haptoglobin, hemoglobin, creatinine, GTP, BUN, Total proteins, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, cholesterol, triglycerides, creatine kinase, amylase, glucose, bilirubin, potassium, sodium, calcium, phosphorus and nitrogen isotopes (13C, 15N) were analysed in body feathers to evaluate inter- and intra-specific contaminant exposure. Due to the low amount of feather samples, Hg could only be analysed in 13 WTE and 8 NG. Mean ± SD were 0.51 ± 0.34 mg/kg in WTE and 0.93 ± 0.30 mg/kg in NG. The significantly higher levels in WTE than in NG (T (12) = 7.61, p < 0.01) may be related to different dietary input, as confirmed by stable carbon and nitrogen isotope analysis of body feathers. The marine prey of WTE seem to determine the Hg loads, as Hg is known to be abundant in the marine environment. Due to the relations between Hg and biochemical parameters (corticosterone, BCPs) showed relations between Hg and aspartate aminotransferase (an enzyme that may increase after liver damage). The effect of mercury on this enzyme seems controversial, as some experimental studies on nestlings of different species have found both positive and negative relations. Moreover, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NILS Science and Sustainability.

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

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Highly brominated flame retardants are being replaced by alternative flame retardants such as 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 U.S. 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 wild animals and humans, are environmentally persistent, transported globally, and are toxic to aquatic organisms at low concentrations. However, few data are available on the potential adverse effects of TBBPA-BDBPE and SCCPs in birds. A comparative exposure assessment of these two classes of flame retardants was conducted using egg injections in a non-model species, the American kestrel (Falco sparverius) to assess survival, molecular, biochemical, and endocrine, growth and reproductive endpoints. Analyses conducted on tissue samples from hatchlings included thyroid related gene expression in the liver, thyroid hormone levels, and thyroid gland histology. Preliminary results will be presented from the molecular to biochemical to cellular level.

MO083
Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk
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More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on the effects of contaminants, lead to expect that a change in the concentration of one component has effects on offspring traits that depend on the concentration of other interacting components (particularly metals), remaining largely unknown. The aim of this study was to evaluate the potential risk of metal contamination in bat species occurring in Portugal, and to evaluate the suitability of non-lethal sampling methods. The concentration of As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se and Zn was measured in two categories of biological samples (lethal samples: liver, heart, bone and brain; and non-lethal samples: wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savii, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus 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 the concentrations of metals obtained in organs and metals (P ≤ 0.001). Depending on the metal, the organ/tissue that showed the highest concentrations varied, but even so far and wing presented the highest concentrations of most of the metals. These results support the hypothesis that non-lethal samples may be useful for studies on wildlife ecotoxicology, and may help to define a protocol capable of being applied at large-scale, to investigate the risk of metal accumulation for bats. For this purpose, non-lethal samples are the best option, and as demonstrated by this study can yield reliable results. Our results therefore provide valuable insights for development of further studies, aiming to understand the importance of metals as a cause for some of the observed declines in bat populations worldwide.

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

The Swartkops River Estuary near Port Elizabeth, South Africa, is an important recreational, industrial, residential, and ecological asset, but under severe pressure. Seabirds are good indicators of trace elements within their environments. Seabirds are good indicators of trace elements within their environments. Seabirds are good indicators of trace elements within their environments. Seabirds are good indicators of trace elements within their environments. Seabirds are good indicators of trace elements within their environments. 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 12 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 positive regressions between egg contents and eggshells. Chromium and Sr had a positive regression in the eggshells, but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.

MO085
Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part
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The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species; for biomonitoring of selected contaminants for aquatic ecosystems. In spite of this, occasional and fragmentary information are available for the species at the Mediterranean scale, where relict and vulnerable populations exist. In this study, we analyzed heavy metals concentrations in osprey eggs from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected, over a period spanning from 2005 to 2016. Mean concentrations of Cd, Ca, Cdmin, Cdmax, Cr, Cu, Pb, Zn, and Znmin, Znmax in these eggs were analysed with two different aims: 1) to evaluate geographical patterns of 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 high levels of Hg concentrations (1.4 ± 1.2 mg/kg on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher Hg concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our results suggest that a study represents a feasible scale to be followed, as well as 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

MO086
Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos
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Oviparous mothers transfer to the eggs components that have both independent and combined effects on offspring phenotype. Functional interactions between egg components, such as antioxidants and contaminants, may influence developmental outcomes. We aimed to investigate 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 non-antioxidative additives 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 concentrations relied on the exposure to these chemicals and the central role of antioxidants is generally inadequate. In addition, no study has considered that the oxidative stress-related toxicity of these compounds may be counteracted by the presence of antioxidant molecules that mothers allocate to their eggs at the time of laying. The independent consequences of variation in the egg concentrations of VE and PBDEs on offspring phenotype, including morphological and oxidative stress effects, are largely unknown, while no study has investigated their combined effects. Thus, we manipulated the concentration of VE and BDE-47, a PBDE congener having a well-known pro-oxidant activity, in the eggs of wild yellow-legged gull (Larus michahellis) by administering a physiological, large (2 standard deviations) dose of VE and 150 ng/yolk of BDE-47 both independently and in combination. We tested for effects on morphological traits (body mass, skeletal growth) and oxidative stress, as changes in total antioxidant capacity, amount of pro-oxidant species, antioxidant enzyme activity, lipid peroxidation, protein carbonylation and DNA fragmentation, in embryos soon before the hatching.
MO087 Sensitivity of freshwater pearl mussel juveniles (Margaritifera margaritifera) to different environmental and contamination factors

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Margaritifera margaritifera is a freshwater bivalve mollusk threatened with extinction in Europe. The population of this freshwater pearl mussel has declined by 90% in Europe, during the XIXth century because of pearl fishing and from the XXth century due to habitat degradation, decrease in water quality and pollution. Nowadays, french population of M. margaritifera is estimated at 100,000 individuals with the largest population found in the river Dronne (Bordeaux - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels are considered as an excellent indicator of aquatic ecosystem health since they require high water quality and they filter up to 50 L of water a day. As a result, they are called «umbrella species», meaning that their conservation will benefit all species living in the same river. With the aim of preserving this pearl mussel, the European project LIFE «Preservation of Margaritifera margaritifera and restoration of river continuity of the Upper Dronne river 2014-2020 » has been set up in which a farm was created in order to produce juveniles in captivity. Some of them will be reintroduced into the environment while others will be used for ecotoxicological studies. The aim of this work was to determine the sensitivity of M. margaritifera juveniles to different environmental and contamination factors, since they are considered as the most sensitive life stage of this species. Acute toxicity tests were carried out on one-year-old juveniles in order to determine toxicity thresholds (LC50) of several factors such as temperature, dissolved oxygen, nitrates, phosphates and metals. Those data will allow to target reintroduction areas of juveniles produced in the farm and help the conservation strategies of Margaritifera marginifera in the Upper Dronne river.

MO088 Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang, WSC Scientific GmbH / Dept E fate Modelling; M. Foudoulakis, Dow Agrociences / 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 where higher tier refinements are applied which make the risk assessment more realistic. The use of standard higher tier refinements or even modelling is sometimes perceived as increasing uncertainty. However, in the present poster we demonstrate that refinements and population modelling help to reduce uncertainty by providing additional insight into the mechanistic understanding of risk and the ecological relevance of effects. This is done based on a risk assessment for a herbicide. It is shown how what-if questions help to address specific questions on uncertainty in the risk assessment and how a margin of safety can be calculated.

MO089 SETAC Wildlife Toxicology Interest Group

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

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

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

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Direct exposure of consumers to chemical ingredients within our daily products is an important pathway that often dominates environmental performance profiles of these consumer products, but has been currently left aside in LCIA toxicity characterization. The aim of the present study is to update and extend the existing framework to consistently incorporate consumer exposure pathways in way fully compatible with existing LCIA toxicity characterization methods, and to illustrate it via a case study of plasticizer chemicals in building materials. We developed a general a framework and a tool that extends the toxicity assessment to the near-field and consumer exposure assessment and combines it consistently with the USEtox fate and exposure scenarios. The chemical mass per functional unit in the consumer product is multiplied by the product intake fraction (PIF) to yields the total exposure expressed. The PIF represents the fraction of the chemical in products that is taken in by the consumer. It is determined by coupling fate processes in consumer environments (near-field) with existing environmental compartments and processes (far-field), via a consistent and mass balance-based set of transfer fractions. The developed tool already enables to calculate characterization factors for 22 types of building products, 8 types of personal care products, 7 contact food materials and multiple cleaning product-chemical combinations. The case study of DEHP plasticizer in a vinyl flooring shows that starting from a mass of DEHP in products of 82 kg, 0.15 kg will be taken in, mostly by the household users via dust ingestion as a dominant pathway. This leads to intake doses of 0.14 mg/kg bw/ad for an adult and 0.5 mg/kg bw/ad for a 3 years old child. Performing a full LCA of the vinyl flooring that shows the 16% of DEHP plasticizer in flooring are associated with dominant shares of impact on human health (43%) and on a specific type of impact (50%), which is attributed to be a contributor to climate change impacts (59%). This case study illustrates well the importance to account for consumer exposure to chemical in product during their use. Final outcome is a consistent and quantitative framework and directly applicable tool to determine factors based on scientific consensus for assessing life cycle exposure and toxicity impacts of chemicals in LCIA, as an input to the LCIA guidance efforts of the Life Cycle Initiative.

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

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The construction sector, representing 44% of the total final energy consumption in Europe, is recognized as a major hotspot of resource use and environmental impacts. Thus, strong efforts are made to encourage the design of environmentally friendly buildings. However, the air tightness of low energy buildings has created particularly confined and polluted indoors. Indoor pollution has been raised as a major public health issue since we spend on average 80% of our time in closed spaces. Designing sustainable buildings with good indoor air quality is even more challenging since this latter is strongly influenced by occupant’s lifestyle and behavior. Life cycle assessment (LCA) is a relevant methodology to account for impacts from indoor air while avoiding potential burden shifting from the life cycle of energy and materials used. Nevertheless, the current use of LCIA does not take into account scientific obstacles such as: (a) the inclusion of the dynamical effects of indoor pollution on human health and (b) the consideration of the behavior of the occupants. In order to address these concerns, a model of autonomous agent has been developed structured around (i) an agent-based model Li-BIM (Live in BIM) which explicitly represents human behavior, (ii) a physical model to capture the building thermal behavior, (iii) the numerical representation of the building (BIM) and (iv) an innovative indoor air quality model Be-BIM (Breathe in BIM). Li-BIM is an operational model which simulates the behavior of the occupants based on an evolved occupational cognitive and social framework. Be-BIM is currently being developed as a dynamic and localized fate model sensitive to users’ behavior and the building and its internal sources. Therefore, Be-BIM will gather the inventory data for dynamic pollutant emissions and (ii) assess the local impacts from air emissions. Expected outcomes of our integrated model include characterization factors for human toxicity due to indoor air which are dynamic and spatially differentiated at the scale of the building. Eventually, our model will allow the comparison of life cycle impacts of different building scenarios with a specific focus on indoor air quality suited for residential dwellings.

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

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freshwater as a resource. In order to clearly define what is to be protected, the freshwater resource is put in perspective through the lens of three safeguard subjects. Considering the current scope of the AoP natural resources, the complex nature of freshwater resources and the dimension of freshwater to safeguard, a definition of freshwater resource is proposed. Also, a wide range of possible impact pathways to freshwater resources is identified, establishing the link between different pathways that may be related to the evaluating subject that may potentially cause freshwater depletion or pollution in the long-term. The concept of recovery period is used to operationalize this framework: when the recovery period lasts longer than a given period of time, impacts are considered as being irreversible and fall into the concern of freshwater resources protection (i.e. affecting future generations).

The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts, as some dynamic fate models already do. Recommendations are also given for freshwater resource impact indicator(s). Therefore, such an indicator would allow LCIA to capture potential long-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

MO094 Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts
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Soil is a rare natural resource and it is at the center of the main issues in agronomy, environment and land use planning. At global level, erosion is one of the major soil degradation processes and it is responsible for the decrease in agronomic potential of soils and in agricultural land surfaces. Water and soil conservation works (WSCW) are built 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 intergateg 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 soil quality in LCA, different types of WSCW with different functions and their impacts on erosion process 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 WSCW in LCA cycle assessment, however it is not possible to evaluate them. It will be also necessary to integrate the impact of the other types of water and soil conservation works in topsoil erosion impact modelling.

MO095 Impact of heavy metals on human toxicity using LCA: a case study for Wallonia
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The study aims at assessing the results when assessing the human toxicity of corn farming in Wallonia, Belgium. The USEtox method is applied to the farming of one hectare of corn. Local data are used for farming data and GaBi datasets are used for background data. The field emissions due to farming are calculated by the most used models. The results in human toxicity, cancer effect, underlie the large contribution of chromium (Cr) emissions due to the use of organic and mineral fertilizers. But diarrhoea is the more represented in the composition of the chromium that is measured and therefore, unspecified chromium is used as emissions. However, it is known that the chromium in natural environment is most probably Cr (III) and this could really decrease the impact as the characterization factor for unspecified chromium, is, in, USEtox, the average of the one of Cr (III) (non-toxic) and Cr (VI) (toxic), therefore really larger than the one of Cr (III). Therefore, a test is realized where chromium is divided by 7, whereas this has no influence on the other results. The impact for human toxicity, non-cancer effect is mostly related to zinc emissions in soil due to the use of organic fertilizers, especially pig manure. However, zinc is abundant and is an important trace element in the human body. It is useful for growth, bone and brain development, etc. and the European Commission recommends the consumption of 7-10 mg of zinc by person and per day. Moreover, mammals are able to eliminate zinc, therefore they are able to maintain a constant level of zinc independently of the exposure level. Consequently, only the exposure to high doses can have toxic effects. A test was made by changing the characteristic factor of zinc equal to 0 in the USEtox model. In this case, the contamination regards human toxicity, non-cancer effect divided by 12 compared to the base case and mostly related to lead and mercury emissions in the soil. In both case, the contribution of pesticide is negligible. In conclusion, although the uncertainties about toxicity categories are well-known, this case study underlines the impact of the user hypotheses and shows that a detailed analysis of the results is essential for a critical view on the toxicity results.

MO097 Comparing ProScale Hazard Factors with USEtox Effect Factors for human toxicity
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The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScaleTM, and the Effect Factors (EF) for human toxicity of USEtoxTM, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting health effect severity based on HMFA and acute toxicity. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research project, including the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized. This poster will describe the research project, including the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Keywords: LCA, LCIA, Life Cycle Impact Assessment, Adverse Effect Management. - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

MO098 Integrating the Use Phase Impacts of Building Materials into Near-Field LCA Characterization
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Historically, LCA has focused on impacts with far-reaching temporal and spatial scales, and not exposures to near-field goods such as consumer products and building materials. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research project, including the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Keywords: LCA, LCIA, Life Cycle Impact Assessment, Adverse Effect Management. - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

MO099 Combined use of Mixed-Integer Optimisation and Thermodynamic, Molecular and Charge Density attributes for predicting Life Cycle Production
Impacts of Chemicals
R. Calvo-Serrano, G. Guillén Gosalbez, Imperial College London / Chemical Engineering

Process sustainability has become one of the fundamental criteria for decision making in chemical industry, being Life Cycle Assessment (LCA) the most popular method in recent years, currently being one of the most extended sustainability assessment methods. Since LCA is based on the analysis of all interactions for all the stages of the life cycle, it ends requiring large amounts of information. This information, however, can be difficult or impossible to gather, being one of the main obstacles when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for small and relatively simple processes and only information of a few hundreds. In these cases, when a full 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 done (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the α-profile (α-profile as attributes, for a better characterisation of the chemical products and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 α-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Impact-Index (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 chemical products and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 α-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Impact-Indicator (EIP)(18.34%).

MO101 Assessment of freshwater ecotoxicity with USEtox
M. LOT, CEHTA; P. Thomas, CEHTA SAS; F. Sahigara, KREATIS; M. Jacob, TOTAL SA

USEtox is determined as the reference tool for freshwater ecotoxicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEP/EOF project, by JRC-IES in ILCD handbook, by Wellcome Trust concerning the sustainable use of chemicals and by USEPA in TRACI tool manual. An assessment of the relevance of the Characterisation Factor (CF) with its associated factors was realized. We found that CF appears to be significantly influenced by the effect factor (EF), implying that the 2 others factors, XF (Exposure Factor) and FF (Fate Factor), do not intervene, or very little, in the final calculation of CF. This finding is surprising because the XF and FF factors should influence the calculation of CF as they represent, significant fate- and exposure-based 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

The transition from a fossil-based economy to a bio-economy is essential for economic sustainability and for reducing the global impact on environmental Proctection Agency / Life Cycle and Decision Support Branch; B. Morelli, T.R. Hawkins, Eastern Research Group Inc / Franklin Associates; H.E. Golden, U.S. Environmental Protection Agency / National Exposure Research Laboratory; J.E. Compton, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory; E.J. Cooter, U.S. Environmental Protection Agency / National Exposure Research Laboratory; A.D. Henderson, Noblis Inc / Environmental Science; A. Eiden, ORISE; J.C. Bare, U.S. Environmental Protection Agency / National Risk Management Research Laboratory; E.A. Garcia, CEHTRA; P. Thomas, CEHTRA SAS; F. Sahigara, KREATIS; M. Jacob, TOTAL SA

MO103 Land Use Change comprehensive framework in LCA for microalgae cultivation systems as emerging production option in the bio-economy
L. Compagnoni, D. Marozza, University of Bologna; S. Righi, University of Bologna / Physics; E. Balugani, E. Merloni, University of Bologna Europe is nowadays facing serious issues about natural resources depletion. From the different scenarios considering the sustainability of the chemical economy, land use has been identified as one of the most relevant factors. A comprehensive framework for the assessment of LCAs of algae-based products has been performed on a wide range of production processes. A Scopus review on “algae LCA”, indeed, reported 228 total papers published in the scientific literature since 1989, experiencing a fast-growing trend from 2010 onwards, mostly regarding biofuels (>77%). However, one impact category of the algal-based process life cycle that is commonly overlooked, while being of high importance for the bio-economy, regards land use change (LUC), with only 8% of algae’s LCA-related studies including it. Land use influences biodiversity as well as the structure and functions of ecosystems, causing damage to many areas of protection through diverse impact pathways, such as biodiversity
Damage Potential, Ecosystem Services Damage Potential, Biotic Natural Resource Depletion and Climate Change. However, only few of these impact pathways are fully implemented in currently available LCIA, also due to lack of significant consensus on this novel impact category. Specifically, LC has to be carefully evaluated when assessing microalgae’s cultivation systems, as they may be strongly diverse one each other, hence impacting through diverse paths. Cultivation layouts may range, in fact, from large open ponds to more compact photovoltaic reactors; they may be installed in different natural environments, such as freshwater ponds or offshore cultivation systems, either in brownfield lands in an optic of redevelopement of industrial areas, hence even generating a positive effect to the environment, mostly in terms of GHG’s fluxes and biodiversity. In this respect, the study aims at providing a consistent framework of the current methodology on LUC impact category and its application to bioeconomy and, specifically, to microalgae’s production in order to provide support to business and policy decision making.

**MO104 Application of LCIA water use methods to renewable energy systems in Spain**

L. Sánchez-De Castro, D. Garrañ, Y. Lechón, CITEMAT / Energy Dept Energy Systems Analysis Unit

The topic of ‘water’ in LCA has emerged as an important approach to quantify the related effects of water use from consumption of goods and services. Several assessment methods have been proposed by the scientific community, encompassing both the computation of water use and its impacts, but differing in their scope of analysis and in their approach to the problem. After a thorough comparative study on the different methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: 1) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Remaining per area in a watershed.

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

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Freshwater stress and its implications for present and human welfare and the natural environment 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 and cannot recharge the groundwater). Additionally, the actual state-of-the-art of the methodologies to consider this impact category, this work presents the identification of the most relevant methods for quantifying the water use in LCA of several renewable energy systems: 1) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Remaining per area in a watershed.

**MO106 Filling the Gap of Overfishing in LCIA: 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; R. Kelle, R. Iten, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

There is a lack of LCIA methods to assess the contribution of fish consumption to the global problem of overfishing. Due to this methodological gap, fish is often determined to have a lower environmental footprint than other sources of animal protein in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a maximum sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FS\textsubscript{MSY}) 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 FS\textsubscript{MSY} 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 stated approach can be used to calculate the full single-score LCIA of meals and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.

**MO107 Constructing life cycle inventories for the hydroelectric sector in Peru: methodological considerations and environmental impacts**

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According to recent reports, hydropower currently accounts for 16% of worldwide electricity generation. Low carbon emissions are usually related to this source of energy, making it an attractive option for nations with hydropower potential to meet increasing electricity demand without relying on burning fossil fuels. However, the new wave of hydropower plant construction is occurring mainly in three tropical river basins: Amazon, Congo and Mekong; therefore, an additional environmental impact must be considered: biogenic greenhouse gas emissions due to the degradation of biogenic carbon in reservoirs. Peru is planning on installing up to 2,000 MW of installed capacity in hydropower until 2021, but the input and output flows, as well as the environmental impacts that these generate have not been explored. In this context, a set of three run-of-river hydropower plants built in the past decade located along the Peruvian Andes were analyzed from a life-cycle perspective. The main objective of the study was to construct and spatially explicit life cycle inventories for each of the three hydropower plants with the aim of having specific information for real conditions in Peru. This information was used to compute the environmental impacts linked to the generation of electricity at the plants. Although the main aim was to determine the GHG emissions linked to this process, considering the important policy implications of decarbonizing the Peruvian electricity grid, other environmental categories, such as eutrophication and depletion of abiotic resources, 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 cases below 3 g CO\textsubscript{2}e 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. Galgani, Radboud University Nijmegen / Department of Environmental Science; A. Beusen, P.L. Van Zelm, Radboud University / Department of Environmental Science

Eutrophication is a key water quality issue triggered by increasing nitrogen (N) and phosphorus (P) levels and potentially posing risks to freshwater biota. In life cycle impact assessment, spatially explicit characterization factors (CFs) of phosphorus and nitrogen emissions to freshwater causing eutrophication have been derived. However, for nitrogen impacts, no efforts have been undertaken yet. Moreover, neither for agricultural emissions of N nor for N spatially explicit CFs have been derived. Therefore, the goal of this research was to determine spatially explicit CFs for...
freshwater eutrophication due to nitrogen as well as phosphorus emissions from wastewater treatment plants (WWTPs) and agriculture on the global scale. CFs were defined as the change in 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 a factor effect. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as from WWTPs from year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on log–logistic relationships between the PNOF (dimensionless) of heterotrophic species and total P (TP) or NO3− concentrations. The PNOF – concentration relationships were determined using data on the highest concentration where a species was observed in field surveys. Our work provides the opportunity to quantify worldwide spatially-explicit a cumulative toxics 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 products in LCIA, as well as to determine country-specific eutrophication footprints using multi-regional input-output (MROI) analysis.

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

MO109 Carbon and material footprint of consumption in Flanders - an input-output based assessment
A. Hauschild, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten, VMM-MIRA
Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks, based on the Flemish environmentally extended input-output model. The Flemish EE-IO model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an interregional IO-model in which trade with the Brussels and Walloon Region is modelled in IO-tables. Imports from outside Belgium are included via the link with the use table of Ecoinvent. A monetary consumption matrix for households divides the final demand vector of households, based on the Flemish environmentally extended input-output model. In 2010 the carbon footprint for 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 households consumption activities e.g. food consumption. The relation between carbon and material footprint, geographical and sectoral distribution of different production chains and consumption activities, and the relation with added value and employment created by Flemish consumption will be discussed. As the model is available for 2003, 2007 and 2010, the evolution over these years will also be presented. Conclusions will mainly focus on methodological issues and policy implications that follow from this analysis. To achieve the greatest possible global environmental benefit, it is not enough to focus on a country or region’s boundaries alone. There is also a need for a policy that is aimed at making production chains and consumer behaviour more sustainable, including internationally harmonised calculation methods and targets of footprints to evaluate the results.

MO110 A cross-country analysis of relationship between economic structural change and CO2 emissions.
K. Shirono, 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 demonstrate the complexity of the economic structural changes including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether or not the development levels of countries can explain those environmental effects. Specifically, we employed a multi-regional input-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 sector activities, and the role of service sectors in economic growth will expand more and more. In developing countries too, since the proportion of production from primary and secondary industries will shrink and that from tertiary industries will rise with their economic growth, the importance of service sectors will be enlarged. For this reason, it is essential to focus on the production systems of service sectors to reduce domestic CO2 emissions. It is especially important to shift to the industrial structure with less emission-intensive material goods.

MO111 Influence of substance coverage on impacts from the electricity sector
A.S. Leclerc, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering 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 E3lice includes emissions emitted to air in 44 countries and regions but only for 33 substances. In comparison, the database Ecoinvent provides emission data for hundreds of substances in the unit process inventories for electricity and heat generation. Here, we aim to develop a globally consistent and extensive database of airborne emissions from electricity production to get a more realistic coverage of toxicity impacts in large-scale life cycle assessments (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (EENEI) 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 EENEI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using E3lice may underestimate the toxicity impacts associated with electricity production by a factor ranging from 1.4 to 1.9, while Ecoinvent may cut them off by up to 4 orders of magnitude in some countries. This demonstrates the importance of having an extensive substance coverage to fully represent the environmental impacts of electricity production.

MO113 Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains
K. 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 are emitted. It offers the potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to any multi-regional input-output (MROI) based economic model. We present new method for locating at a subnational level the environmental emissions induced by global supply chains. As the world economy becomes more complex it is increasingly difficult to connect consumers and other downstream users to the origins of their GHG emissions and other impacts. Given the important role of subnational actors in GHG abatement and other environmental protection efforts, it is advantageous to connect consumers to the locations where their purchases are driving environmental pressure. We present spatial footprint results for 187 countries showing the footprint of GHG emissions, air pollution hotspots, and biodiversity threats, and discuss our spatial footprint methodology.

MO114 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
created so that they meet requirement sets, such as, for example, related to PEF. Meanwhile, the “DAMA” has been applied to various sectors, products, and data sources. The presentation will summarise key steps of the development and will demonstrate the DAMA, for specific data sets and also for specific use cases. The LCA data machine will be demonstrated in three different application cases: 1) finding and if necessary creating data sets in situations where no data set is directly available, i.e. for data gaps; Paper machine example 2) creating a data set as copy of an existing data set, e.g. creating specific inventory for India from soy bean production US 3) Product comparison, identification of differences between compared products The approach with DAMA will also be compared to approaches currently used in LCA, with examples from the PEF 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.

MOI15 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. Landis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Population and Public Health

TRILANT online 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 power generation processes. Our LCA model incorporates hourly energy use data for on-site renewable production at a net-zero energy building (NZEB), and hourly or sub-hourly electrical energy usage data at a LEED Gold building: both are situated in an energy conservation district located in Pittsburgh, PA. Seven iterations of both static and dynamic life cycle assessment (DLCA) based-models were performed and evaluated based on building energy use (predicted vs. observed), electrical grid time resolution (yearly, monthly, hourly), and region-specific electrical grids and data sources (Environmental Protection Agency, Department of Energy). Our results illustrate that the use of photovoltaics at the NZEB produced excess electricity by on-site renewables which is distributed back to the grid and can be interpreted as avoided upstream emissions (generation at the power plant), which in some cases may offset or erase emissions from other phases. 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 DLCA research domestically.

MOI16 Life cycle framework for environmental assessment of public transport systems
A. Shinde, Indian Institute of Technology Bombay, Mumbai, India; A. Dikshit, Indian Institute of Technology Bombay, Mumbai, India / Centre for Environmental Science and Engineering (CESE); R. Singh, Thinkstep Sustainability Solutions Pvt. Ltd., Mumbai, India

Several studies have assessed life cycle environmental impact of public transport systems. However, there is no single platform, software or tool for comparing the environmental impacts of different commuting options. The objective of this study was the development of an LCA based-framework to evaluate, analyse and compare the life cycle environmental impact of public transport systems. The modular and parameterized system of GaBi 6.5 platform has been used for exploring the life cycle environmental performance of commuting trains, public bus transport and intermediate public transport (IPT) modes viz. taxi, auto-rickshaw. The system boundary comprises environmental lifelong 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.

MOI17 Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment methodology
A.L. MERCHEAN, University of Liege / Chemical Engineering, PEPs; S. Groslandmet, 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 of increasing the rail freight transport is linked to the European Commission’s White Paper on transport (2011), which aims to shift the 30% of road freight over 300 km to other modes of transport more energy-efficient such as rail or waterborne transport by 2030. In the framework of the BRAIN-TRAiNS project, the Life Cycle Assessment (LCA) methodology has been chosen to analyse the environmental impact of the intermodal rail freight transport in Belgium. In a first stage we have carried out the LCA of rail freight transport (distinguishing between electric and diesel traction), inland waterways transport and road freight transport independently. In a second stage we have carried out a study of the environmental impacts related to intermodal rail freight transport. For this, we have studied several consolidated intermodal road-rail routes in Belgium. The aim of this analysis is to compare the environmental impacts of these intermodal models and 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 have not be completely reached by 2030, respectively. The results obtained in this research will be used to build plausible scenarios for rail freight transport in order to define the sustainability impact of future intermodal transport. They could help in making optimised policy decisions relative to the development of intermodal transport in Belgium, including environmental aspects and allowing the reduction of emissions in the transport sector.

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

MOI19 Quantifying visual assessment of kinetics - Development of an objective criterion to support visual assessment of SFO fits of parent soil degradation
J. Witz, Bayer AG / Environmental Safety; S. Boecke, Envissearch Ltd; S. Ford, JSC International Limited; D. Patterson, Syngenta; B. Erzgraeber, BASF SE; M.A. Thomas, Monsanto Company; I. Hardy, Batelle; R.L. Jones, K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; J.A. Hingston, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi- phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err magnitude 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, indicating the subjectivity 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 experimental data). Then, the SWARC is weighted depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data
point. Thus, the criterion mimicks the visual assessment process, taking into account the presence and size of systematic deviations, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFOP should also be assessed. Testing of the criterion for metabolite fits showed that the test was conservative, but it was considered to also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MO120
"Southside"- Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe
B. Gottesbauren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASF SE; K. Platz, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modelling; B. Erzarhaeger, BASF SE; F.P. Donaldson, BASF Corporation / APD/EPR; J. Goulet-Forlin, BASF SA; F. Kröger, Eurofins Agroscience Services GmbH

In European regulations degradation rates in soil (DegT50) from terrestrial field dissipation studies TFD studies considered for exposure modeling may originate from "any" sites with soil and climatic conditions similar to Europe. An OECD Ecoregion similarity model (ENASGIS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. It was found acceptable. The normalized SFO DegT50 be used to other regions of the world. An experimental and GIS/modeling feasibility study ("Southside") was initiated to demonstrate if TFD studies conducted in the Southern hemisphere (i.e. New Zealand, Chile) under climatic, soil and cropping 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 ENASGIS tool as well as an adapted GIS crosswalk with JRC-EFSA climate and soil maps for EU. The trial sites had soil types ranging from loamy sands, sandy loam, loam and silty loams. In New Zealand the sites were located on the Northern Island having an average annual air temperature of ~12-13 °C and an average annual rainfall of ~780-970 mm. In Chile the sites were located in the Region del Bio-Bio east of Concepcion 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-square) 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, limitations and consequences
J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX, P. Kosubova, Central Institute for Supervising and Testing in Agriculture; S. Polakova, Central Institute for Supervising and Testing in Agriculture / Official control section; M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Brodký, Charles University in Prague / Institute of Science, Masaryk University / Faculty of Science, RECETOX; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinisová, AQUATEST Inc. / Z. Simek, L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Jadwina, University of Utrecht / Institute for Testing and Research; M. Slátka, Czech University / Central Institute for Supervising and Testing in Agriculture; M. Svobodová, L. Krkošková, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); N. Neuwirthová, Masaryk University

Current agricultural management is usually based on high consumption of pesticides which may bring a lot of environmental problems. Alarming results from monitoring pesticide residues in EU groundwater and surface water evoke the question of whether the arable soil can contain significant contamination as a result of the intensive use of pesticides in the present or past. Therefore, in 2014 - 2017, agricultural soil was monitored at more than 100 locations in the Czech Republic for more than 50 representatives of currently used pesticides, their selected transformation products and also banned atrazine and simazine with their transformation products. The results showed that the contamination of the monitored soils with the analysed pesticides is quite extensive. At least one pesticide was detected in 99% soils and in 81% soils the concentration of 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 terbuthylazine it was concluded that banned toxic simazine is still introduced significantly to the soils as an allowed impurity of massively applied terbuthylazine. 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).

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

Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessments
W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and/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/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure conditions and the context sensitivity of the monitoring location to broader regional context. In this paper, we summarize a set of recently developed approaches to infer and quantify realistic pesticide exposure potential based on monitoring data, including bias factor (BF), universal kriging (UK), and survey statistics. These approaches can be used in a systematic way to provide a useful reality check for comparison with exposure model output in regulatory assessments, thus increasing confidence in decision making. Examples of applying these approaches are provided to demonstrate their usefulness for watershed scale assessments.

MO124
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SETAC Europe 28th Annual Meeting Abstract Book
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing
D. Weber, M. Brauer, Eurofins Regulatory AG / Environmental and Ecological Modelling; A. Boelehan, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The calculations of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goëtz, 2015, Bach et al., 2016, Poulson, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e. any comments from official side (EFSA FOCUS Repair Group) or from other sources can be addressed according to given consensus. The aim is to contribute to the development of an improved and generally accepted approach for surface water calculations representing a realistic worst case based on a robust evaluation. Bach M et al. (2016): Pesticide exposure assessment for surface waters in the EU. Part 1: Some comments on the current exposure assessment. Pevl. Nature Sci. 2015; 172:1721-1724. Comments connected by G (2015): Long term surface water simulations using the FOCUS scenarios. Pesticide Behaviour in soils, Water and Air, York, UK. September 2013 Poulson V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Luxembourg. September 2016 Weber et al. 2017: Multi-Year evaluations in the FOCUS Surface Water assessment. Conference Pesticide Behaviour in Soils, Water and Air, York, 2017.

MO125 Spatial and temporal explicit catchment modelling in aquatic risk assessment using the modular framework CMF
S. Multsch, F. Krebs, S. Reichenberger, DR. KNOELL CONSULT GmbH; S. Heine, Bayer AG / Effect modelling; P. Kraft, L. Breuer, Justus Liebig University Giessen / Chair of Landscape, Water and Biogeochemical Cycles; T. Schad, Bayer AG / Environmental Modelling


MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models
B. Kinder, A. Guccion, J. Kleinmann, WS International GmbH

For the zonal registration in the EU predicted environmental concentrations in surface water need to be simulated based on the FOCUS models. Three different entry paths are considered: runoff (simulated in PRZM), drainage (MACRO) and spray drift (SWASH drift calculator). While the latter only depends on the amount sprayed, the distance to the water body and the spray equipment used, runoff and drainage amounts are also triggered by substance properties, e.g. degradation in soil and adsorption to soil. Often, a lot of runs need to be simulated for different crops or application timings to proof a safe use of plant protection products as defined in the Good Agricultural Practice (GAP). For this paper we evaluate the FOCUS scenarios compared to the substance properties DT50 and KOC. The idea is to find DT50 and KOC values which trigger runoff and drainage events and to distinguish worst-case FOCUS scenarios for different DT50 and KOC values. Dummy substances will be created which have different values for KOC and/or DT50 in soil. The remaining properties will be identical for each KOC/DT50 variation. Using automated FOCUS surface water simulations PECsw values were calculated for different scenarios at different application times within the active substance lifetime. The spray drift as entry path is used to model the occurrence of spray drift. The results of different scenarios for a single scenario were compared to identify a trigger value for runoff or drainage in this scenario. Furthermore, the results of different scenarios for a single substance will be compared to find the most sensitive scenario for these KOC/DT50 values. Finally, the amount of simulations necessary to show a safe use might be reduced to certain worst-case scenarios depending on the DT50 and KOC properties of the substance.

MO127 Quantitative evaluation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation
E. Guerri, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittius, V. Huck, Luxembourg Institute of Science and Technology LIST

Pesticide monitoring remains the blind spot in WFD monitoring schemes because of the episodic occurrence of their emissions following application periods. Full coverage of relevant exposure periods is logistically impossible on a larger scale with classical monitoring methods like grab or automatic sampling. Passive sampling offers a cost-effective solution that is well suited to derive general or local numbers 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 weight-averaged events 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 tested to derive load 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 mesoscale agricultural catchment using passive sampler data
M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; J. Farlin, Luxembourg Institute of Science and Technology LIST

The impact of agricultural practices on water pollution can be assessed by process-based reactive transport modelling using catchment scale models. Most studies only use simulation to fit parameterisation and/or test model calibration and validation. Thus, even if the applied model is spatially distributed, predicted spatial differences of pesticide loss cannot be directly compared to observations. In this study, we applied the spatially distributed reactive transport model Zin-AgroTRa 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 assessing time proportional uptake by passive samplers. Continuous discharge measurements and high-resolution monitoring of events during extreme events were allowed for accurate load calculations at the outlet. Detailed information about maize cultivation in the catchment and nation-wide terbutylazine application statistics (average of 341 g/ha in the 3rd week of May) were used for a definition of the pesticide input function of the model. The hydrological model was manually calibrated to fit baseflow and spring/summer events. Substance fluxes were calculated using 1000 Monte-Carlo simulations of physicochemical substance properties according to the literature: surface soil half-lives of 10-35 d, Freundlich KOC of 150-330 mL/g, Freundlich n of 0.9-1 and adsorption/desorption kinetics of 20- 80 1/d. A multi-criteria Nash-Sutcliffe efficiency including substance loads and concentrations at all stations was calculated resulting in values up to 0.80. The best 100 parameter sets were evaluated for terbutylazine pathways and balances. The model simulated overland flow to be the major source (80-95%) of terbutylazine in the main channel and localised inputs and surface water fluxes to be the most important pathways in the tributaries. Simulation results suggest that 0.07-0.14 % of applied terbutylazine mass was exported to the river in the Wark catchment. In addition to calibration of substance characteristics, passive
MO129
Recallibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data
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Vegetative filter strips (VFS) are widely used for mitigating pesticide inputs into surface waters via surface runoff and erosion. To simulate and assess the performance of VFS in reducing surface runoff volumes, eroded sediment and pesticide loads the model VFSMOD (Muñoz-Carpena and Parsons, 2014) is frequently used. While VFSMOD simulates infiltration and sedimentation mechanistically, the reduction of pesticide load in surface runoff by the VFS (delP) is calculated with the empirical multiple regression equation of Sabbagh et al. (2009). This equation uses the following inputs: predicted reduction of total inflow (delQ) and eroded sediment load (delE), absolute surface runoff volume and eroded sediment load entering the VFS, linear adsorption coefficient Kd of the pesticide, and the clay content of the field soil (as a proxy for the clay content of the eroded sediment). The Sabbagh et al. (2009) equation, the coefficients of which were obtained by calibration against 47 data points, has not been widely accepted by regulatory authorities, on the grounds that its reliability has not been sufficiently established yet. Hence, evaluation against additional experimental data is necessary. Chen et al. (2016) proposed an alternative regression equation with a different structure based on 181 experimental data points. This equation uses fewer independent variables, but has more parameters than the Sabbagh equation. The objective of the present study was to improve the predictive capability of the Sabbagh et al. equation by broadening the underlying data. For this, additional, additional experimental VFS datasets were compiled from the available literature and thoroughly checked for their suitability. Moreover, existing errors in the calibration and validation data points of Sabbagh et al. (2009) were corrected. The consolidated experimental dataset (n = 244) was used to recalibrate the Sabbagh and Chen equations. Moreover, a full cross-validation analysis was performed to assess the predictive capability of both models. The Sabbagh equation fitted the whole dataset slightly better than the Chen equation (r² = 0.82 vs. r² = 0.79) and performed consistently better in the cross-validation exercise (with respect to the prediction performance indicators Q², predictive r², and RMSEP). Finally, a maximum-likelihood-based calibration and uncertainty analysis were performed for the Sabbagh equation using the DREAM algorithm.

MO130
Vanda - Visualize and Assess: a tool for the pesticide risk mitigation in surface water
F. Galimberti, G. Azimonti, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; A. Moretto, Università degli Studi di Milano
The Directive 2009/28/CE of the European Parliament and Council on Sustainable Use of Pesticides introduced a community action framework to protect the Environment of the EU and requested Member States to implement policies and actions in order to reduce the risk of pesticide use. In the Region of Lombardy, in Italy, this Directive was adopted with DGR n. X/3233. The aim of the present work is to develop an interactive, easy to use tool to visualize the potential risk of surface water contamination, assess the potential pesticide risk and identify areas where to introduce mitigation measures to reduce the contamination, and consequently to reduce the risk in the surface water compartment. The datasets to start with are the monitored concentrations of pesticides in surface water, produced by the Regional EPA. These values are used in this context as Measured Environmental Concentration - MEC. The ratio MEC/PNEC is proposed in this work as a sort of risk assessment, even though the limitation and the complexity of usage of monitored data is well known. In addition, the ratio MEC/EQS - Environmental Qualitative Standard (annual average concentration), is considered, to address the water quality with respect to the regulatory limit for pesticides in surface water (European Directive 2000/60). A MS Excel tool has been developed to map the monitored residues of pesticides, assess the potential pesticide risk (MEC/PNEC) and identify “hot spots”, that is areas where mitigation measures should be included. The tool is thought to be an anyone-can-use one, even with no particular knowledge of GIS or database management. Its peculiarity to be built inside MS Excel gives itself the possibility to share and to ease the dissemination of results. For more advanced mapping, the tool can interact with ESRI ArcGIS. The openness of Vanda makes it a tool suitable to work with other environmental compartments or other environmental theamtics.

MO131
Selecting application dates for UK higher tier drainflow modelling: comparing the FOCUS PAT and CRD PAT rules, and assessing the role of soil trafficability
J. Camall, G. Hughes, Cambridge Environmental Assessments; J.A. Hingston, J. Evans, Chemicals Regulation Division
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 from a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8): 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil. Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g. in dry springs applications might take place in March while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuisance is often lost from the risk assessment, and applications are forced into months when farmers would not have been able to travel their lands and apply crop protection products. Using a soil moisture deficit based approach to trafficability, the FOCUS/CRD-PAT approach requires that two different algorithms were modified to account for this agronomic restriction. In this poster, the results from the four approaches – namely CRD PAT, FOCUS PAT, CRD Traffic PAT and FOCUS Traffic PAT – are contrasted and compared, with a view to drawing conclusions for the standard and refined UK higher tier drainflow risk assessment process.

MO132
Considering diffuse urban and agricultural sources of pesticides at the landscape and catchment scale
G. Hughes, J. Camall, Cambridge Environmental Assessments; F. Ericher, CEAGetera; E. Arba, IBCS Intercollege of Environmental Science and Technology; S. Reichenberger, University of California, Berkeley; F. Galimberti, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; A. Moretto, Università degli Studi di Milano; F. Viovy, University of Orleans
TheDirective 2009/128/CE of European Parliament and Council on Sustainable Use of Pesticides introduced a community action framework to protect the Environment of the EU and requested Member States to implement policies and actions in order to reduce the risk of pesticide use. In the Region of Lombardy, in Italy, this Directive was adopted with DGR n. X/3233. The aim of the present work is to develop an interactive, easy to use tool to visualize the potential risk of surface water contamination, assess the potential pesticide risk and identify areas where to introduce mitigation measures to reduce the contamination, and consequently to reduce the risk in the surface water compartment. The datasets to start with are the monitored concentrations of pesticides in surface water, produced by the Regional EPA. These values are used in this context as Measured Environmental Concentration - MEC. The ratio MEC/PNEC is proposed in this work as a sort of risk assessment, even though the limitation and the complexity of usage of monitored data is well known. In addition, the ratio MEC/EQS - Environmental Qualitative Standard (annual average concentration), is considered, to address the water quality with respect to the regulatory limit for pesticides in surface water (European Directive 2000/60). A MS Excel tool has been developed to map the monitored residues of pesticides, assess the potential pesticide risk (MEC/PNEC) and identify “hot spots”, that is areas where mitigation measures should be included. The tool is thought to be an anyone-can-use one, even with no particular knowledge of GIS or database management. Its peculiarity to be built inside MS Excel gives itself the possibility to share and to ease the dissemination of results. For more advanced mapping, the tool can interact with ESRI ArcGIS. The openness of Vanda makes it a tool suitable to work with other environmental compartments or other environmental theamtics.

MO133
Calibration of passive samplers for the monitoring of chlordecone in French Caribbean rivers
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The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordecone obsolete and new approaches should be explored to monitor the fate of this compound aquatic system. Integrative samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordecone: the classical POCIS (Polystyrene Organic Chemical Integrative Sampler) (with Polysulphone membranes), the POCISny 30µm (with nylon membranes), and the POCISny 1µm. Calculated sampling rates (Rs) were corrected by a PRC (Performance Reference Curve) approach. Labratory calibration was done in triplicates under a continuous flow system, and the field calibration was done in triplicates in river Capisterre (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.97±0.01 L.day⁻¹ for the POCISny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCISny 30µm. Two distinct Rs were calculated for the POCIS and the POCISny 0.1µm: one for the first five days of the experiment (R=0.19±0.01 L.day⁻¹ for the POCISny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCIS); and one for the overall experiment (R=0.19±0.02 L.day⁻¹ for the POCIS; R= 0.43±0.01 L.day⁻¹). POCISny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than
in the laboratory calibration (Rs=0.82 ±1.93 L g⁻¹). POCIS and POCISnly samples can accumulate chlordecone efficiently despite its hydrophobic properties. POCIS 30µm seem to be a useful tool to monitor short flash floods, which happen regularly in this area.

MO134 Temporal patterns of pesticide residues in four major river basins in Korea C. Kim, K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection
To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples at these sites were collected from April to July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongjin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, isoprothiolane, iprobenos and flutiazaflamide as fungicides were mainly detected in rice season. While other fungicides including dimiconazole, propiconazole, fenarimol, nuarimol and bosalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphorus, cesafos, diazinon, fenitrothion, fenithion, phenothioe and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Of the herbicides monitored, nine pesticides which include alachlor, butachlor, dimethametryn, diethiony, ethalfluralin, oxadiazon, simetryn and thiobencarb were detected with frequencies of 1-48% and in their residue level of 0.01-1.9 µg/L. Detection frequencies and residue levels of insecticides and herbicides were the highest in waters sampled in May and June. Almost pesticides detected were for the rice plants and their residue levels were very low to compare with standard values.

MO135 Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil R.D. Acayaba, SCHOOL OF TECHNOLOGY UNICAMP; C. Raimundo UNICAMP / Institute of Chemistry; A. de Albergure, G. Umbuzeiro, School of Technology, UNICAMP / LAEG São Paulo State is the biggest sugarcane producer in Brazil and the second at pesticide consumption. The aim of this project was to develop a method to determine the presence of 14 pesticides representative from sugarcane plantation, 7 herbicides (simazine, atrazine, ametryn, clomazone, diuron, hexazinone and tebufluoron), 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 0.9 to 22 ng L⁻¹ and from 2.8 to 74 ng L⁻¹, respectively, and 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%), tebufluoron (91%), fenoxanil (91%), imidacloprid (96%) and ametryn (91%). 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 groundwater the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbendazim (10%), tebufluoron (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebufluoron, reaching 107 ng L⁻¹.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil B. Jene, BASF SE / Environmental Fate; R.P. SCORZA JUNIOR, Embrapa / EMBRAPA AGROPECUARIA OESTE; D. Máximo, R. Rebelo, IBAMA / DIIQA / CGASQ; A.V. Waichman, Universidade Federal do Amazonas; N. Peranginangin, Syngenta Crop Protection, LLC / Product Safety; A. Tornisielo, Bayer / GENCS - E-Fate; L. Murakami, Bayer AG Crop Science Division; O. Perez-Ovilla, Bayer CropScience / Environmental Safety; E. Henry, Bayer / Environmental Safety; T. Haering, BASF SE
A tri-partite technical working group consisting of regulators, academia and industry was formed to develop a framework for aquatic risk assessment of pesticides in Brazil. The framework should include a sophisticated science based approach resulting in a comprehensive guidance. The basis of the exposure assessment is the selection of the 90th percentile vulnerability which is seen to represent a reasonable worst case and is used as basis of the exposure assessment in other parts of the world. Surface water scenarios should be identified in six pre-defined climatic zones for the seven most important crops soybean, maize, sugar cane, wheat, cotton, citrus and coffee. Runoff and spray drift were found to be the main entrance pathways of pesticides into surface water bodies. Whereas spray drift mainly depends on technology and local climatic conditions during application, surface runoff is influenced by pedoclimatic conditions that could be assessed in a spatial vulnerability analysis. For this the USDA Runoff Curve Number approach (RCN) which is implemented in PRZM was used. A simple model based on the equations of the RCN approach was developed to calculate daily surface water runoff volumes for the agricultural area of Brazil for 34 climatic years. Calculations were carried out on highest available resolution of soil data resulting in more than 63,000 raster cells. Hydrological soil groups were determined by using a Brazilian specific classification scheme applied to the national soil map. Relative runoff vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.

MO137 Identification of Herbicide Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment H. Rathjens, M. Winchell, Stone Environmental, Inc / Environmental Systems Modeling; B. Sur, Bayer AG Crop Science Division / Sustainable Operations; F. Krebs, DR. KNOELL CONSULT GmbH; D. Lembrich, Bayer AG Crop Science Division The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and erosion during storm events, subsurface transport through lateral flow and through subsurface tile drainages, and from spray drift during applications. The Soil and Water Assessment Tool (SWAT) is widely used in the United States and the EU for catchment scale hydrologic and water quality modeling of non-point source chemicals in the environment. The SWAT model was applied to a 992 ha agricultural catchment in the Flanders region of Belgium to help in better understanding the dominant pesticide transport processes. Selection of herbicides 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 incorporated model-based identification of point sources, 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 surface flow was found to be important as well, especially in the western portion of the catchment. Spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmyards as well as diffuse sources.

The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuary at Porto and Gaia cities. Therefore, the presence of pesticides is suspected. Accordingly, the toxicity of different categories (insecticides, herbicides, and fungicides) should be viewed as a priority for this habitat due to their negative impacts on the biota. For this purpose, water was collected over one year at six sampling sites in the Douro River estuary. Samples were extracted by solid-phase
MO139

Moisture 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 (0.0001-0.0002, 94% of cases) and in all areas, 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-dichloroprene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl / RD; C. Vai, Dow AgroSciences Italia s.r.l.; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; 1,3-Dichloroprene (1,3-D), also known as Telone™, is an active substance used worldwide in soil fumigant products for the control of cyst and free-living nematodes. It is used in a variety of crops including fruiting and vegetable crops. Soil sorption studies have shown that 1,3-D and its metabolites present characteristics of highly mobile molecules with a potential to leach into groundwater when applied in vulnerable areas such as sandy soil and in areas characterized by shallow groundwater. European member states have a wide range of groundwater monitoring activities for plant protection products and their metabolites, but analysis of 1,3-D and its metabolites is not currently part of the routine programme. In this study we illustrate a methodology allowing to identify areas most at risk where monitoring should be focused in priority, taking the example of Italy. The methodology considers three parameters: i) crops distribution, ii) soil properties and iii) 1,3-D use. The data, structured as layers of information were managed within a GIS, and are intersected to get the so called Uniform Geographic Units (UGU) which are areas of uniform in their characteristics and are representative of a specific set of values parameters. The data about the spatial distribution in Italy of crops where the 1,3-D is applied were first gathered from the last agricultural census, which provide information at a provincial scale. Successively, these data were refined at municipality scale. The identification of sandy soil areas in Italy was performed using pedological information extracted from different official sources. Subsequently, the information was weighted in order to identify the areas where the percentage of sand in 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.™ of DowAgroSciences

MO141

Development of an European Tier 3+ Spatially Distributed Modelling Framework

G. Hoogeweg, Waterborne Environmental, Inc / Data Technologies; P. Sweeney, Syngenta

Higher tier groundwater assessment in the European Union (EU28) allow the use of spatially distributed modeling approaches for the assessment of groundwater and exposure of soil organism under the need of a deeper analysis of the model 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. This model was developed to integrate data from multiple databases and from different countries. The GeoPEARL 4R model was developed for the EU28, member state, FOCUS zones or crop specific groundwater vulnerability assessments, screening of existing and new plant protection products, context setting of standard scenarios, test sites, and lysiometer, site selection. In this presentation we will show how we developed the framework and several example outputs as well as discuss the implications of conducting large-scale distributed modelling assessment.

MO142

Influence of aquifer parameters on groundwater residue concentrations

F. Hegler, DR. KNOELL CONSULT GmbH; D. Liss, SGS Institut Fresenius GmbH/Agro; W. He, DR. KNOELL CONSULT GmbH; O. Naeh, SGS Institut Fresenius GmbH; S. Rehfeldt, DR. KNOELL CONSULT GmbH / Environmental Fate / Modelling / GIS

FOCUS leaching models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1m 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 of a distributed model, 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-tiered modelling framework that includes spatio-temporal assessments in the higher tiers; e.g., tier 3a and 3b. As part of the spatio-temporal assessment several GIS and daily climate
datasets were recommended. These recommended datasets, however, have been superseded by new datasets in the past few years. Specifically, daily weather and soils data have undergone significant updates, which are reflective of the considerable effort in Europe to update this spatial information. Not only does dataset choice, but also how datasets are being processed in a geographic information system, impact modelling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution influence our modelling results. In this poster, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 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 tolls 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 program 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. Ullucci, ICPS; L. Menaballi, International Centre for Pesticides and Health Risk Prevention

The calculation of Predicted Environmental Concentration of pesticides in groundwater (PECgw) is a crucial point in the registration and authorization process of plant protection products (PPPs) in Europe. Calculations are usually performed by FOCUS models, in particular PEARL and PELMO models. These models allow a realistic but conservative assessment of the potential leaching of pesticides in the groundwater compartment. Model results are influenced by substance specific parameters such as DT50, KOM and Freundlich coefficient (1/n). Great variations in PECgw values are expected when high variability occurs in one or more of the parameters listed above. In this work, we demonstrate that PECgw outputs are significantly affected also by minimal variation of the same parameters.

Considering that a minimal variation is intrinsic in all laboratory studies (es. 25% uncertainty in KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically justified. In 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 contest. Leachate concentrations were plotted as a function of KOM and as a function of degradation rate coefficient. PECgw obtained by the simulations of these two models were used to create a classification system for the input parameters KOM and DT50 according to models sensitivity. Conservative values for each parameter class, to be used in PECgw calculations, are proposed for all substances. This approach can minimize the effects of the intrinsic input variability providing a better scientific approach to the assessment of groundwater modelling in the regulatory context.

**MO146 European regulatory network on pesticide groundwater monitoring**

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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 monitoring data are available in the national language of the origin country, which makes it hard for other countries to have access to the data and (iii) the interpretation of data, 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**

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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 but rather as average effect (EFSA 2015, 2017). The foliar wash-off factor of a compound is a product (formulaion) 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 h after foliar pesticide spray. The determined wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1. EFSA 2010: PPR - FOCUS - Outline on exposure of organisms in soil EFSA 2012: Scientific Opinion 2562 – Science behind the guidance on soil scenarios EFSA 2015: Guidance Document 4093 - Predicting environmental concentrations in soil EFSA 2017: Guidance Document 4982 - Predicting environmental concentrations in soil

**MO148 Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions**

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In recent regulatory discussions about the plant uptake process the question was raised if tracer-like substances (very low or zero sorption, very slow or no degradation) are fully available for uptake by plant roots under dynamic outdoor conditions. An alternative hypothesis is that such substances move so quickly in the soil column that they are taken up by plant roots to a lower extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor container study was conducted with 14C-labeled trifluoroacetic acid (TFA) and winter wheat plants for a time period of 228 days after application onto soil. Trifluoroacetic acid is a common breakdown product of several chemical pesticides (e.g. herbicides). This study was performed in addition to experiments with other pesticides, such as: heavy metals, pharmaceuticals, pesticides, pyrosis of PTFE (used as coating in may 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 (hydronic study design). The translocation and uptake of trifluoroacetic acid observed in the outdoor container study was evaluated with the PEARL model considering root uptake processes as routinely applied in standard FOCUS modelling. A transpiration stream concentration factor (TSCF) for TFA under cereal growing outdoor conditions could be derived. The results demonstrate that mobile, tracer-like substances are taken up extensively by plant roots even
under dynamic outdoor conditions; the hydroponic study design is suitable to determine conservative input parameters for regulatory modelling; uptake experiments with cropped outdoor container may be suitable as higher-tier to derive a refined TSCF. Further experiments will indicate to which extent this study design is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO149 Investigating the variance of edge-of-field deposits of spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray drift 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. 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 treatment field at 2, 5 and 10 m. Consequently, the part of the spray that is applied during the experiments. Horizontal and vertical movements of the sprayer boom were recorded as well. Variance of spray deposits at 2 m downwind from the field edge was about 50%. At 5 m downwind variance was about 30%. A quasi-dynamic model was developed based on the IDEFICS spray drift model. In the new model the effect of both horizontal and vertical boom movements on downwind spray deposits was studied. From the above mentioned experiments, the most important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift deposits similar to those established experimentally. Effects of fluctuating wind directions are to be investigated in the near future.

MO150 Exposure assessment for edge-of-field watercourses next to tree nurseries regarding spray drift deposits
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray drift along tree nurseries involves spraying techniques that apply the pesticide in upward or sideways direction. Particularly for high avenue trees the downwind loss of pesticides due to spray drift can be relatively large. The upward directed part of the spray that is blown towards the top of the trees may reach heights above the trees, where wind can take the spray cloud and move it far downwind. Usually, the branches and leaves at the lower part of the stems of high avenue trees may pass the canopy and reach downwind areas easily. Measurements of downwind spray deposits for tree nurseries indicate deposition levels comparable to those occurring for fruit orchards, which are well above those occurring when spraying arable crops. The current paper deals with the countrywide exposure assessment for pesticides applied to tree nurseries reaching downwind field watercourses in the Netherlands, where high avenue trees, nurseries with the younger spindles and transplanted trees are considered as well. Although the total area of tree nurseries is limited, exposure risk to edge-of-field watercourses is important enough to investigate. Spray drift mitigation techniques are considered and evaluated as well.

MO151 Investigating the exposure of residents to pesticides due to airborne spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, J. Michielsen, H. Stallinga, P. Van Velde, Wageningen University and Research / Agrosystems Research

In the Netherlands, about 90,000 people live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides while head exposure was monitored by face/neck wipe technique. Inhalation exposure was measured using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M. 2008

P. Adrian, M. Liegeois, M. Dariet, B. Jouanol, CEHTRA SAS

This study is to provide evidence guidance on how to conduct a risk assessment for consumers for co formulators present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co formulators is applied onto crops. To our knowledge only one software is predicting the level of crop residues of chemicals after application i.e. PARDIS (1) Prediction of Agricultural Residue Data. Formulation fruit using an Informatic System) however the use is limited to orchards. In addition in the case of polymers, from an analytical point of view it may be difficult if not impossible to analyse the crops for residue content of this type of co formulant. The objective of this work is to develop a methodology to be applied under this conditions. As a case study we present this methodology for latex polymers i.e. polymer based on methylene succinic acid with buta-1,3-diene, styrene and methacrylic acid. (1) Prediction of agrochemical residue data on fruit using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M. 2008

MO153 Dietary exposure to pesticide residues: the big picture
L. Viñas Baroza, L. Ferreira, EFSA - European Food Safety Authority / Pesticides Unit

Science-based approaches and integrated risk assessments by using experimental data, models for pesticide residues intake estimations, monitoring data considering real exposure, etc. are working tools to contribute to the mission of the European Food Safety Authority (EFSA) on protecting European consumers’ health and the environment in the field of pesticide residues. Maximum residue levels (MRLs) are the upper levels of pesticide residues that are legally permissible in food of plant and animal origin. Before an MRL is established, the EFSA assesses the residue behavior of the pesticide and the dietary exposure resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues are estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed through the diet. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and in its transformation, the possible uptake and translocations of the residue to the edible parts of the crop and degraded products as result of industrial and household processing are considered to set the residue definitions for risk assessment purposes. Secondary metabolites characterized by metabolism studies and degraded products may pose a completely different toxicological profile than the parent compound, being more, less, or equal toxic than the pesticide under assessment, and showing a new big picture for an active substance and its residues that should be assessed in detail to avoid consumers’ concerns. The dietary risk assessment of pesticide residues takes into consideration these possible scenarios in order to protect consumers, reason why residue definitions might be different for monitoring and for risk assessment purposes and where the uncertainty due to missing data might play a fundamental role in risk assessment.

MO154 Exposure and Risk Assessment for Agricultural Applicator to Insecticide Flubenamide during Cabbage Cultivation using Whole Body Dosimetry
Y. Shin, Seoul National University / Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National University / 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. Shin, 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

Flubenamide belongs to diamide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s exposure and risk assessment for residues in the environment is important to prevent the residues to which applicators are exposed during spraying. The applicator’s exposure was measured by employing the radioactive water balance method (WBDM) which was performed, which consists of cotton/polyester outer clothing and cotton inner clothes. Hand exposure was measured by washing of nitrite gloves and hands, while head exposure was monitored by face/nape wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL, with good linearity (R2 > 0.99) of calibration curve. Recovery (77-117%) of insecticide from various exposure matrices were reasonable including field recovery (77-109%). Field exposure measurements were carried out by replicate. During application, total

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MOI55 Multi-focus surface water calculations: what do they mean for real regulatory cases?
D. Schaefer, Bayer Crop Science / Environmental Safety; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Boledhan, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer AG / Effect modelling; G. Goerlitz, Bayer Crop Science AG / Environmental Safety

The surface water exposure calculations for pesticides according to FOCUS are currently under revision by an EFSA working group. In particular the working group was mandated to extend the calculation period from a preselected single year to 20 years, with the objective to better capture the effect of variable weather conditions in aquatic exposure patterns. This is meant to provide a more robust and reliable basis for aquatic risk assessments in a regulatory context. The planned revision requires decisions on some technical aspects of the calculations (e.g. evaluation of the original FOCUSss weather data, filling of data gaps, completion of irrigation data sets, definition of multi-year application dates) and also new rules for the interpretation of the results. The main challenge in this context is the lack of experimental data with which to compare the modelled 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-focus calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-focus FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-focus aquatic exposure calculations, and may support the technical and regulatory decisions that the ESA working group has to take.

MOI156 Effectiveness of grass buffer strips in reducing Spinosad runoff
S. Otto, Italian National Research Council, S. Gottardi, M. Pasin, Agrea SRL; R. Bordoni, AgroSciences Italy srl / RD; O. de Cirugeda Helle, Dow AgroSciences

Outcome from FOCUS and a recent Document from Italian Ministry of Health allows vegetated buffer areas as a mitigation measure for runoff to surface water. The modelling framework includes default values relating to the pesticide removal efficiency of such buffers. Recent research suggests that these default removal efficiency values are too low for many substances with low water solubility. Surface water exposure is driven strongly by individual weather events triggering run-off or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-focus calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted an investigation by running multi-focus FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We provide some generic conclusions with regard to the consequences of currently discussed options for multi-focus aquatic exposure calculations, and may support the technical and regulatory decisions that the ESA working group has to take.

MOI157 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 risks. In the process, 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 ARfD distribution for pesticide active substances and three case studies illustrating the practical application of this modular approach to derive a residue definition for dietary risk assessment for isoproturon, spiroxamine and flubendiamide. In September 2016, EFSA organised a technical meeting with stakeholders on its new guidance to exchange views. 1EFSA PPR Panel (EFSA Panel on Plant Protection Products and their Residues), 2016. Guidance on the establishment of the residue definition for dietary risk assessment. EFSA Journal 2016;14(12):4549, 129 pp. doi:10.2903/j.efsa.2016.4549.1OECD (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. 2Information on applications – pesticides – technical meeting with stakeholders on EFSA GD on residue definition for dietary risk assessment. http://www.efsa.europa.eu/it/events/event/160926

Alternative Approaches to Animal Testing for Ecotoxicity Assessments (P)

MOI158 Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; G. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schulte, Fraunhofer IME; I. Ebersbach, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; 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 performed with rainbow trout hepatocytes or rainbow trout hepatocyte S9 fractions. Flow-through test with almost 20 compounds showed, that the H. azteca bioconcentration test could be an appropriate test to predict bioaccumulation in the standard fish test. Bioconcentration studies with H. azteca would support laboratory animal welfare considerations using a non-vertebrate species, improve efficiency and reduce costs for BCF-testing. The results of the in vitro depletion assays have been successfully applied to improve in-silico predictions for BCF values by adding the highly variable effect of metabolism as an additional parameter. In this study a total of five substances with different characteristics, four substances with log Kow values ranging from 2.5 to 4.5 and one ionic substance, were tested both test systems. To obtain a more detailed understanding of the metabolic activities in H. azteca, its metabolism of the five tested compounds were compared to the metabolites generated in vitro by rainbow trout hepatocytes. The results show that Hyalella BCF testing, in addition to in vitro assays and in silico predictions, may help to reduce, refine, and replace the classic BCF estimation with fish in accordance to regulatory needs.
MO159 Assessing Differences in Sensitivity to Aromatase Inhibitors Among Freshwater Fish Species


There is significant concern regarding potential impairment of fish reproduction associated with exposure to endocrine disrupting chemicals (EDCs). Aromatase is a steroidal 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 calculated from 0.0004 to 0.068 μM among these species. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodon spathula), 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 the production of aromatase and will be used to develop a basis for the design of qAOPs for other enzymes. Results of this study are also being used to develop a cross species qAOP for the production of aromatase and will be used to develop a basis for the design of qAOPs for other enzymes.

MO161 Assessing differences in sea turtle organ sensitivity using cell-based toxicity assessment

K. Finlayson, Griffith University - Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, J. van der Merwe, Griffith University / Australian Rivers Institute

The long-lived nature of sea turtles and their lengthy residence in coastal foraging grounds can result in high exposure to contaminants from urban, industrial and agricultural sources. Organic or inorganic contaminants have been quantified in all species of sea turtles worldwide. However, very little is known about how these contaminants impact turtle health, valuable information for identifying populations at risk. In vitro exposure experiments using cell cultures established from turtle tissue provide an ethical, reproducible and cost-effective method to identify threats of environmentally relevant contaminants to sea turtles. In recent years, the majority of sea turtle cell lines have been established from skin samples. However, as ingestion is the main route of exposure for these animals, cell cultures established from organ tissues may be more pertinent. This study used a number of primary cell cultures established from the skin, ovary, heart, liver and small intestine from three individual green turtles to investigate the variation in sensitivity between organ types. Cytotoxicity of five organics and five inorganic compounds was investigated using a short-term exposure method. In vitro effects were assessed 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 cells lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO162 Comparison of rat liver S9 to an animal-free alternative ewoS9R in the Ames fluctuation assay

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The Ames test is the most important in vitro test for mutagenicity performed in many variants. The original agar-plate assay was modified to reduce the amount of assay components like rat liver S9 and the length of time needed for test preparation and evaluation. The Ames fluctuation test was established as a less time and manpower consuming method and introduced into international guidelines like OECD 471 and ISO 11350. In the Ames test the bacterium Salmonella typhimurium, with a lack of histidine-synthesis, is exposed to a sample to determine the mutagenic potential, measured by the ability of revertant bacteria to synthesise histidine. The resulting growth in a histidine-free medium is visible due to a colour change caused by acidification in a pH indicator medium. Nevertheless, it can be further improved and combined with the RAMOS technique (Respiration Activity Monitoring System). This technique improves the sensitivity and the data output of the fluctuation variant. It enables a precise measurement of the oxygen transfer rate (OTR) and therefore conclusions on growth and metabolism of the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenicity in applications like drinking water monitoring. However, as the Ames test is conducted with a microorganism, it lacks the metabolic activation of a mammalian metabolism. Hence, the mutagenicity of promutagens would be underestimated. Therefore, the bioassay is supplemented with an animal-derived product the rat liver S9. In animal experiments rats are treated with toxic substances via percutaneous or intravenous injections or feeding. Subsequently, the animals are euthanized to obtain the liver, which is homogenized, centrifuged and frozen. The commonly used rat liver S9 is a necessary component of various in vitro tests to increase the information about potential mutagenic substances. However, this product varies in its enzyme consistency and purity from batch to batch. Therefore, in the context of 3R to reduce animal experiments and to obtain more reliable in vitro assay components alternatives should be introduced. In the present study, we investigate the applicability of a substitution of rat liver S9 with the biotechnological animal-free ewoS9R in the Ames fluctuation assay and the Ames-Ramos system. Therefore, we investigate 26 promutagens with both metabolic systems. Preliminary results suggest that ewoS9R is a suitable alternative to rat liver S9.

MO163 QSAR: a predictive approach for electronic cigarettes toxicological assessment

D. Zarin, University of Insurbia; E. Papa, A. Sangion, University of Insurbia / SETAC Europe 28th Annual Meeting Abstract Book
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Evaluation of QSAR models for daphnia and fish chronic toxicities of human pharmaceuticals

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Recently, medical regulatory agencies require pharmaceutical companies to assess environmental impacts of new pharmaceutical products before marketing. Hence, it would be valuable to predict ecotoxicity of new pharmaceuticals at developmental stages. As a tool for predicting toxicity in daphnia and fish, two QSAR programs, ECOSAR by USEPA and KATE by Ministry of Environment in Japan are available, both of which are built using dataset of mainly industrial chemicals. In this study, we evaluated applicability and predictivity of the QSAR models using external dataset of the chronic ecotoxicity of human pharmaceuticals. The chemical structures and toxicity data based on D. magna reproduction test (OECD TG211) and fish early-life stage toxicity test (OECD TG210) were gathered from public domain. In order to examine the applicable domain where more reliable prediction results can be obtained, the following criteria were defined in this study; (1) logP values of target substances are within the lowest and highest values of the category chemicals, (2) number of category members is 5 or more, and (3) correlation coefficients of the linear regression are greater than 0.70. Since KATE equips models for acute toxicity only in both species, Acute-Chronic Ratio of 10 was applied to estimate NOEC values. Then, ratio of calculated NOEC and measured NOEC (CM) was determined. For ECOSAR daphnia model, 82 out of 126 pharmaceuticals satisfied the criteria. Of these, 44 pharmaceuticals had CM between 0.1 and 10, some of which were assigned to amides or aliphatic amines. 72 pharmaceuticals had CM between 0.01 and 0.1 and 12 compounds had CM values greater than 100, half of which have pharmacological action to neurotransmitter receptors in human. For KATE daphnia model, 19 pharmaceuticals met the criteria. The CM values were between 0.1 to 10 for 15 substances, most of which belong to primary amines aliphatic/ aromatic, amides or imides, or neutral organics. For fish chronic toxicity, only 11 and 21 out of 72 pharmaceuticals satisfied the criteria with ECOSAR and KATE models, respectively. Further examination will be needed to expand applicability by modifying the criteria, combined with other approaches including acute-to-chronic extrapolation or daphnia-fish interspecies extrapolation.

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

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The Ecological Threshold for Toxicological Concern, or ecoTTC, has been proposed as a natural next step to the well-known human safety TTC concept. The ecoTTC is particularly suited for use as an early screening tool in the risk assessment process, in situations where chemical hazard data is poor, or when an appropriate QSAR is unavailable. ecoTTCs are developed using statistical distributions of Predicted No-observed Effect Concentrations (PNECs) to reflect the breadth and depth of the ecotoxicological dataset beneath, and therefore, the ecological and quality of the underlying dataset is crucial to the future utility of the ecoTTC. An eco-database consisting of approximately 110,000 unique ecotoxicological records, 6200 unique CAS numbers and 1900 species from three trophic groups has been created based on recent assessments of published data and modern Methodologies. These models will be developed using data from alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric, on the growth of rats. This allows for a database format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools.

This 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 species-specific 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

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According to 2011 figures, 80% of the animals used for testing procedures in the European Union are rodents and almost 23% are used in longer term repeated dose tests. Alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric, on the growth of rats. This allows for a database format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. These models will be developed using data from regulatory toxicity testing of pesticides. Experiments will then be designed to assess the effects of known intracellular pesticide concentrations on cell population growth in vitro. Cell number can be converted to cell mass, after which it should be possible to model the effects of matching internal doses on growth over time, in vitro and in vivo. The weight normalised effect on growth (mass [dose group] / mass [control] at a given time point) can then be calculated at various points along the predicted in vitro growth curves. These predictions can then be compared to corresponding in vivo growth curves to determine the equivalence of in vitro and in vivo. The predictions of this extrapolation will be explored for 10 pesticides, which will provide a good indication of the reliability and repeatability of the methods. The predictions prove to be consistently accurate, which will provide a fast and inexpensive in vitro screen for body weight effects in rodents. Initially this may be applied as an alternative to range finding studies which are not a regulatory requirement but are commonly carried out prior to regulatory testing. In the longer term this may form part of a suite of in vitro and in silico alternatives to in vivo chronic toxicity testing.

MO167

Screening of metabolic- and neurotoxicity of environmental chemicals using C. elegans and transgenic zebrafish models

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Metabolic and neurodevelopmental disease have been attracting attention as
MO170 Chemoavailability of Organic Electrophiles - A Nonanimal Approach to Identify Candidates for Reactive Toxicity
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Organic electrophiles are important components within the exposures of humans, flora and fauna. Their toxicity toward aquatic organisms is driven by two molecular initiating events (MIE): the hydrophobically-triggered disturbance of cellular membranes and the chemical reaction with intracellular electrophilicity and/or nucleophilicity. The toxicity enhancement $T_e$ 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 $T_e$ does not solely depend on reactivity, but also decreases with increasing hydrophobicity. This indicates that the relevant nucleophilic targets are located in aqueous compartments and that the hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemoavailability to set a 58 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on $T_e$. To this end, reactivity was quantified by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH) via 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 $T_e$ with increasing $K_m$ 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 $K_{ow}$ and log $K_m$, is shown as a promising nanoanimal tool to analyze for atherogenic aquatic toxicity predominantly driven by the hydrophobic or the reactive MIE, or both MIEs working in parallel. The authors thank the EU-funded project OSIRIS (GOCE-CT-2007-037017) and the BMF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüürmann G 2013. Mol. Int. 32: 98-107. [2] Böhme A, Lapa A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] van Ame D, Thaens D, Paschke A, Schüürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO171 Local Electrophilicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis
D. Wolfond, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry - 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 the DNA. The toxicity enhancement or the DNA toxicity enhancement as measured by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH) was analyzed in vivo in Tetrahymena pyriformis. This allowed to screen reactive esters and to unveil primary mechanisms of toxicity without the need to use living beings. To this end, reactivity was quantified by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH) assessed in vitro in Tetrahymena pyriformis. This allowed to screen reactive esters and to unveil primary mechanisms of toxicity without the need to use living beings. The electrophilic reactivity toward Tetrahymena pyriformis was investigated. For this purpose, their correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which acts as a protector against electrophiles in the cytosol. The dataset of electrophilic chemicals contained 97 α,β-unsaturated esters, ketones and aldehydes. In the context of aquatic toxicity toward Tetrahymena pyriformis, reactive toxicity is assumed to be the primary mode of action of the aforementioned compound classes. Therefore, the decisive power of calculated and experimental GSH reaction rate constants was compared: Both models perform equally well and yield root mean squared errors of about 0.4 log units in modeling the toxicity enhancement as deviation from narcosis level based on 48h-inhibition-growth concentrations.

MO127 Using mechanisms of toxic action to classify and predict ester ecotoxicity
P. Bicherg, P. Bauer, KREATIS, P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment

Even though esters are often used and released into the environment, little is known about the mechanisms of action to their toxic effects and the toxicity of esters is usually assessed in vitro. 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 conducted the in vivo screening using C. elegans mutant: og-1(ok1207), ogt-1(ok1474), ngl-1(ok259), transgenic zebrafish. The treatments, suggests that copper may enhance motility at low concentrations. On the monitored parameters, but for the first observation period (time=0 minutes) viability was measured using an eosin nigrosin staining procedure. Endpoints were determined as per the OECD 305 guideline. The outcome of these in vitro assays will be presented along with the in vivo BCF data.

MO168 In vitro effects of two pesticides on the motility and viability of bovine spermatozoa
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The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the incorporation of pesticides. CMI/MIT, PGI, were screened using C. elegans reproduction assay and zebrafish transgenic assay. The preliminary results showed CMI/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. Embury, ILSI; R. Sharma, Pfizer / PDM Aquatic Toxicity Assessment Department of Medicinal Products for Human Use, a fish bioconcentration study is triggered in Phase I for pharmaceuticals having a log $K_{ow}$ > 4.5 to support the Persistence, Bioaccumulation and Toxicity (PBT) assessment and in Phase II, Tier A for pharmaceuticals having a log $K_{ow}$ > 3. The recommended protocol for bioconcentration is OECD Test Guideline 305: Bioaccumulation in Fish, Aqueous and Dietary Exposure. However, in order to reduce 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 the 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.
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 able to catalyze therefore hydrolytic activity of ester-like algalicides is negligible. The di-esters appear to be more toxic than mono-esters for fish and daphnids because they can produce two times more metabolite than mono-esters. The more reactive esters are usually unsaturated, like allyl/vinyl-esters and alpha,beta-unsaturated esters, whose double bond can be activated by the carbonyl group. For these compounds the substitution around the double bond plays a decisive role in effective reactivity. Thus, methacrylates which have an alkyl substituent in position alpha of the carbonyl are not more toxic than aliphatic esters for any of the three aquatic species. On the other hand, Acrylates clearly express excess toxicity and have to be considered as acting through yet another mechanism of action 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 Environ. Systemic Science; A. Yamahara, National Institute of Technology, Sendai; 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: transcriptomic characterization of the RTgutGC cell line.
L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal derived cell lines are useful in vitro models which allow for focused investigations of specific organ function. 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 model. In this study, the transcriptomic profile of the RTgutGC cell line was compared to the native tissue while 229 were shown to be downregulated against the NR database. In addition, the RTgutGC cell line is more toxic than the native tissue, demonstrating the potential of this organotypic model as a potential animal replacement model. Over 84% of the sequences were mapped to the rainbow trout genome and these data will be used to understand the transcriptional profile of this model. Further pathway and network analyses to understand the molecular mechanisms of chemicals in 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.

MO176 Biological effects of 3 metals on "D" larvae of Japanese oyster Crassostrea gigas
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The Japanese oyster is an introduced species from Asia, which is cultivated in the coastal systems of the Mexican Pacific. Due to the fact that in the last 10 years the populations have had problems in their survival, in this work the evaluation of 3 biomarkers was performed in "D" larvae of this species, exposed to the metals Cd, Cr, Pb and their 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 8 concentrations of metal and their mixtures in proportions 1:1. With the obtained data, the LC50 was calculated and the evaluation of 3 biomarkers was measured in the surviving organisms: the degree of lipoperoxidation (Thars: Buege & Aust. 1978), the activity of the AChE enzyme (Eilman 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 most toxic metal tested was the Cd-Cr. The Kruskal-Wallis test indicated that there are significant differences in the degree of lipoperoxidation, inhibition of AChE activity and genetic damage between the exposed organisms and the control group. The metal with the highest oxidative stress was Chromium (32 ± 8.97 µM Thars mg−1). And the metal mixture: Cd + Cr + Pb (45 ± 11.89 µM Thars mg−1). In the evaluation of genotoxicity it was observed that cadmium had the highest effect (91% cells with damage) and Lead the lowest (43%). Cadmium and the mixture of metals caused inhibition in the activity of AChE (56% 38% respectively). The results of this study show that the Cd, Cr and Pb metals in sublethal concentrations have deleterious effects on the "D" larvae of Crassostrea gigas.

MO177 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels
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Dichlorvos (DDVP) is an organophosphate insecticide considered by the EPA as highly toxic. Because there are few studies of the effects of DDVP in aquatic organisms The objective of this study was to evaluate the toxicity of Dichlorvos in organisms of different trophic levels Cladocerans: Daphnia magna, Daphnia exotic, Daphnia pulex and Simocephalus williamsoni. The ostracod Cypris sp. and fishes: juvenile Chinook salmon (Oncorhyncus tshawytscha) 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 (LC50) 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 magna was more sensitive to DDVP compared to D. pulex and S. williamsoni, but not to D. magna. The toxicity of Dichlorvos in different trophic levels was assessed using aquatic organisms.
to other species. The O:N index had values below 9 fact indicates that organisms were in a high degree of stress. Growth rates of intoxicated organisms were between 19 to 49% lower than those observed in the control group. The average concentrations of Thars registered organisms varied from 2.5 to 25.6 M Thars mg⁻¹ and show a direct dose-response relationship, since when increasing the time of exposure to DDVP increased the degree of lipid peroxidation in the tissues. A decrease in AChE activity was observed in 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 models

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Contaminants from anthropogenic activities find their way to the Arctic through long-range atmospheric transport, ocean currents and via transport by living organisms (migrating fish or seabirds). Although the levels of POPs in arctic fish are generally low, local hot-spots of contamination have been demonstrated in freshwater systems affected by seabird guano, such as Lake Ellasjøen at Bear Island (Norway). High concentrations of organic halogenated compounds have been measured in resident populations of Arctic char. Accumulation of dioxin-like compounds of up to 8 times higher levels than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that residential Arctic char might be at risk for adverse effects at the individual and population level. In this study the aim was to compare the toxic potency of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of liver samples. Using the following steps of extraction and fractionation (F) were produced: F1- nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F2- polar pesticides and metabolites of POPs, and F3- polar POPs (phenols such as chlorinated phenols and hydroxylated metabolites of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was established and used together with the established method for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER) mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the F3 fraction, higher induction was observed in rainbow trout than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F3 and F2 from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F3 having largest effect. Chemical analysis was preformed to identify potential contributors to the observed effects in knowledge. The project was funded by the Norwegian Research Council, project No. 221373.

MO179 Ultrasound: A novel approach to non-lethally measure hepatosomatic index in sentinel fish for environmental monitoring programs

A. G. M. A. Al-Maroof, University of Luxembourg / Veterinary Medical Sciences; V. Palacios, ISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Franchuk, ISDExperimental Lakes Area; M. Murdoch, Stantec Consulting Inc; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences Canada’s environmental effects monitoring (EEM) program studies impacts of metal mining and pulp mill effluents on aquatic receiving environments. The EEM regulations recommend lethal sampling of 20 fish (male and female) of different species to study body condition, liver size (hepatosomatic index-HSI), and gonad size (gonadosomatic index-GSI) during every monitoring cycle. Developing and implementing non-lethal methods for environmental monitoring programs provides an opportunity to protect sentinel endangered fish which might be threatened by research methods. Lethal sampling is currently the only method to investigate fish that are part of systems with low productivity. Ultrasound is a non-invasive tool that has been tested to assess gonad size in fish. Currently, its potential as a non-lethal tool in environmental monitoring programs is not well explored. We conducted feed withdrawal studies in the laboratory to test the accuracy and sensitivity of ultrasound to measure HSI in sentinel fish with a compact liver such as rainbow trout (Oncorhynchus mykiss). With the ultimate goal of providing empirical evidence of the applicability and ease of this technique in the field, we also tested the accuracy of ultrasound method to measure HSI in lake trout (Salvelinus namaycush) at ISD-experimental lakes area. Our laboratory studies provide a significant correlation for the accuracy (HSI, r²=0.73, n=16, p<0.05) and evidence for the sensitivity of ultrasound method (p=0.06, n=7) versus traditional lethal gravimetric method (ps 0.05, n=7) to measure HSI within the acceptable critical effect size for HSI mandated by EEM. Our field ultrasound method testing also revealed a significant correlation between the traditional lethal and ultrasound method in measuring HSI (r²=0.81, n=9, p<0.05) in lake trout. Our field analyses provide evidence for the ease and potential application of this technique for future environmental monitoring programs. Our ongoing method refinement and exploration of this technique in sentinel fish with diffuse livers across different size ranges will strengthen our goal of proposing ultrasound as a viable non-lethal alternative to measure HSI on a global scale.

MO180 Weight of evidence for fish acute toxicity: a Bayesian network modelling approach

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Reduction of animal testing wherever possible is requested by EU Directive 2010/63/EU. Fish Embryo Toxicity (FET) testing can be an alternative to using juvenile fish in acute toxicity testing. However, FET data are currently not accepted as a replacement to juvenile fish acute toxicity data for regulatory purposes such as REACH, without sufficient weight of evidence (WoE). The development of a WoE approach for FET data has been recommended by the European Chemicals Agency to significantly reduce the number of animals required for hazard assessments of chemicals. We propose a Bayesian network (BN) modelling approach for quantifying the weight of evidence. BN is a probabilistic modelling methodology which is an increasingly used in ecological risk assessment as well as in environmental monitoring programs provides an opportunity to protect sentinel endangered fish which might be threatened by research methods. Lethal sampling is currently the only method to investigate fish that are part of systems with low productivity. Ultrasound is a non-invasive tool that has been tested to assess gonad size in fish. Currently, its potential as a non-lethal tool in environmental monitoring programs is not well explored. We conducted feed withdrawal studies in the laboratory to test the accuracy and sensitivity of ultrasound to measure HSI in sentinel fish with a compact liver such as rainbow trout (Oncorhynchus mykiss). With the ultimate goal of providing empirical evidence of the applicability and ease of this technique in the field, we also tested the accuracy of ultrasound method to measure HSI in lake trout (Salvelinus namaycush) at ISD-experimental lakes area. Our laboratory studies provide a significant correlation for the accuracy (HSI, r²=0.73, n=16, p<0.05) and evidence for the sensitivity of ultrasound method (p=0.06, n=7) versus traditional lethal gravimetric method (ps 0.05, n=7) to measure HSI within the acceptable critical effect size for HSI mandated by EEM. Our field ultrasound method testing also revealed a significant correlation between the traditional lethal and ultrasound method in measuring HSI (r²=0.81, n=9, p<0.05) in lake trout. Our field analyses provide evidence for the ease and potential application of this technique for future environmental monitoring programs. Our ongoing method refinement and exploration of this technique in sentinel fish with diffuse livers across different size ranges will strengthen our goal of proposing ultrasound as a viable non-lethal alternative to measure HSI on a global scale.

MO181 Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.

I. Dekker, Wageningen University & Research; T.H. van der Berg, N. van den Brink, Wageningen University / Dept of Toxicology

Cadmium can induce toxic effects via different mechanisms, e.g. depletion of cellular antioxidants leading to increase of ROS levels and induction of apoptosis. Such effects have been addressed in different types of tissues and cells, including the immune system. However, these mechanisms of toxicity may have different impacts among physiological and histological changes, depending on the type of target cells to deal with these toxic effects. Considering the multitude of different types of immune cells and cell-subsets with different functions, cadmium could impair immune functions, such as the immune responses against infections, through cell-type specific effects. Macrophages and mast cells are two types of innate immune cells part of the first line of defence, able to initiate fast inflammatory responses, type 1 and type 2. Type 1 or cell-mediated immunity is involved in the defence against intracellular bacteria and infected cells, carried out especially by phagocytes like macrophages. In contrast, mast cells are associated with type 2 or humoral/antibodies-mediated immunity, concerned with extracellular pathogens and parasitic infestations. In order to study the immunomodulatory effects of cadmium on macrophages and mast cells we carried out a mechanistic in vitro study. Exposure to cadmium depleted glutathione in the four cell lines tested, potentially modulating functional parameters in macrophages mainly as a result of activation of redox-sensitive pathways leading to pro-inflammatory effects. Mast cell showed steeper GSH-depletion, compared to macrophages, prior to the onset of cytotoxicity, indicating increased ROS levels, resulting in potentially increased oxidative stress. A dose-response inhibition in the secretion of histamine was shown, suggesting that mast cell function could be impaired by cadmium. In this way, cadmium may modulate the function of the innate immune system, in such a way, that favours to a type 1 response by enhancing macrophages responses and at the same time affecting the function of mast cells.

MO182 Changes in protein expression of primary sea turtle cells exposed to contaminants indicate the potential for in vitro proteomic as a high throughput tool to support biomarker discovery.

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The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilized. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development of non-destructive biomarkers 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 investigate the feasibility of the approach. For this purpose, we performed experiments using the unicellular green sea 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 10,000 unique protein identifications. Our results show that a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (superoxide dismutase) was expressed by cells exposed to PCB. These methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtle cells, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

MO183
Baseline vs. Reactive Toxicity toward the Nemateode C. elegans as Alternative Bioassay
M. Amospas-Offeh, University of Duisburg-Essen; S. Saleem, E. Buttner, A. Bier, A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

MO184
Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Non-animal Tool for Mimicking Phase I Metabolism
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The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemicals' ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduction formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosassays, 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 chemosassays or in vitro bioassays because these methods typically do not sufficiently include an activation step. We present a new tool, based on an Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophilic phenol and dihydroxybenzene derivatives to electrophilic forms through catalysis and trapping of electrophilic metabolites with the tripeptide WCG (tryptophan, cysteine, glycine) and analyzed using high performance liquid chromatography coupled to tandem mass spectrometry. Profiling of the obtained adduct patterns enable the identification of formed electrophiles, and provides new insights into the oxidation pathways causing the reactive toxicity of pro-electrophiles. The authors thank the EU-funded project OSIRIS (GOC-CT-2007-035707) and the BMBF-funded project ProfHapTox (FKZ 03K1422A and 03K1422B) for financial support. [1] Böhme A, Laqua A, Schürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [2] Mulliner D, Schürmann G 2013. Mol. Inf. 32: 98-107. [3] Chipinda I, Ajibola RO, Morakinyo MK, Ruwona TB, Simonyi RH, Siegel PD 2010. Chem. Res. Toxicol. 23: 918-925. [4] Böhme A, Thaens D, Paschke A, Schürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO185
Integrated assessment of aquatic ecotoxicity for regulatory purposes
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The REACH regulation requires the assessment of the CMR and PBT properties of the chemicals produced or imported in EU in amounts exceeding 10 t/a in order to protect the human health and the environment. The JANUS project aims at the development of a JAVA application to prioritize and assess the chemicals according to the PBT, CMR and endocrine disruption properties with uncertainties estimation. To assess the ecotoxicity part of the toxicity, we developed six continuous QSAR models for acute and chronic aquatic endpoints for the main trophic levels: EC_{50} 96th and NOEC 96th algae (Raphidocelis subcapitata), EC_{50} 48h and NOEC 21d Daphnia magna, LC_{50} 96h fish (Oryzias latipes) and NOEC fish (more fish species). We used gaseous and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R^2 up to 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.vegahub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARs for fish, three QSARs for specific fish species).

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. Hedgforth, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Sciences; B. Kelley, D. Letinski, ExxonMobil Biomedical Sciences Inc.; M. 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/experimentation. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocotol and isoundecanol. 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 isoalcohols. The data demonstrate that the QSAR model employed accurately characterized the hazard of iso-alcohols and is protective of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

MO187
Looking for an alternative to glyphosate-based herbicides

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Glyphosate-based herbicides are widely used in agriculture. When these products are regularly applied to the market, they are thought to affect only target species i.e. plants. However, over the past decades there is growing evidence on the toxicity and genotoxicity of glyphosate on non-target species. On 27th November 2017 the EU member states agreed on a five-year renewal period for the use of glyphosate based herbicides. However, in case glyphosate-based herbicides become prohibited eventually, the availability of alternative active substances will become an urgent need. Nonanoic acid (a.k.a pelargonic acid) is a biologically derived substance considered as an environmental friendly herbicide. Its toxicity to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide against pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrafish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC50 were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was estimated in EthoVision software. The potential effect of the tested substances on the respiratory system of aquatic organisms was investigated in vitro by performing the Neutral Red Uptake assay on the trout-derived gill cell line RTGill-W1. Results of our in vitro and in vivo 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 neurological 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

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Salicylates are widely used as fragrance additives or UV light absorbers in cosmetics and consumer care products, and thus can contribute to the human exosomes. Moreover, hospital waste from these industries may act as constituents of the exosomes 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 have turned out as promising nonanimal approaches and employ simple chemicals or model peptides as surrogates for the nucleophilic sites of biomolecules to profile the reaction behavior in terms of kinetic rate constants and adduct patterns. For this communication, the chemoassay reactivity of selected salicylates toward model peptides featuring the SH sites of biomolecules to profile the reaction behavior in terms of kinetic rate constants and adduct patterns. The discussion of the results includes a structure-reactivity analysis to provide new insights into the behavior of salicylates. Augmented by in vitro bioassay analyses addressing the aquatic toxicity of salicylates, it is shown how their chemical reactivity, as one component of an electrophiles’ chemoaavailability, translates into aquatic excess toxicity, i.e. toxicity enhancement over baseline toxicity. The research is funded by the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Böhme A, Thaens D, Paschke A, Schüttmenn G 2009. Chem. Res. Tox. 22: 742-750. [2] Thaens D, Heinzelmann D, Böhme A, Paschke A, Schüttmenn G 2012. Chem. Res. Toxicol. 25: 2092–2102. [3] Slawick C, Neckermeyer C, Brehm M, Böhme A, Schüttmenn G 2017. Environ. Sci. Technol. 51: 4018–4026. [4] Böhme A, Laqua A, Schüttmenn G 2016. Chem. Res. Toxicol. 29: 952-962

MO189
Membrane-water partition coefficients to aid ionogenic surfactant risk assessment

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Surfactants are important ingredients in various household products, personal care products and industrial processes. Many surfactants are technical mixtures of ionogenic head groups and linear or branched hydrophobic alkyl chain lengths ranging between C₁₂-C₂₀. As for many ionogenic compounds, the environmental fate assessment of ionogenic surfactants is complicated because it is not clear how to accurately parameterize critical micelle concentrations such as Kcmc. Knowledge of Kcmc is important to account for uptake in organismal tissue. For example, for one of the most common anionic soap ingredients, SDS, the entry for logP in the REACH registration dossier of ECHA provides a range from -2 (calculated, and recommended) to 1.6 (experimental, but considered erroneous), ranging more than a factor of 3000. Various techniques to determine Kcmc for surfactants are described in these REACH dossiers, with conflicting argumentations on which is most relevant. It is well known that Kcmc is a problematic parameter for surfactants, but this means that to reduce animal testing for bioconcentration factors and (baseline) toxicity of surfactants, insight in the key parameters of pure surfactant components driving uptake in biota is highly needed, alongside better understanding of elimination rate processes for such compounds. The BIONIC model could apply such key parameters for ionogenic surfactants. The phospholipid-water partition coefficient is considered to be the dominant contributor to the overall tissue-water partition coefficient for ionogenic surfactants, because membranes lipids allow for both ionic interactions at the zwitterionic head groups and hydrophobic interactions at the membrane core. Sorption experiments verify orders of magnitude higher affinities of ionogenic surfactants than for organic components. OECD is currently validating this in vitro assay, the final stage of validation has been completed in 2017 and it is expected that the XETA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of effluents. During the 12 past years we applied this assay to effluents including municipal wastewater, treated wastewater and hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed 1) Daily variations of the thyroid effect in wastewater are linked to the biological activity of effluent sampled and 2) the wastewater 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 decarbonization process. The major removal of the thyroid active molecule occurs during the nitrification step of the wastewater treatment.

MO190
The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.

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The Xenopus Embryonic Thyroid signalling Assay (XETA) was designed as a rapid (< 72h) way to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XETA provides a rapid method to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XETA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn’t be stored or sampled in large quantities. OECD is currently validating this in vivo assay, the final stage of validation has been completed in 2017 and it is expected that the XETA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of effluents. During the 12 past years we applied this assay to effluents including municipal wastewater, treated wastewater, hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed 1) Daily variations of the thyroid effect in wastewater are linked to the biological activity of effluent sampled and 2) the wastewater 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 decarbonization process. The major removal of the thyroid active molecule occurs during the nitrification step of the wastewater treatment.
studies focus on terrestrial and aerial species in comparison to aquatic organisms. A reason for this discrepancy is that compared to terrestrial species, additional technical challenges need to be overcome when studying aquatic species e.g. light refraction and reflection interferences at the air/water boundary, positioning of the light source and suitable body marking techniques. However, a deeper understanding of the movement patterns of small-sized aquatic invertebrates and planktonic organisms is urgently needed, and development of behavioral tracking may facilitate the understanding of environmental effects. 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 Paramaecium caudatum. In order to do so, custom-made, polidimethylsiloxane/glass or polymethylmethacrylate plates were made plates and recorded under the microscope or in the observation chamber DanoVision. The horizontal and/or vertical tracking of the tested species were performed with the software EthoVision. The results of the present study showed that our custom-made plates had a higher tracking efficiency and a higher reproducibility score compared to the commercially available multi-well plates. Therefore, these easy to fabricate and cost-efficient plates can be implemented on behavioral and ecotoxicological studies on small-sized aquatic invertebrates and planktonic organisms in any lab with an access to a tracking system. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO192 Validation of the in silico prediction tool for toxicity of Algae by pharmaceuticals in environment

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There are some concerns for environmental impacts of the pharmaceuticals due to the unintended environmental effects, which may be different from biological medicinal effects. Therefore, medical regulatory agencies require the assessment 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 prediction accuracy for ecotoxicity prediction by the ECOSAR software, which is widely used for regulatory predictions of industrial chemicals. In the last year, we evaluated the prediction performance of Daphnia magna reproduction and of the fish chronic toxicity. In this study, we evaluated prediction performance of the acute and chronic toxicity for algae. We used the ecotoxicity test data sets of about 100 pharmaceuticals. The EC50 values for the acute toxicity and the ChV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals of which the predictive values are different in less than one digit from the actual measured values are 43% and 44% for acute and for chronic toxicity, respectively. Overall applicability of toxicity prediction for algae was similar to that of toxicity for Daphnia magna or fish. In the case of Daphnia magna or fish, some antibiotics, anticancer, 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 Broad Taxonomic Groups


Cell-based high throughput screening (HTS) and computational technologies are being applied as tools for toxicity testing in the 21st century. The U.S. Environmental Protection Agency (EPA) embraced these technologies and created the ToxCast Program in 2007, which has served as a screening and prioritization tool for thousands of chemicals. The rapid and automated screening methods take advantage of hundreds of (primarily) mammalian-based HTS assays for identifying biological activity suggestive of potential toxic effects. The data can aid in identifying chemicals that are most likely to impact biological pathways that lead to adverse health effects. To realize the full potential of the ToxCast data for predicting adverse effects to both humans and wildlife, it is necessary to understand how broadly these data may plausibly be extrapolated across species. Therefore, the U.S. EPA Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was used to evaluate conservation of the 460 protein targets represented in the ToxCast assay suite. The SeqAPASS query sequence was selected based on the model organism used in the ToxCast assay (e.g., human, cattle, chimpanzee, guinea pig, rabbit, rat, mouse, pig, or sheep). Similarity of primary amino acid sequences and sequences from appropriate functional domains were considered across species to identify any target across taxa. To demonstrate application of the SeqAPASS data for extrapolation of ToxCast targets, case studies were developed that focused on the extrapolation of targets being evaluated as part of the Endocrine Disruptor Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins in the insulin signaling pathway. These efforts 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

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The Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was developed to address needs for rapid, cost effective methods of species extrapolation of chemical susceptibility. Specifically, the SeqAPASS tool compares the primary sequence (Level 1), functional domain sequence (Level 2), or individual amino acid residues (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 in the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and ecdysone receptor (EcR) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, while differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabled automatically generated species-specific predictions of chemical susceptibility. These predictions were shown to agree with Level 1 and 2 predictions of AChE and EcR for more than 90% of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity tests. The consistency of automated predictions of susceptibility across Levels 1, 2 and 3 and agreement with results of standard toxicity tests provides a compelling line-of-evidence for use of SeqAPASS in supporting species-specific chemical susceptibility predictions across broad taxonomic groups applicable to addressing challenges in species extrapolation for human and ecological hazard assessment. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO195 Survival and Teratogenic Evaluation of 91 compounds with environmental impact

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ZeClinics (www.zeclinics.com) is a biotech company interested in developing efficient and reliable zebrafish screening tests to predict compound toxicity in non-human and organ related species. This is part of the development of a universal set of rules – incubation time, chorion/no chorion, analysis timing, type and 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 were exposed at key tested concentrations (Log3 dose/response curve: 100µM, 33 µM, 10µM, 3.3 µM and 1 µM) for a single biological replicate. Experiments were performed in chorionated embryos from 3 hpf to 96 hpf. Endpoints were analysed at 24, 48 and 96 hpf. Quantified phenotypes include mortality rate, teratogenic, target specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and ecdysone receptor (EcR) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, while differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabled automatically generated species-specific predictions of chemical susceptibility. These predictions were shown to agree with Level 1 and 2 predictions of AChE and EcR for more than 90% of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity tests. The consistency of automated predictions of susceptibility across Levels 1, 2 and 3 and agreement with results of standard toxicity tests provides a compelling line-of-evidence for use of SeqAPASS in supporting species-specific chemical susceptibility predictions across broad taxonomic groups applicable to addressing challenges in species extrapolation for human and ecological hazard assessment. The content of this presentation neither constitute nor necessarily reflect US EPA policy.
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'-hexafluoroisopropylidenephone, 3-ido-2-propynyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methylmercury chloride, rotenone and tetraethylthiamium di sulfide.

MO196 MPA - an alternative for the standard procedure of Ames Test
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The Salmonella/lactose assay (Ames Test) is the most widely used mutagenicity test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specially in Europe. It is has similar sensitivity with the standard Ames as well as other protocols and good performance in interlaboratory studies. However, the MFP has some disadvantages such as being difficult to apply with strains with low and high spontaneous mutation frequencies.

Another miniaturized version of the Ames test is the microsuspension assay, which is used to select more sensitive tests. 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 comparison of spontaneous mutation 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 less 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. Lilliecop, NIVA Norwegian Institute for Water Research / Ecotoxicology

Bioavailability and realistic risk assessment of organic chemicals (P)

MO198 The necessity of OASIS bead and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration: a case study for alkylphenol monitoring in produced water
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Produced water (PW) is one of the largest discharges from the oil and gas industry and includes formation and injected water. It contains several toxic compounds such as polycyclic aromatic hydrocarbons (PAHs), alkylphenols (APs), heavy metals, etc. PW is usually treated on the platform and then directly discharged into the sea. Despite the low content of toxic compounds that remain in PW after treatment, the large volume of PW lead to high total amounts of toxic compounds discharged every year into the sea; thus an effective tool for monitoring the hydrophilic organic compounds (HpOCs) is necessary. Passive sampler devices (PSDs) are the most common tools for monitoring a wide range of organic contaminants in water. By this regard, several PSDs have been used to monitor hydrophilic organic compounds (HOCs) in PW including semipermeable membrane devices (SPMDs). However, SPMDs are not suitable for monitoring HpOCs in PW owing to the nature of these chemicals. It is therefore necessary to develop and standardize a passive sampler for HpOCs, such as APs. Polar organic chemical integrative samplers (POCIS) is a PSD that has been used to monitor a wide range of HpOCs. It allows the time weighted average (TWA) concentration to be measured and thus assess fluctuation in discharge concentrations. POCIS is composed of a sorbent (OASIS beads), two polyethersulfone (PES) membranes and two stainless steel rings. POCIS is calibrated by evaluating the sampling rate (R_s), which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the R_s following the extraction of both the sorbent and the PES membranes. This study demonstrated that there was a lag phase in uptake for APs, and that APs with log Kow>5 were accumulated more efficiently in the PES membranes. The extraction of both the PES membranes and the OASIS beads is thus needed when working with the POCIS in order to capture low contaminant concentrations and allow the detection of the less hydrophilic APs. This can be very useful in environmental applications because it may justify the use of only one passive sampler to monitor a wider range of contaminants.

MO199 In situ passive sampling methods to measure freely dissolved concentration of PAHs in contaminated soil: comparison with ex situ measurements and evaluation over one year
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Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments contaminated by hydrophobic organic contaminants (HOCs). Over the past decade, researchers have successfully developed various passive sampling (PS) methods to assess the freely dissolved concentrations of HOC in soil pore water or suspensions (C_mic). C_mic play a key role for environmental fate and toxic effects of these compounds. Field conditions such as temperature, ionic strength or soil water content may influence the distribution of HOCs and are accounted for by the concept of the in situ PS method providing promising results to measure C_mic 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 and field sampling campaigns under field conditions. A total of three were located in potted 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
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The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field-controlled (sterilization after contamination) and freshly spiked (sterilization prior to spiking and dwelling of earthworms) soils. The aim of this study was to check if there was a difference in uptake for APs, which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the R_s following the extraction of both the sorbent and the PES membranes. The extraction of both the PES membranes and the OASIS beads is thus needed when working with the POCIS in order to capture low contaminant concentrations and allow the detection of the less hydrophilic PAHs. 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.
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

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The pesticide fate in soil is currently studied through laboratory experiments, using homogenized soil and controlled incubation conditions. However, the representativeness of such experiments is questionable regarding to field conditions, i.e., soil heterogeneity, vegetation cover and climatic variations. Upon the few studies performed simultaneously under fields and laboratory, the pesticides persistence and/or sorption on soil were evaluated as different; thus bioavailability could also be different. This study aimed at comparing the dissipation and the bioavailability of dimoxystrobin and epoxiconazole (two fungicides used in the commercial formulation of Swing Gold®) in a loamy soil and in earthworms under laboratory and field conditions. Field experiments were conducted in a meadow located in Versailles (France) on 100 m² plots. The field soil and earthworms were regularly sampled after the treatment, over one year (April to April). Laboratory experiments were performed by mixing the fungicide solution with surface soil issuing from the same field, and incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swing Gold® dose, extra doses adapted to observe ecotoxicological effects and controls. The dimoxystrobin and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method engaging hydroxypropyl-β-cyclodextrin. At the same time, the bioavailability of the two fungicides was evaluated by determining their concentrations in exposed earthworms Aporrectodea icterica and Aporrectodea caliginosa. All analyses were performed by UHPLC-MS/MS. Under field conditions and five days after pesticide application, only 10% to 45% of pesticide residues were measured in topsoil, with high heterogeneity between replicates. After one month, the concentrations in soil increased, probably due to a plant-soil transfer. By contrast, applied dose was observed at initial time under laboratory conditions. For later dates and in both cases, dissipation was observed. The available fraction showed homogenous rates under field conditions and highly heterogeneous in the laboratory. However, the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO202 Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat

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Environmetrically significant risk assessment decisions in EU for Plant Protection Products (PPP) regulation are based on information obtained from Environmental Fate models. Such models (e.g., FOCUS PEARL and PELMTO) attempt to quantify the potential for movement of pesticides and their metabolites to ground water and require data derived from experimental studies based on validated guidelines. Currently, guidelines detailing degradation and absorption processes of pesticides and their metabolites in soil do not accurately account for uptake by plants via root system, with plant uptake compartments only being given a default value. As plant uptake affects the environmental availability of these substances, accurately quantifying this step is critical in the risk assessment procedure. The plant uptake describes the process of translocation of dissolved compounds in the soil pore water to the plant via the transpiration stream and it can be described using the plant uptake factor (PUF)— uptake into shoots and roots — or the transpiration stream concentration factor (TSCF)— uptake into shoots. Recent work by the ECPA/IVA Working Group “Plant Uptake Factor” has produced a draft working protocol designed to experimentally determine the uptake of active substances as well as metabolites via plant roots. The purpose of the present study was to obtain reliable substance-specific plant uptake data — with different root zone exposure concentrations — using the study design proposed in draft working protocol. The set-up of the experiment was chosen to enable optimal growth of the test plants — wheat seedlings — grown in a hydroponic system under controlled environmental conditions. At BBCH 13 (3 leaves unfolded) —C16-labeled 1,2,4-triazole was spiked into the hydroponic solution at different concentrations and the plant root system was exposed for 8 days. Mass balance — calculated from the sum of radioactivity found in the hydroponic solution, root wash plus roots and shoot tissue — and transpiration – calculated gravimetrically — were determined. The experimental data obtained were used to calculate uptake parameters – PUF and TSCF – according to the formulas mentioned in the literature. MON29 LFER Models for Partition Coefficients of Environmental Concern

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Traditionally, partition coefficients of environmental concern, including bioconcentration factors (BCF) and soil or sediment sorption coefficients, are predicted using approaches based on simple linear relationships with the octanol/water partition coefficient (Kow). Recently, more sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate sorption descriptors but, however, this requires data on distinct partitioning processes, which are rather scarce. For theoretical models without the need for additional experiments, the partition coefficients for these separate processes have to be estimated. While these coefficients basically could be roughly estimated from Kow, the more sophisticated LFER equations, known as Abraham models, are preferred for such predictions. The and the respective partition coefficients were estimated for the bioconcentration factors of neutral organic compounds between water and immobilised artificial membranes (IAM), liposomes (membrane lipids), triolein (storage lipids), and sediment. The development of the models was based on new experimental data, as determined by the authors. Possible sources of the required Abraham parameters are examined, compared and discussed. Particular attention is given to the species dependency of the models. Acknowledgment: This study was financially supported by the European Union 7th Framework Programme SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

MO204 Influence of grain size on the bioavailability and bioaccumulation of sediment-associated cypermethrin to benthic invertebrates

H. Li, J. You, Jinan University / School of Environment Sediment particle-size distribution is an important factor influencing the bioavailability and toxicity of hydrophobic organic contaminants (HOCs) in sediment. Cypermethrin, a pyrethroid, was used as an example in the current study to investigate the effect of particle size on the sorption kinetics and bioaccumulation potential of sediment-associated HOCs. Bioaccumulation test with oligochaete Lumbricus variegatus and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., < 20 μm, 20-63 μm, 63-180 μm, 180-500 μm and >500 μm. The respective particle-size fraction ranges were 12.1%, 10.6%, 14.7%, 2.86% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among sediments with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cypermethrin measured by Tenax extraction decreased with decreasing particle size, which supported the hypothesis that HOCs in this study were more strongly adsorbed to coarse sediment particles than coarse sediment. The different desorption rates of cypermethrin in different particle-size sediments may influence the freely dissolved concentrations in sediment porewater, and subsequently bioaccumulation potential and toxicity.

MO205 Effect of suspended particle on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrasfish (Danio rerio)

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Hydrophobic organic compounds (HOCs) tend to be associated with suspended particles in surface aquatic systems, however, the bioavailability of HOCs on suspended particles to fish is not well understood. In this study, a passive dosing device was used to control the freely dissolved concentration of polycyclic aromatic hydrocarbons (PAHs) including fluoranthene and pyrene, and the influence of particle-associated PAHs on their bioaccumulation by zebrasfish was investigated. Results showed that the body burdens of PAHs in the zebrafish including the digestive tract (without the head part) were higher than that in the zebrasfish excluding digestive tract at the beginning of PAH bioaccumulation, and lower after two day bioaccumulation. The difference may be caused by the effect of PAHs associated with particles in the digestive tract. When PAHs on suspended particles were ingested and they were mainly stored in the digestive tract of zebrafish in the beginning of the bioaccumulation; because the bioaccumulation factors of PAHs in zebrasfish were higher than the partition coefficients of PAHs in suspended particles, the concentrations of PAHs in zebrafish excluding digestive tract were higher than that in zebrafish including digestive tract in the later bioaccumulation.
process. Suspended particles promoted the uptake and elimination rate constants of PAHs to zebrafish body excluding head and digestive tracts. The uptake rate constants with 0.5 g/L suspended particle were approximately twice that without suspended particles, and the body burden in zebrafish increased by 16.4% - 109.3% for pyrene and 21.8% - 490.4% for fluoranthene during the first 8-d exposure. The findings from this study indicate that PAHs on suspended particles are partly bioavailable to zebrafish and particle ingestion is an important route in PAH bioaccumulation. Therefore, it is important to consider the bioavailability of HOCs on suspended particles to improve ecological risk assessment.

Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomonas sp. strain ADP

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Atrazine as herbicide used to control grassy and broadleaf weeds in sugarcane, wheat, corn, sorghum and corn crops. Although since 1992 in European Union Countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 70,000–90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium *Pseudomonas* sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction responses at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of *Pseudomonas* sp. strain ADP was modified after 28 d. The data was non-parametric, it was increasing using Kolmogorov-Smirnov. The physiological relevance of the chemioattraction to pollutants lies in the fact that these compounds serve as carbon and energy sources. The overall results suggest that we can use the behavioral responses of motile bacteria as a useful method to estimate pollutant toxicity at ecologically relevant concentrations. The bacterial behavioral assay on pollutants can be an alternative or complementary method to the current ones, because it is a high sensitivity and visualization method.

MO206

Methods for Deriving Site-Specific Relative Bioavailability Factors from Ambient Bioavailability Measurements

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The U.S. Department of Defense is responsible for the environmental restoration of properties that were formerly used for firearm training ranges. Remnants of spent shell casings and bullets are 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 spent shells were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone mixture of the spent fragments reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benzo[a]pyrene in solvents added to diets. To test this hypothesis, soil samples were collected from the two sites to provide a range of PAH concentrations. Female B6C3F1 mice were fed diets amended with soil or soil extracts at a ratio of 5% in the diet for fourteen days. For benzo[a]pyrene (BaP), the fraction of total dose excreted in the urine (FUE) was determined for the soil- and soil extract-amended treatment groups. The Relative Bioavailability Factor (RBAF) is the ratio of the FUE in animals treated with soil over the FUE in animals treated with soil extracts of soil. Because each soil sample was tested in four cages of mice (two for soil and two for soil extract), there are different ways of computing the RBAF of each soil and the grand RBAF for the site. Pairwise RBAFs can be determined and averaged, but the more robust way to determine a site-wide RBAF from multiple sample points is to determine a linear regression of metabolism rates versus daily dosing rates. The FUEs produced coefficients of determination (r2) that were greater than 0.83 and typically greater than 0.95, showing that the rate of BaP metabolite excretion was directly proportional to the daily dose rate of BaP. RBAFs were determined using Monte Carlo simulations to calculate the 95% upper confidence limit on the ratio of the soil and soil extract FUEs. The site-wide RBAF was equal to 1% for BaP. Particular 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

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The determination of adsorption parameters is a critical key parameter for the assessment of the leaching properties of low adsorbing compound’s through the vertical soil profile. In case of expected low adsorption of a chemical compound, several experimental preconditions need to be considered to enable accurate adsorption parameter determinations: (1) An initial soil/solution ratio of 1/1 and (2) the liquid phase needs to be removed as completely as possible from the soil phase upon completion of the equilibrium. An experimental approach was developed and optimized allowing the efficient separation of the soil and liquid phase by centrifugation through the soil itself and a filter/frit system. Determination of distribution coefficients is done based on the direct method, hence extraction and analysis of the soil phase as well. Apart from the optimized experimental approach the evaluation is addressed. This includes the elimination of any apparent sources of experimental random errors e.g. by suitable outlier tests. Possible systematic errors have been addressed by the experimental design/data evaluation itself leading always to an underestimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e.g. Kf) and of p-values with p=Kf * (mol/mol) / solution; note: mol/mol/insolution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFCFA, 2017. Technical report on the outcome of the pesticides peer review meeting on the OECD 106 evaluators checklist”. If p>0.3, additional considerations are necessary, e.g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95 % confidence intervals of Kf and Kfoc from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of that approach.

MO208

Chlordecone elimination kinetics in ewes

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Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against vector-borne diseases in the French Guiana. Ewes were exposed to CLD in feed. The object of this study was to characterize the CLD elimination in ewes (linearity of the toxicokinetic, half-life in serum, metabolism, excretion forms and excretion routes). Three groups of 5 ewes received an intravenous single dose of CLD (0.04, 0.2 mg/kg body weight (BW)); Blood, urine and feces samples were taken at defined times up to 84 days after CLD administration. CLD analysis in serum (analysis for each dose) was performed at the CART (Belgium) and CLD and its metabolites were analyzed in urines and feces (for the 1 mg/kg BW dose) at ANSES (France). For 1 mg/kg BW, 0.2 mg/kg BW and 0.04 mg/kg BW the half-life was respectively of 28.5 ± 3.0 days, 24.0 ± 6.3 days and 27.7 ± 5.0 days. These three
values were not significantly different (P > 0.05). Thus, it was possible to conclude that CLD toxicokinetic of CLD in ewe is linear. In urines, CLD and conjugated CLDOH were quantified. By comparing the two way of CLD excretion, feces appears to be the principal route of CLD elimination. Almost 60% of the 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 that CLD in ewes 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


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 tends to collect data about the CLD elimination in ewe so as to propose a decontamination strategy. CLD is mainly eliminated in feces and low amounts of CLD can be found in urines. CLD can be metabolized into chlordecol (CLDOH) in human, pigs and gerbils livers. Then CLD and CLDOH can be conjugated by the glucuronyltransferase. In feces, CLDOH was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewes is available. These findings results were based on a former extraction method developed in 1990 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and more sensitive method, a new development was carried out with this work. The extraction was carried 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 CLD metabolism was modeled concentrations. A screening 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 bee 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. Pucheu, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

One of the main factors in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHE project, the transfer of PCBs and PCD/Ds to plants and invertebrates has been studied. BCF in several plants and in earthworm had been measured and different models have been tested. The ecotoxicity of these compounds is based on the comparison between the contaminant concentration in interstitial water and the BCF. But this BCF, relatable to interstitial water, is not comparable with BCF measured with available guidelines as OECD 317 – Bioaccumulation in Terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHE project allow for the comparison between PCB-PCDF/Ds BCFearthworm measured with the OECD 317 guidelines and PCB-PCDF/Ds BCFearthworm 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, EQSs are expressed in terms of concentrations in water but in some cases they are 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...
MO216 Risk Associated with Alternative Cleaning Method for Carrot

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ABSTRACT Risk Associated with Alternative Cleaning Method for Carrot

Introduction Carrot is a nutritional root vegetable which is loaded with beta carotene, a precursor of vitamin A. It is necessary to wash carrots in order to remove soil and other foreign materials before eating either raw or in processed form (Moos et al., 2002). It is common practice nowadays to soak carrot in detergent solution before washing to achieve better cleaning. Some components of detergent are toxic (HERA, 2013; Chukw, et al., 2015). The aim of this study is to evaluate the detergent residue accumulated in carrot exposed to detergent. Methodology The first stage involved distribution of questionnaires to determine the popularity of the use of this chemical substance in washing carrot before selling to consumers. The second stage involved soaking 2 kg of fresh carrots in five increasing concentrations of Detergents 1 and Detergent 2. The carrots were soaked for 20, 40 and 60 minutes, after which they were grounded and analyzed using the titrimetric method as described by IPAN (2005). Results a. 64.29% of the respondents agreed to the use of detergent in soaking before washing. 25.14% do not use detergent in washing their carrots before selling to consumers while 10.57% were indifferent. Anionic Surfactant Residue in Exposed Carrots There was a concentration and time dependent increase (P < 0.001) in the percentage anionic surfactant in the exposed carrots Figure 1: Anionic Surfactant present as Residue in Carrot Washed with Detergent. c. Percentage Cationic Surfactant Residue in Exposed Carrot The percentage cationic surfactants residue increased with concentration and length of exposure. Figure 2: Percentage Cationic Surfactant Residue in Exposed Carrot. Figure 29: Quantity of Detergent Residue in Exposed Carrot. Conclusion The presence of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting publics.


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

MO218 Uncertainty concepts and misconceptions for landscape scale risk assessment

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In Europe there appears to be two opposing views on the future of ecological risk assessment of pesticides. One aims to improve ecological realism and move towards landscape scale risk assessments whereas the other aims to simplify and focus on lower tier exposure and effect assessment. To some extent this dichotomy is based on differences in uncertainty perception. Thus, one camp focuses on what we here term “in-situ uncertainty” and therefore holds that higher tiers are more uncertain than lower tiers. The other camp focuses on what we term “extrapolation uncertainty” and therefore holds that higher tiers are closer to real uses in real landscapes than lower tiers. Two different views of uncertainty. Two different views of uncertainty are typically not multiplicative. Further complicating the different views of uncertainty, is the natural variability in real landscapes. One view holds that the effects of pesticides should be isolated from the natural variability to describe the “true” effect and, since this is difficult, holds that landscape scale risk assessments increases uncertainty. The other view holds that the effect of pesticides should be related to the natural variability and hence landscape scale risk assessments reduce uncertainty. Here we describe different components of uncertainty, what role they play in landscape scale risk assessment and we propose a way forwards for making uncertainty analysis more useful for decision making.

MO219 Concept for a regional geospatial landscape analyses to predict site specific vegetation covers

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The spatial pattern of plant communities in the agricultural landscape is depending on land management and the site specific environmental and soil conditions. In vegetation science the composition of plant species and their abundances in dependence on these factors are extensively described. This project follows the hypothesis that if the decisive environmental and soil parameters (soil type, tree species, soil type, pasture etc.) are included in the model, this model could be useful for a quantitative prediction of vegetation community compositions. Here we propose a concept for a regional geospatial landscape analyses to predict site specific vegetation covers.

MO220 B-Rice: bird focal species identification in rice paddy

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Pesticide registration in EU (Reg. 1107/2009 EC) requires appropriate risk assessment for non-target organisms including birds. The European Food Safety Authority developed a Guidance Document (GD) to conduct the risk assessment considering a series of exposure scenarios from a combination of crops and growth stages, selecting relevant species at the lower steps of a tiered approach. The actual GD doesn’t include scenarios for pesticide applications on rice; nowadays bird risk assessment is generally performed considering rice as the other cereals. Rice paddy is managed in rice paddies by rice cultivation: the dry one, comparable to bare soil scenario (as common cereal), for which groups of species are equivalent to those identified for the actual risk assessment and already reported in GD; the flooded one, typical of aquatic environments and wetlands, representative of a unique exposure scenario not yet considered in the employed GD. The aim of this work is to characterize areas of rice growing in Northern Italy, which are representative for humid scenarios (via GIS approach), identify and link the relevant focal species to them. A review of the grey literature will be performed in order to estimate presence, abundance, dominance and diet of species associated to North of Italy rice paddies. Indicator and generic focal species will be proposed for the lower tiers of a Specific Rice Pesticide Risk Assessment and suggested as potential model for the Southern European Zone.

MO221 A process-based population model for algae

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EFSA’s guidance document for the risk assessment of edge of-field aquatic organisms recommends a maximum of 8 weeks for the ecological recovery option (ERO) of aquatic organisms in a risk assessment for plant protection products (PPP). Here, we propose a process-based model for algal abundance to simulate effects and recovery of algal populations over time following exposure to PPPs. The model integrates the main processes driving algal cell growth, such as (1) toxicity of the PPP and (2) growth limitations due to the dry one, comparable to bare soil scenario (as common cereal), for which groups of species are equivalent to those identified for the actual risk assessment and already reported in GD; the flooded one, typical of aquatic environments and wetlands, representative of a unique exposure scenario not yet considered in the employed GD. The aim of this work is to characterize areas of rice growing in Northern Italy, which are representative for humid scenarios (via GIS approach), identify and link the relevant focal species to them. A review of the grey literature will be performed in order to estimate presence, abundance, dominance and diet of species associated to North of Italy rice paddies. Indicator and generic focal species will be proposed for the lower tiers of a Specific Rice Pesticide Risk Assessment and suggested as potential model for the Southern European Zone.

MO222 Population dynamics of a soil arthropod simulated using an individual based population model and established fate model data

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The prediction of concentrations of plant protection products in soil, surface and ground water using chemical fate modelling is established since decades and applied in European environmental risk assessments (ERA). Many issues, concerns
and limitations were discussed and adequately addressed by scientific communities, applicants and authorities. As a result, a variety of accepted tools are now available for exposure assessment. In contrast, population modelling approaches used in ERA for effect assessment in ecotoxicology are still at a relatively early establishment stage. In this respect, although effect modelling is recognised as a beneficial tool for adding ecological realism to ERAs, EFSA has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidances and opinions as a refinement option. However, so far, outcomes of submitted effect modelling approaches in ERAs are not often considered by authorities. Many of the available models deal with protection goals that 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 time varying source concentrations of DOC leached from a variable pre-exposure time series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

M0223 
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-soil exchange 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 with a series of column leaching experiments performed after variable pre-exposure 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 nutation phenomena. The addition of endogenous DOC incremented mobility (up to a factor of 4) especially for brief contact time (non-equilibrium conditions) and within the Log Kow range 6-7.5. Samples leached at room temperature showed concentrations up to a factor of 9 higher in comparison to samples collected at lower temperature probably because of the different amount of endogenous DOC produced. Samples kept in pseudo field capacity conditions for seven days and then flushed resulted in about double the concentrations of the samples flushed in saturated conditions with a brief contact time, showing that drying-wetting cycles may determine concentration peaks. These trends were not caught by the model predictions as well as the relevance of the transport associated to fine particles, pushing for incorporation of this dynamic in models.

M0224 
Assessing the trait-based ecological vulnerability of aquatic invertebrates for phenol 
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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 a numerical evaluation. The toxicological sensitivity was derived by indirect prediction based on traits because no sensitive 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 (KEIT) through “The Chemical Accident Prevention Technology Development Project”, funded by Korea Ministry of Environment (MOE) (No. 2016001970001).

M0225 
Assessing and managing food-web effects of Plant Protection Products 
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Assessing impacts on biodiversity needs to integrate indirect effects ( trophic chain interactions, also referred to as food-web effects or effects on biodiversity). Plant protection law requires protecting biodiversity and data requirements for Plant Protection Product (PPP) active substances (Regulation EC 283/2013) also acknowledge this aspect by mentioning indirect effects to be considered in the assessment of the impacts of PPPs on biodiversity. The regulatory framework for 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 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 infield. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the individual measures with regard to their value for supporting in-field biodiversity (and thus to compensate for indirect effects of PPPs).

M0226 
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 risks to food webs from indirect effects. We developed a scientifically well described and highly relevant for the achievement of the legally defined environmental protection goals, eliminating these blind spots in the risk regulation has failed so far. The ‘indirect effect’-issue is an illustrative example for what we recognize is that progress in ERA notably seems to be hampered for types of risk for which no effective risk assessment and management 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 wish to put forward a radically new approach in risk management: Compensating adverse effects of pesticides where established methods of risk assessment fail to prevent them. Once implemented into the iterative process of risk assessment, such new risk mitigation approaches would allow to manage actual risks more adequately than currently possible, thereby preventing an increase of non-authorisations. It has not escaped our notice that our proposal could also make excessive higher tier assessments dispensable, thereby helping to solve the problem of the increase of complexity in ERA.
Fish model species in human and environmental toxicology (P)

MO228
Historical control data of the optimized Zebrafish Embryo Development Toxicity Assay (ZEDTA)
D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Bekhuizen, 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 protocol with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for this test. Therefore, a protocol based on the OECD guideline No. 236, has been developed and optimized by Charles River Laboratories Den Bosch, the Netherlands. Multiple studies were performed using the optimized protocol, which allowed for collection of historical control data on the frequency of malformations, mortality and development of the embryos/larvae exposed to the control treatment. In our protocol, embryos in the blastula phase (2-4 hours post fertilization (hpf)) were selected and exposed to adjusted ISO medium. Twenty four embryos (one embryo per well in a 24 wells plate), were exposed at a temperature of 26°C for a period of 96h. Exposure medium was renewed after 48 hours. Development was assessed daily using the Extended General Morphology Score (GMS). Teratogenic endpoints were scored as ‘present’ or ‘absent’ after 96 hours of exposure. The Extended GMS grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consisted of, but were not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf was 18. Teratogenic endpoints scored during the assessment comprise of malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted ISO medium). The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development, whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

MO229
Optimization of the Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)
D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Bekhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for the ZEDTA. The aim of this research was to optimize the protocol, i.e. examine which combination of exposure parameters is optimal for embryonic and larval development and is at the same time most cost-effective. An optimal embryo condition should yield normal growth and development with minimal mortality and/or malformations. The OECD guideline No. 236 was used as base. In our protocol embryos in the blastula phase (2-4 hours post fertilization (hpf)) are exposed to adjusted ISO medium. The following factors and their combinations were investigated: temperature (26 vs. 28°C), exposure vessels (24 vs. 96 well plates), renewal periods (static (no renewal) vs. semi-static (24 or 48 h renewal)), and use of solvent (0.05% v/v DMSO vs. adjusted ISO medium). Development was scored daily, using the Extended General Morphology Score (GMS). This system grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consist of, but are not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf is 18. Teratogenic endpoints such as malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body were scored as ‘present’ or ‘absent’ after 96 hours of exposure. Mean developmental and teratogenic scores were calculated and used to select the most optimal condition for each factor. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not induce more malformations or mortality than exposure to adjusted ISO medium.

MO230
Reliability of ecotoxicological studies in fish
H. Winnemann, Bavarian Environment Agency; H. Ferling, Bavarian Environmental Agency; G. Dembek, W. Schmidt, W. Koerner, Bavarian Environment Agency; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

For the 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 EQSs. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not statistically significant data, or unknown origin of test fish, 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, thereby increasing the significance of results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

MO232
Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabit in heavy metal contaminated river
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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 higher than those in an unpolluted river, the Omoi River. In previous study, our group investigated the heavy metal accumulation status (Cu, Zn, As, Pb, Cd and Fe) in organs of japanese dace Tribolodon hakonensis captured from mid reach sites in the Watarase and Omoi River, and also analyzed those river water and sediment concentrations. Water and sediment concentrations in the Watarase River were generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb and Cd concentration in liver of Japanese dace in the Watarase River were lower than those in the Omoi River. Additionally, although there were no significant genetic differences between both riverine dace in microsatellite analysis, bile metallothionein (cysteine-rich protein involved in metal detoxification) concentration of dace in the Watarase River was significantly higher than that in the Omoi River. It suggests that the dace inhabit in the Watarase River may have been adapted to metal contamination by biological responses not depending on genetic characteristics. In the present study, for understanding biological response mechanism of dace to the metal contamination, we analyzed multiple biomarkers (such as erythrocyte 6-aminolevulinic acid dehydratase, blood protoporphyrin and hemoglobin concentration, and bile metallothionein concentration) in dace captured in the Watarase and Omoi River, as well as metal accumulation status of those fish. In this presentation, we will show detailed results, and discuss about the relationship between heavy metal bioaccumulation and biomarker responses in riverine fish inhabit in metal contaminated river.

MOC1
Micronucleus test to evaluate effects of 4 metals on DNA damage of zebrafish
S. Figueroa, A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Department of Biology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Laboratory of Cytogenetics; E. Idiazabal, Universidad Autonoma Metropolitana / Lab. Toxicology and Geology; Department of Hydrobiology

Danio rerio is a species of importance since it is used as a test organism for ecotoxicological studies at the International level. In our country the tests with this organism are still only used in medical research, for this reason
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxy-PAH mixtures on cardiac development in zebrafish (Danio rerio) embryos (ZFEs). ZFEs (24 hpf) were exposed to a dose range of single PAH (benzo[a]pyrene, BP), oxy-PAH (the ketones 4H-cyclopenta[def]anthracene-4-one (4H-CPO), benzo[a]fluoranthene (BFO) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, 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 BFO 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 oxy-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFO and 4H-CPO in mixture with BP. Gene expression analysis showed significant up-regulation of genes related to the heart. Overall, our results highlighted the irreversibility of the effects on cardiac development (including) especially for ZFE exposed to the combination of oxy-PAHs with BP. Notably, the up-regulation of these two genes correlated with the formation of string heart. In summary, the binary mixtures were more potent than oxy-PAHs alone in inducing cardiotoxicity, except in the case of 6H-BPO which seems to be a very potent oxy-PAH. The oxy-PAHs and PAHs interact and thereby increase the adverse effects of single compounds as a mixture.

MO234 Oxidative Stress Induced by PAH Metabolism: Comparing Three Exposure Routes in Red Drum, Florida Pompano, and Southern Flounder to DWH surrogate oil
D. Wetzde, Mote Marine Laboratory / ELF, R. Medvecky, C. Miller, K. Main, T.A. Sherwood, Mote Marine Laboratory
The magnitude of the oil and dispersant released during the Deepwater Horizon blowout caused significant immediate, and often lethal, damage to exposed organisms. However, the sub-lethal impacts of the chronic spill on offshore and near shore biota are still not fully characterized. To help understand one of the most significant responses in important Gulf fish species, four different exposure-route experiments, DWH surrogate oil contaminated feed, sediments, and seawater, were designed and carried out to examine biological responses of aquaculture reared red drum, Florida pompano, and southern flounder. Environmental pollutants, like polycyclic aromatic hydrocarbons (PAHs) found in crude oil, have the potential to induce oxidative stress. We exposed newl y hatched rainbow trout fry (Oncorhyncus mykiss) to binary mixtures of single PAH (the ketones 4H-CPO, BFLO and BPSIP in combination with BP) for 4 days. 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. The other oxy-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFO and 4H-CPO in mixture with BP. Gene expression analysis showed significant up-regulation of genes related to the heart. Overall, our results highlighted the irreversibility of the effects on cardiac development (including) especially for ZFE exposed to the combination of oxy-PAHs with BP. Notably, the up-regulation of these two genes correlated with the formation of string heart. In summary, the binary mixtures were more potent than oxy-PAHs alone in inducing cardiotoxicity, except in the case of 6H-BPO which seems to be a very potent oxy-PAH. The oxy-PAHs and PAHs interact and thereby increase the adverse effects of single compounds as a mixture.
includes detoxification enzymes induction (CYP1A), hemorrhaging, cardiovascular defects, pericardial and yolk sac edemas, craniofacial deformities or growth attenuation. The cardiovascular tissue is one of the most sensitive to PAHs, and all the aforementioned symptoms are caused by the activation of the aryl hydrocarbon receptor (AhR). However, the mechanisms involved downstream of the AhR activation by PAHs are still unclear. Some weak AhR agonists such as polycyclic aromatic hydrocarbons (PAHs) are mutagenic, as well as chemically alter cell cycle and cellular metabolism (e.g., aromatization) via unknown AhR-independent mechanisms. In this study, we aimed to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhynchus mykiss) ELS by 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 genotoxic or nongenotoxic mechanisms 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 interchangeable between the different treatments. Exposure to pyrene 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.

Human and fish cell lines were exposed to different doses of PBDEs until 72 hours. After these experiments, sub-lethal doses were chosen for long term treatments. Expression of genes related to cell cycle, stress, biotransformation, apoptosis and oxidative stress, were analyzed by enzymatic assay, spectrophotofluorimetry, immunoblotting and real time PCR. The preliminary results revealed that fish cell lines are more sensitive to the PBDE than human cells. A condition of oxidative stress was observed by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecules/enzymes, seems to be the crucial event influencing the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible of cancer promotion. Acknowledgements: the project CISAS “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP B62F15010700085) is funded by CIPE- MIUR.

MO240

In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhynchus mykiss) proteins.

D. Dejil Esposito, Iristea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iristea / UF R. Casadio, University of Bologna / Department FaBitt; M.P. Babut, Iristea / Water Perfluoroalkyl substances (PFASs) represent an important class of environmental contaminants which have been widely detected in humans and wildlife as well as in surface waters and aquatic sediments. PFASs have been shown to accumulate in aquatic species and some of them have displayed reproductive and development toxicity, hepatotoxicity and behavioral effects. Numerous studies in fish and mammals have demonstrated higher PFC concentrations in liver and blood compared to other organs. Such a distribution could be explained by PFAS binding to specific proteins, in particular the L-FABP (Liver-Fatty Acid Binding Protein) and the serum albumin. However, the data concerning the binding affinities of PFASs to specific proteins are rare, refer mainly to mammalian proteins and to some extent to another model of the mammalian fish. The elucidation of the interactions of PFCs in fish. Moreover, biochemical in vitro approaches are often not possible due to the lack of purified proteins for most common fish species. The use of in silico approaches such as protein structure modeling and molecular docking between the chemicals and the proteins of interest, may improve our ability to evaluate chemical-protein interactions and allow the extrapolation of biochemical parameters, such as binding constants. This kind of data would be helpful in building more refined toxicokinetics model in aquatic organisms. Here we present a simple two-step method based on protein modeling followed by molecular docking using free online tools. We inferred dissociation constants for 3 different perfluorooalkyl acids (Perfluorooctane Sulfonate, PFOS, perfluorohexane sulfonate, PFHXL) and 3 different perfluorooalkyl polyether (PFPE) compounds that are known to accumulate in rainbow trout and in human homologue protein. Comparison with experimental data on the human protein showed that this approach provides estimates that range in the same magnitude as those obtained by experimental approaches, such as ligand displacement assays.

MO241

Impact of metformin on zebrafish (Danio rerio) embryos

S. Mieck, University of Heidelberg / Aquatic Ecology and Toxicology; T. Braunbeck, University of Heidelberg / Centre for Organismal Studies

The biguanide metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its antihyperglycemic effect, metformin is one of the most abundantly prescribed pharmaceutical treatments for 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%) get excreted through urine and faeces, the poor metabolism rates of metformin in humans add to this outcome. As a consequence, metformin poses a potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C\textsubscript{6}H\textsubscript{11}N\textsubscript{3}HCl) according to OECD test guideline 216 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. In vitro approach for the identification of early warning biomarkers, related to exposure to PBDEs, in human and marine systems: oxidative stress, toxicity and cell cycle modulation

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The 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 \mu g/L) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural effects were measured with time. Exposure to the drug significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisoning symptoms were recorded at higher dose. Exposed embryos were observed to have poorly formed somites, coagulated embryos, non-detached tail, altered spontaneous movement and inhibited swimming performance. Observed physiological alterations include cardiac edema, sac yolk edema, pericardial edema, tail malformation and lordosis. The result demonstrated that acetaminophen has the potential to alter the development of the early life stage of the African catfish.

MO239

In vitro approach for the identification of early warning biomarkers, related to exposure to PBDEs, in human and marine systems: oxidative stress, toxicity and cell cycle modulation

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The 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 \mu g/L) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural effects were measured with time. Exposure to the drug significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisoning symptoms were recorded at higher dose. Exposed embryos were observed to have poorly formed somites, 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.
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 compounds, and 320 μg/mL of pyrogallol inhibited the COX activity by 81%. 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 by unexpected inhibitory effects on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

MO243 Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos
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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. Bouaicha, UNIVERSITE PARIS 13 Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in water bodies throughout the world. Their mechanism of toxicity consist of a potent inhibition of protein phosphatases 1 and 2A, which causes disruption of the cytoskeleton and consequent cell death. They can also alter the antioxidant system and induce oxidative stress in various organs of many species. Microcystin-LR (MC-LR) is the most studied variant due to its high toxicity and frequent occurrence in surface waters. In this study, we used a Microcystis aeruginosa bloom extract contained mainly the congener MC-LR (>95%), in male and female of juveniles of common carp (Cyprinus carpio). The fish were then randomly assigned to three groups. Group I, is the control group, received daily physiological serum (500 μL), groups II and III were daily exposed by gavage (5 days per week) to lyophilized Microcystis aeruginosa bloom dispersed in physiological serum (500 μL) containing 2 and 10 μg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated by histological observations and determination of some endpoints are often overlooked, they are important to consider when evaluating the overall risk of oil exposure.

MO247 Effect of skatol and its metabolites on piscine Phase 1 metabolism
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Research Center of Aquaculture and Biodiversity of Hydrogenosomes Vodnany Czech Republic; G. Zamaratskaia, Swedish University of Agricultural Sciences / Department of Food Science

Cytochrome P450 (CYP) enzymes are dominant players in metabolism of xenobiotics and a wide range of endogenous compounds. Skatole is well known mammalian metabolite, however rarely considered as environmental relevant pollutant. In fact, presence of skatole in aquatic environment is highly harmful to the species due to its biological effects. To the best of our knowledge, no studies attempted to investigate the effect of skatole and its major metabolites on piscine CYPs. The aim of this study was to identify weather skatole and its metabolites, 2-aminoacetoephone, indole-3-carbinol, 3-methylindole, and 3-hydroxy-3-methylindole, can interact with fish CYP isoforms. Enzyme activity measured for CYP1A, CYP1B, and CYP1F in rainbow trout hepatic microsomes were measured in the presence or absence of skatole and its metabolites. Following concentrations of tested inhibitors were used: 0.5; 5 and 50 µM. Skatole and indole-3-carbinol showed no inhibition potency on either CYP1A or CYP2A, 2-Aminoacetoephone, 3-methylindole and 3-hydroxy-3-methylindole reduced CYP1A enzyme activity by approximately 25-35%, whereas CYP2A activity remained unaltered. Physiological consequences of such inhibition for fish ability to detoxify xenobiotics remain to be elucidated. Keywords: rainbow trout, cytochromes, EROD, COH Acknowledgement: The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, projects CENAKVA (No. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15082S) and Swedish University of Agricultural Sciences.

MO248 Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
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The herbicide glyphosate and the pharmaceutical lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and gene expression patterns in the fish embryo acute toxicity (FET) test and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and malformed larvae. Gene expression patterns of such inhibition for fish ability to detoxify xenobiotics remain to be elucidated. Keywords: rainbow trout, cytochromes, EROD, COH Acknowledgement: The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, projects CENAKVA (No. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15082S) and Swedish University of Agricultural Sciences.

MO249 New insights on cross-species differences in the modulation of human and zebrafish nuclear receptors by single chemicals and environmental mixtures
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In the context of contamination of aquatic ecosystems by endocrine disrupting chemicals (EDCs), this work aims to provide new insights on cross-species differences in the modulation of nuclear receptors (NRs) and the human hydroxysteroid receptor (AhR) by individual chemicals and environmental mixtures, in order to help further cross-species extrapolation in the frame of the environmental risks of EDCs. To this end, a panel of individual ligands and environmental mixtures from an urban waste water treatment plant (WWTP), were screened on a set of recently developed in vitro reporter cell lines based on both human (h) and zebrafish (zf) NRs and AhR. The panel allowed that cross-species differences were observed for PXR, PPAR, RXR 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 clotrimazole -a bronchoactive 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 zAR whereas the dexamethasone was a more potent agonist of the zGAR than the hGAR. 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 observed. Also, strong zf mineralocorticoid activity was observed in both induced and effluent whereas only zf mineralocorticoid activity was detected.

MO250 Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
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Triclosan (TCS) constitutes a common household product 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 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. In the main 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 hitherto unknown pathway of TCS uptake. Furthermore incorporation of different detection approaches, for a comprehensive toxicity assessment of environmental stressors in aquatic organisms. The zebrafish embryo toxicity assay was used to calculate the LC50 value of TCS as well as to perform the morphological phenotyping. In addition, a liver specific fluorescent transgenic line (Tg:LFABP:GFP) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolomics experiment, 96 hpf zebrafish embryos were used. Samples were collected at 5 different time intervals, from 30 s up to 24 hours post exposure (hpe). Detection and identification of tentative TCS-bio-TPs was performed through in-house developed suspect and non-target screening workflows. Bio-TPs arising from both oxidative and conjugative metabolic reactions were identified. Regarding the metabolomics part of the study, a database of over 600 endogenous metabolites (carboxylic acids, amines, nucleosides, etc.) was established in a broad range of different species. The biotransformation data of TCS is of high interest in view of the limited and non-existing knowledge. A particularly interesting approach is the application of the food Web as a model for the integration of information on the mode of action of TCS. 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 stimulus and enables to unravel the involvement of unexpected metabolic pathways.

MO251 Isoprostanes in fish mucus - a non-lethal biomarker for oxidative stress
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Prostaglandin F2α-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2 isoprostanes (F2-isopos). F2-isopos are the free-radical catalyzed products of non-enzymatic lipid-peroxidation of arachidonic acid, a fatty acid found in brain tissue and cell membranes. Fish mucus has been investigated in several studies as a potential biomarker and matrix for the assessment of oxidative stress. Fish mucus is a protective layer which we already know that is affected by the specific stimulant and enables to unravel the involvement of unexpected metabolic pathways.
Molecular expression of xenobiotic metabolism in the intestines of walleye, brook trout, and northern pike.}


data extracted was then centrifuged, filtered and reconstituted in methanol. Separations of the 3.5um particle size) using methanol and acetonitrile.


differences between the pyloric, anterior, mid and posterior intestine. The embryonic injection model could also support mechanistic and omics-based approaches. Preliminary characterization of the rainbow trout intestine using omics-based tools focused on maternal transfer of dietary SeM and its effect on the F1 generation. Initially, the maternal transfer of dietary SeM and its effect on the F1 generation was characterized in a short-term study using short-lived fish species native to North American freshwater systems, the fathead minnow (Pimephales promelas). 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 mg Se/kg bw worms dry weight (dw) and bred for 28 days. Embryo Se concentrations increased immediately upon onset of exposure and Se concentrations reached approximately a 1:1 ratio in food:embryo after 28-30 days of the diet. There was a significant difference in mean embryo Se concentrations from the control (1.18 mg/kg embryo dw) in the medium (8.75 mg/kg embryo dw) and high (29.58 mg/kg embryo dw) treatment groups. Embryos collected on days 26, 27 and 28 were reared to swim-up and assessed for morphological abnormalities. Preliminary assessment revealed an increasing, although not significant, trend in the frequency of deformities between the control and high treatment groups (p=0.057); however, a more robust analysis is ongoing. Average Se embryo concentrations from this study will serve as the basis for subsequent embryo injection studies in fathead minnow. Developmental endpoints from both studies (e.g. mortality, frequency of deformities, types of deformities, severity of deformities) will be compared to determine if the embryo injection model is an appropriate model for studying the maternal transfer of Se. The embryonic injection model could also support mechanistic and omics-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as walleye, brook trout and northern pike.


data extraction 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 the class III and VI F2-isoPs were measurable in rainbow trout mucus (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.


data was performed 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.


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Zebrafish responses to the fourth-generation progestin drospirenone exposures

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Synthetic progestins (PGs) represent an important class of active ingredients of hormonal medicines/pharmaceuticals. Among these compounds, drospirenone (DRP) has led to environmental contamination by these substances. Although the knowledge about their environmental concentrations and effects on fish is still scarce, PGs are rapidly uptaken through fish gills and can cause deleterious effects even at low concentrations, such as the inhibition of fish reproduction. Drospirenone (DRP) arises as one of the most used fourth-generation PGs in pharmaceuticals. In relation to its endocrine activity, it is known that DRP can interfere with other processes in fish, such on regulation of circadian rhythm. Thus, the present work aims to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical level. Zebrafish embryos exposed to 0.01 – 100.0 µg/L of DRP during 96h to evaluate lethal and sublethal parameters. Survival, heart beat, length and imporatns on normal development such as malformations and hatchings 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, was a detection of a number of chemicals were identified as DRPs by GC. Biochemical processes were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

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Fish caging experiment as a tool for detection of in situ effects of untreated wastewater: 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 concentrations of some heavy metals were identified which might act as potential endocrine disruptor substances (EDS). To test this hypothesis, a fish caging experiment was conducted with the aim to check if the biological effects observed in vitro can be seen in situ, through a battery of biomarkers in liver and brain of caged fish. Ten specimens of common carp (Cyprinus carpio (L.); Cyprinidae), both male and female, were exposed for nine days at three sites in the River Danube: upstream and downstream the wastewater effluents discharge point, and in the downstream of the major discharge point of the untreated sewage into the River Danube. Certain detected chemicals are recognized causative agents of endocrine disruption and stress in general with a potential to lead to adverse physiological effects. Therefore, stress marker enzyme assays (catalase, carboxylesterase and glutathione s-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (cox1), metallothionein (mt), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor a (era), estrogen response β (erf), androgen receptor (ar), cortisol receptor (cr) and vitellogenin (vgt) as endocrine disruption related genes; interleukin1β (il1β) and tumor necrosis factor (tnf-α) as immune response related genes, while light chain 3 β (lc3βII) and dynein (dyn) were selected as autophagy related genes. Expression of these 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 vgt was down-regulated at discharge point. Expression of era 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.

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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 reaction. Enzymes related with neithroid hormone receptor (trhr), thyroid-stimulating hormone receptor (tshr), sodium-iodide symporter (nix), thyroid peroxidase (tpo), thyroglobulin (tgb), transthyretin (ttr), deiodinases 1, 2, 3a, and 3b (diol1, diol2, diol3 and 3b), and thyroid hormone receptors alpha and beta (thra and β). A loess regression method was successful in identifying maxima and minima of transcriptional expression during early development of both species. Further observations were made for a range of species, both males, and females were sampled at two monthly intervals. Our results illustrate that the gene ontology of the HPT-axis has led to environmental contamination by these substances. Although the knowledge about their environmental concentrations and effects on fish is still scarce, PGs are rapidly uptaken through fish gills and can cause deleterious effects even at low concentrations, such as the inhibition of fish reproduction. Drospirenone (DRP) arises as one of the most used fourth-generation PGs in pharmaceuticals. In relation to its endocrine activity, it is known that DRP can interfere with other processes in fish, such on regulation of circadian rhythm. Thus, the present work aims to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical level. Zebrafish embryos exposed to 0.01 – 100.0 µg/L of DRP during 96h to evaluate lethal and sublethal parameters. Survival, heart beat, length and imporatns on normal development such as malformations and hatchings 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, was a detection of a number of chemicals were identified as DRPs by GC. Biochemical processes were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

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Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.


The fast expansion of socio-economic activities on coastal areas has increased the presence of anthropogenic pollutants from industrial and domestic sources over the last decades. Recent studies have reported the presence of many persistent organic pollutants in water, sediments and in vertebrates from Antarctic areas; however, information about their potential impact on fish physiology is still scarce. The southernmost city of the world, Ushuaia (Tierra del Fuego, Argentina), and its bays are not the exception to the decline of the environmental quality. Nototomis fish are the dominant group in the Antarctic region, and they play a key role in these ecosystems. The black southern cod, Patagonotothen tessellata is widespread in the Beagle Channel, lives in the intertidal zone, and possess paternal care. The aim of the present work is to validate vitellogenin (vtg) and estrogen receptor (ren) as biomarkers of estrogenicity in skin samples of this species in order to provide a helpful tool to develop and perform risk assessments of marine and coastal water and to better understand environmental risk in places where contamination already exists. Male fish were injected with 17β-estradiol (i.p, single dose of 10 mg/g or vehicle). Vitellogenic females were used as positive controls. Samples of skin and liver were obtained to assess vtg and ERα mRNA expression and physiological responses were studied through different endpoints: histological analysis, vtg detection in plasma samples, and sex steroid levels (estradiol (E2) and testosterone (T)). Seventy-two hours post-injection histological analysis showed normal unrestricted testis and intense cytoplasmic basophilia in hepatocytes. No vtg was detected in plasma samples of control males or before E2 injection; however, three days after treatment, males showed plasma

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vgt-ir bands similar to those of females. Likewise, plasma E2 concentration in males was significantly increased but the opposite was observed in T levels. These changes were also reflected in E2/T ratio. Furthermore, E2 levels in treated males were even higher than those of females. Vtg and ERα gene expression was up-regulated both in liver and skin after E2 treatment. Potential impact in parental behavior is discussed. We conclude that vtg and ERα expression in skin are sensitive and non-harmful biomarkers of estrogenicity in this Sub-Antarctic fish.

MO261 Thyroid disruption and its effects on neuronal development of zebrafish A. Haigis, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; G. Sterbouni, RWTH Aachen University / Ecosystem Analysis ESA; L. Legendre, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; H. Hollett, RWTH Aachen University / Institute for Environmental Research

The endocrine disruptive 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 species. Our study investigated how estrogenic compounds cause behavioural alterations in zebrafish (Danio rerio) larvae.

Thereby, substance and concentration dependent effects were observed, indicating differing toxic modes of action. Within this study we aim to further investigate thyroid disruption in zebrafish early life stages and elucidate a possible link to (developmental) neurotoxicity. Therefore, embryos and larvae of zebrafish are exposed to different thyroid disrupting compounds. The methodology approach 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 through transcriptomics, proteomics and metabolomics. This work will be conducted within the scope of the “NeuroBox” project. In NeuroBox novel bioassays 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 K. Blium, University of Saskatchewan / School of Environment and Sustainability; A. Legrandi, Vrije Universiteit Amsterdam / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Department of Ecosystem Analysis ESA; J. Legradi, Vrije Universiteit Amsterdam / Department of Ecosystem Analysis ESA; J. Figueroa, Instituto de Ambiente del Sureste / Hidrobiologia

Chlorpyrifos is an organophosphate insecticide that acts as a neurotoxicant through inhibition of the enzyme cholinesterase. The mode of action of organophosphates in vertebrates is well studied, however, the exact mode of action in 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 DNA-based base calling analyses 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 the improvement of water quality guidelines. 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 Hidrobiologia; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia

This study evaluated the toxicity effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparasites in fish, and insecticide Imipropim which belongs to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (lipoperoxidation), the activity of the enzyme acetylcholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg L⁻¹) to determine the 50 lethal concentration (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 yolk and the activity of AchE (LC₅₀ = 1.67 ± 0.87 nM Tbars mg⁻¹) 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 AchE enzyme was observed and from 14% to 64% in the juveniles exposed to Imipropim. 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 Imipropim tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imipropim 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, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia; J. Salazar Hernandez, 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 gastric emptying time, and potentially the risk of gastrointestinal bleeding. In zebrafish, the embryonic stage appears critical for the development of the gut. The effects of Omeprazole on zebrafish embryos were examined by means of the evaluation 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 LC₅₀. In the evaluation of the toxicity 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, LC₁₀ and LC₁₀0 for 24 hours to evaluate the degree of lipid peroxidation, by means of the evaluation test 236 (Buege and Aust, 1978), the activity of the enzyme AchE as an indicator of effects neurotoxic (Ellman et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the 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 LC₅₀. The percentage of inhibition of AchE varied from 9 to 66.7%. A higher frequency of VC gens (Buege and Aust, 1978) and AchE activity were observed and from 14% to 64% in the juveniles exposed to Imipropim. In 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).

MO266 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME

Venlafaxine, a psychotropic drug used as antidepressant, is a component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (lipoperoxidation), the activity of the enzyme acetylcholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). The effects of Venlafaxine on zebrafish larvae were examined by means of the evaluation 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 LC₅₀. In the evaluation of the AchE activity, significant differences were obtained between the control and the embryos exposed to omeprazole (p < 0.05), in the concentrations LC₁₀ and LC₅₀, a decrease in the activity of this enzyme was observed. The results of this study showed that omeprazole has a neurotoxic and possibly genotoxic effect in sublethal concentrations in zebrafish embryos.

MO267 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME

Venlafaxine, a psychotropic drug used as antidepressant, is a component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (lipoperoxidation), the activity of the enzyme acetylcholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). The effects of Venlafaxine on zebrafish larvae were examined by means of the evaluation 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 LC₅₀. In the evaluation of the AchE activity, significant differences were obtained between the control and the embryos exposed to omeprazole (p < 0.05), in the concentrations LC₁₀ and LC₅₀, a decrease in the activity of this enzyme was observed. The results of this study showed that omeprazole has a neurotoxic and possibly genotoxic effect in sublethal concentrations in zebrafish embryos.
year. Considering the ecosystem services/antiprinciple, effects on single species or communities and whole ecosystems would increase that up to hundreds of 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. It 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 larvae by evaluating transcriptomic profiles and behavioral alterations. The locomotor activity in ‘in situ’, light-dark transition test and thigmotaxis were evaluated in 5 dpf larvae exposed to 24 h at 10 nM, 100 nM and 10 µM venlafaxine using DanioVision® and EthoVision. A significant difference in swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome level were verified in zebrafish chronically exposed to Venlafaxine and n= 100 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples (n= 25 fish) and submitted to ‘In situ’ Green quantitative real-time chain reaction (qPCR) of a panel of target genes involved in circadian rhythm regulation, muscle processes and responses to antidepressants. Behavioral results indicated decreased swimming distance and increased thigmotaxis in vivo exposed fish, in agreement with previous own data for continuous venlafaxine exposure. Results in vitro and qPCR indicated modulation of some of the pre-selected target genes such as sklp5 and, currently unconfirmed qPCR results are being evaluated. Further investigations on these points are planned. A new proteome ‘in vivo’ and metabolome analysis. This study is expected to be part of a bigger overview and understanding of ‘in situ’ 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 toxicologic; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; I. Domingues, University of Aveiro / CESAM Department of Biology; E.D. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, University of Oxford / Laboratory of Evolution and Diversity of Organisms. Psychotria viridis, also known as Ayahuasca is a psychoactive concoction prepared with the plants Banisteriopsis caapi and Psychotria viridis and used ancestrally by Amazonian Indian populations, and recently, by Christian religions in Brazil and other countries. The present study aimed at identifying the ayahuasca effects in early fish development and compares its neurobehavioral effects in the zebrafish embryo and rat models. Toxicity endpoints are screened 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 transcript factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and C5), associated with mitochondrial metabolism, at 120 hpf. This comprehensive study could suggest the importance of the embryonic zebrafish model on the methodology and set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.

MO270: Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures.

J. Lee, Seoul National University of Science and Technology / Environmental toxicology and health; S. Lee, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental Engineering

Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on toxicological studies. We evaluated mitochondrial dysfunction in dechorionated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachloreocyclohexane (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 C5), associated with mitochondrial metabolism, at 120 hpf. This comprehensive study could suggest the importance of the embryonic zebrafish model on the methodology and set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.
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, generation of offspring within hours and the ability to obtain conserved vertebrate drugs targets to a great extent. Early stages of zebrafish are called as non-protected life stages and are therefore used for testing chemicals for their toxicity as an alternative to conventional animal testing. Moreover, zebrafish larvae are amenable to test neurotoxicity and behavioural effects of chemicals as their small body size allows tracking a large number of individuals with full control over the environment. Aim: The aim of the project is to investigate behavioural inter- and intra-individual variability in zebrafish larvae as a basis to better estimate effects of chemicals on behavioural responses. Analysis of inter-individual differences might offer new insights into mechanisms of toxicity considering that every individual’s response to a chemical differs based on their genetic make-up.
Hypothesis: We are testing whether inter-individual variability is constant over time and whether levels of locomotor activity correlate with physiological and morphological properties of the larvae. Methods: At first, spontaneous locomotor activity is measured for 40 min in continuous light at different timings of the day from 5-7 days post fertilization. Heart rate, body size and other physiological properties of the same individuals are analysed at different time points. Results: From the preliminary results of the locomotor activity analysis, we could assign the larvae to three categories based on their activity levels compared to the average activity: highly active, less active and the individuals close to the average activity, which are also the ones less variable over time. To attribute this variability in the individual’s activity to its physiology and phenotype, the analysis of heart rate, length and blood flow are on-going. Outlook: The variability of each individual will be taken into account to better evaluate effects of the chemicals on behavioural responses. Inter-individual differences will be explored as a source of information on mechanisms of toxicity of chemicals with unknown targets and mode of action.

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

MO272
Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water
C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill / Department of Environmental Science and Engineering; M. Llanes, K. Lamanna, 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 disinfection byproducts (DBPs) during drinking water disinfection. This work investigated the effect of different ICMs, iopamidol (IPAM), iopromide (IPIR), diatrizoate (DTZ) and iohexol (IHX), in the formation of different classes of DBPs during source water disinfection by either free chlorination or chloramination. To do this, we performed large-volume (~120 L each), laboratory-controlled, headspace-free disinfection reactions with 5 μM ICM and 100 μM as Cl₂ disinfectant concentration. The resulting DBP mixtures were chemically characterized for 21 DBPs and non-DBPs containing water including iodoacetonitrile, trichloroiodomethane and several iodo-aromatic compounds. Our results indicate that ICMs enhance the formation of both I-DBPs and non-iodinated DBPs when present during chlorination and that IPAM, in particular, is a relevant iodine source in water undergoing chlorination or chloramination. Acknowledgments: CP acknowledges support provided by EU FP7 (No. 274379, Marie Curie IOF) and the Government of Catalonia and the COFUND programme (Marie Curie Actions, EU FP7) (2014 BP_B00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF124865 to SDR.

MO273
The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection
R. Vera, University of Girona / Chemistry; C. Fontas, University of Girona / Department of Chemistry; M. 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 (IPAM) formed of poly(vinylidene fluoride-co-hexafluoropropylene) as the polymer and Aliquat 336 as the extractant, for the online preconcentration and separation of As(V) in a PIM cell. The sample solution is propelled for a predetermined period of time through the PIM cell where a PIM separates the sample stream and an acceptor stream which is stopped during the sample passage through the PIM cell. The analyte (As(V)) is transported across the hydrophobic interface 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% H₂O₂ and 0.5 % ascorbic acid. This is followed by arsenite generation using another reagent stream incorporating 0.5 % NaBH₄ and 0.05 M NaOH. The generated arsenite is transported across the hydrophobic membrane of a gas-diffusion cell into a solution containing 0.02 mM K₂MnO₄ and 0.05 M NaOH where it is oxidised thus producing a decrease in the K₂MnO₄ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system has detection limit of 0.94 pg L⁻¹ with a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 μg L⁻¹) and 2.8% (n=5, 50 μg L⁻¹). The FA method has been successfully applied to the determination of As(V) in tap water in the μg L⁻¹ concentration range. <strong>References</strong> [1] Villaescusa I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sci Policy 11(4): 307–323. [2] World Health Organization (WHO). 2011. Guidelines for drinking-water quality, 4th edition

MO274
Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers
V.P. Cimmino Medía, Catalan Institute for Water Research (ICAC); J. SEVERYN, EQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICRRA 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 diclofenac as the unregulated microcontaminant. The algorithm simulated the performance of WWTPs in this catchment requiring an upgrade to minimize the EQS exceedance of diclofenac in all river sections and the total investment cost. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. We simulated an optimization algorithm to validate this hypothesis.
hydrological conditions in the Llobregat). Finally, we demonstrated that the reduction of uncertainty in the modelling process (through R&D activities) provides transparency in the decision-making process.

MO275 Calibration of passive samplers for the monitoring of drugs in French Caribbean
N. Tapie, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; D. Devault, Univ. Paris Sud / ESE UMR 8079; S. Karolak, Univ. Paris Sud, CNRS, AgroParisTech / ESE UMR 8079; Y. Levi, Univ. Paris Sud / ESE UMR 8079; H. Budzinski, University of Bordeaux
Drs 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 (WWTW). 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. For an analytical development by ESI- LC/MS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaïne, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) 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 0 days, 3 days, 5 days, 7 days, 10 days, 13 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, benzoylecgonine, cocaethylene, ecgonine methyl ester), cannabis markers (11-nor-9-carboxy-THC) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L/1 for cocaine.

MO276 Passive sampling in surface water as an immission-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg
T. Galle, Luxembourg Institute of Science and Technology; D. Pitois, M. Bayerle, Luxembourg Institute of Science and Technology LIST
The pressure on surface waters that is exerted by emerging pollutants depends on the WWTPs load to rivers and on the surface water flow conditions. 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. Analytical determination of EQS exceedence can be realized by analyzing river water samples with the established orococital approach to routine environmental analysis. Primary applications to be highlighted are the discovery of new disinfection by-products (DBPs) resulting from water treatment processes, using a non targeted approach, as well as the potential for addressing the difficult analytical challenges for a complex class of emerging persistent organic pollutants: short chain chlorinated paraffins (SCCPs).

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) provides detection limits in high-ionic-strength matrices as low as conductivity detection alone. These low detection limits are achieved without sample preparation. Our study updates the IC-MS method published in U.S. EPA Method 332.0 for determination of perchlorate in environmental waters. The method uses a Thermo Scientific™ Dionex™ IonPac™ AS20 column set, on a recently introduced compact IC system coupled with a recently introduced singlequadrupole 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 cover 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.
RPLC-HILIC-ToF/MS system. The analysis data were then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine very polar compounds, of which six have not been reported previously in water surface samples.

MO281 Analysis of Per/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements
T. Anamol, L. Toelgyesi, T. Sosienski, Agilene Pharmaceutical GmbH / UFZ; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research; S. Bayen, McGill University / Singapore-Delft Water Alliance

Perfluorooctanesulfonate (PFOS) and perfluorooctanoic acid (PFOA) at 70 ng/L. However, several other PFASs are also used in manufacturing and need to be monitored. To respond to this, a method was developed for the detection of PFAs in drinking water using a newly developed triple-quadrupole mass spectrometer and a modified high-performance liquid chromatography system. The USEPA has developed a method for analysis in drinking water for 14 PFAS and this method expands on that method with lower detection limits, and more QA/QC data. The water samples were extracted with solid phase extraction using a novel weak anion exchange cartridge which was optimized to achieve good recoveries for all compounds and will be presented. Several different classes of PFASs including perfluorooctanoic acids (PFCAs), perfluorosulfonylic acids (PFASs), sulfonamides (FOSA), sulfonamide acetic acids (FOSAAs) and others were separated on a liquid chromatograph (LC) using a reversed phase C18 column. Since fluoropolymers are used in all LC systems, special precautions including replacing solvent lines and addition of a delay column were employed to avoid PFAS background contamination. The compounds were analyzed in negative electrospray ionization using a tandem quadrupole mass spectrometer in dynamic multiple reaction monitoring (DMRM) mode. Water samples were extracted using both an offline and automated online solid phase extraction techniques and the data was compared. All PFASs were analyzed and method performance parameters such as method detection limits, inter- and intra-day repeatability, matrix spike recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with %RSDs well below 15% that are needed to meet USEPA 537 requirements. Some PFASs were not detected (PFOS) and perfluorooctanoic acid water and wastewater samples that were analyzed in the ng/L range. All this was done on a triple quadrupole mass spectrometer that is fully stackable with the HPLC system.

MO282 Optimisation of solid phase extraction parameters for the isolation and characterisation of benzodiazepines in wastewater
S. Nzube, Cape Peninsula University of Technology / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry

Pharmaceutical pollutants entering the aquatic environment have become a growing environmental concern. These pharmaceuticals are unique pollutants because of their special characteristics and behaviour that cannot be simulated with other organic pollutants. The untreated wastewater effluent that contains pharmaceuticals poses a considerable threat to the aquatic ecosystem because of the negative effects of non-target organisms in the water. Recent years have seen a growing concern about the benzodiazepines, as emerging pollutants, and their effects on the aquatic environment. These compounds are nowadays widely detected in sewage wastewater. It is important to increase the emphasis on the characteristics of the benzodiazepines in order to differentiate them from industrial chemical compounds. In this study, various solid phase extraction techniques have been employed focusing on the isolation of benzodiazepines in wastewater matrices. Employing these techniques, it has been shown that receptors from rivers and many species of fish and seafood contaminant monitoring traditionally relies on the surveillance of known chemicals, an approach referred to as targeted analysis. However, very few tools are available to monitor “unexpected” or “unknown” compounds. Non-targeted approaches are particularly useful to detect emerging contaminants in items related to the human diet such as fish and seafood. The non-targeted approach is however quite challenging for trace contaminant analysis as it involves isolating relatively small signals from complex matrices, and this, in absence of a good knowledge about the analyte identity. In the past decade, the coupling of liquid chromatography, high-resolution tandem mass spectrometry (HRMS/MS) and advanced data processing algorithms has proved to be a robust approach for the analysis of unknown molecules in biological samples. In this study, a non-targeted workflow was developed with the objective to detect/identify unexpected organic contaminants in a predator fish from the St. Lawrence River (QC, Canada), the northern pike (Esox lucius), with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Montreal’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOS) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.

MO285 Prioritising site-specific emerging contaminants in surface water based on LC-HRMS nontarget screening data
M. Krauss, C. Hug, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; R. Bloch, Helmholtz Centre for Environmental Research GmbH / UFZ; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

MCs eluted between 2.2 – 5.2 minutes allowing for the analyses time to be 3] MC-RR, [Asp] MC-LR, MC-His 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 water will be underestimated greatly, and 2) an unambiguous chemical needs to be determined for this method. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS-based method for screening of non-targeted chemicals of potential concern in northern pike.
L. Tian, McGill University; J. Reimling, Université du Québec à Montréal / Département des sciences biologiques; J. Verreault, Université du Québec à Montréal / Département de Biologie; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Baven, McGill University / Singapore-Delft Water Alliance

Benzodiazepines; Emerging pollutants; Solid Phase Extraction; Spectroscopy; Wastewater

MO283 Monitoring source and drinking water for Microcystins using online LC/MS/MS method
J. Westrick, Wayne State University / Lumigen Instrument Center; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

Microcystins (MCs) are widespread toxic cyanobacterial compounds that are currently regulated in the US by numerous regulatory agencies and several environmental health guidelines. It is important to increase the emphasis on the characteristics of the Microcystins in 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 ESI+ detection 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-His 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 water will be underestimated greatly, and 2) an unambiguous chemical needs to be determined for this method. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO282 Monitoring source and drinking water for Microcystins using online LC/MS/MS method
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In 2015 the USEPA announced an age-dependent drinking water Health Advisories (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 ESI+ detection 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-His 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 water will be underestimated greatly, and 2) an unambiguous chemical needs to be determined for this method. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.
MO286
Analysis of Phenanthrene Transformation Products Using High-Resolution Mass Spectrometry Coupled to High-Performance Liquid Chromatography
M. Leonard, Oregon State University / Environmental & Molecular Toxicology; J. Schirau, Oregon State University / Environmental and Molecular Toxicology; S.L. Moxley Simonich, Oregon State University / Department of Environmental and Molecular Toxicology
Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants generated by the incomplete combustion of organic compounds. Several PAHs have been identified as toxic, mutagenic and/or carcinogenic, which has led the United States Environmental Protection Agency (US EPA) to list 16 PAHs as priority pollutants. PAHs can be metabolized by mammals and some microbes to form hydroxylated PAHs (OH-PAHs) and a variety of other transformation products (TPs). These TPs have the potential to be more toxic than their parent PAHs, but they are not included on the EPA priority pollutant list. Hence, they are often not screened for in environmental samples. Non-targeted screening based on high-resolution mass spectrometry (HRMS) coupled to high-performance liquid chromatography (HPLC) has become an established method for PAH analysis. However, the scarcity of TP research concerning studies in drinking water highlights the need for the development of new methods for the rapid and reliable detection of 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 some signals of specific TPs. We also characterized the transformation products of the TPs using database searching and isotope-pattern comparison.

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 in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C18, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxyphenanthrene (OH-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C18 and phenyl-hexyl columns using a gradient of water (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
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 systemically 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 some signals of specific TPs. We also characterized the transformation products of the TPs using database searching and isotope-pattern comparison. The parent aromatic ECs of the TPs were then traced back by spiking each aromatic EC to one 100-mL Milli-Q water. Eight of the aromatic ECs were partly removed by chlorination, where triclosan showed the highest removal (99.4%), followed by bisphenol A (72.5%). Nine of the features that were present in the chlorinated and absent in the untreated water samples were indicated as TPs. The results of database searching and isotope-pattern comparison showed that the molecular formulae of all of the nine TPs contain at least one chlorine. Each chlorinated TP was then successfully traced to one aromatic EC. The nine TPs were transformed from five aromatic ECs, including all of the four parabens and triclosan, by replacing one or two hydrogens with chlorine atoms. The HR-MS method successfully identified nine chlorinated TPs. The results of this study demonstrated that parabens and triclosan could be transformed into more persistent, bioaccumulative, and toxic chlorinated compounds. The proposed method will be applied to the systemic identification of TPs in real water samples containing multiple ECs.

MO289
Unravelling the potential of a partial nitritation/anammox biomass towards micropollutant biodegradation
In the past few years, anammox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of micropollutants by the microbial groups responsible of these processes and the few results available are inconclusive. This study aims to assess the degradation capability of biomass withdrawn from a partial nitritation/anoxic ammonium oxidation (PN/A) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metoprolol, venlafaxine and carbamazepine). Batch experiments were performed under different conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitrifying bacteria), iii) aerobic conditions with allylthiourea (an inhibitor of nitritation/anammox 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, carbamazepine and venlafaxine were hardly removed (< 10% in the majority of cases). Results demonstrate that the activation of different microbial groups in combination with altering operational parameters can actually enhance the removal of some of the studied micropollutants.

MO290
Removal of pharmaceuticals in a biofilm reactor: effects of manipulating carbon substrate availability
L. Zhang, Aarhus University / Department of Bioscience; P. Carvalho, U.E. Bollmann, H. EI-taliawy, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science
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. Therefore, in this study, we built up a saturated sand filter based on 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, carbamazepine and venlafaxine were hardly removed (< 10% in the majority of cases). Results demonstrate that the activation of different microbial groups in combination with altering operational parameters can actually enhance the removal of some of the studied micropollutants.

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operated for 1.5 HRTs, after which four samples were taken over 6 hours. The results showed that with the different acetate additions, the effluent oxygen concentration decreased, reaching the lowest value of 0.98 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased always to initial conditions (4.7 mg/L) in each starving phase between the feeding phases with acetate. The acetate addition resulted in three different compound dependent removal patterns of the pharmaceuticals. Briefly, un周转 and inolohed removal was attributed to co-metabolism (enhanced acetate). Metoprol, isopem, diclofen, propanol and sulfamethizole removal were removed 1) at lower acetate concentrations by co-metabolic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, suldivazed, sulfamethoxazole and trimethoprim were removed indiately or slightly and acetate concentration could be considered as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioe敬or’s performance.

**M0291 Investigating inhibitory effect of anti-inflammatory pharmaceuticals on activation sludge**

M. GREEN, E. Topuz, G. Yucek, E. Ubay Cökgörü, D. Okutman-Tas, 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 priority micropollutants is recommended in order to be able to embrace the fact that there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 10L aerobic reactor (sludge age of 5 days; @22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in Istanbul. The culture was fed daily with a synthetic wastewater (ISO 8192) (600 mg COD/L) and 20 mg COD/L acetate. To assess the acute inhibitory effect of pharmaceuticals, micropollutants respirometric assays were performed with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75µg/L each; Naproxen, Diclofenacen, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aqauimiz.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10µg/L PMx did not result in considerable change compared to control 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 accumulated in sludge phase (< 0.2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD (k₇) 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 oxidation rate (k₉) and hydrolysis rate (k₇) resulting in more readily hydrolysable COD (S₉). The results of this study will help to clarify the 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-GEBİP Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.

**M0292 Elimination of tramadol and methadone in model ozonization experiments: removal kinetics and identification of transformation products**

P. Kostanjeveki, Rudjer Boskovic Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. Matotic, Faculty for Food Technology and Biotechnology; M. Abe, 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 processes, are necessary to be able to transform, degrade and/or to minimize the possible overall ecotoxicity of the effluents. Therefore, the aim of this work was to examine the removal of two opioid analogues, tramadol and methadone, using ozonation. The experiments were performed in three different matrices, including pure water, phosphate buffer and secondary effluent from the Central wastewater treatment plant of the city of Zagreb. The removal rates of opioid analogues was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two main transformation products characterized by m/z 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.

**M0293 Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water**

C. Raimundo, UNICAMP / Institute of Chemistry; K.H. Cochran, B. Fryer, University of South Carolina; S. Kimura-Hara, University of Calgary; W. Abdelraheem, Y. Huang, University of Cincinnati; X.L. Coffin, University of California, Riverside / Environmental Toxicology; D. Schlenk, University of California, Riverside / Environmental Toxicology; D. Schlenk, University of California, Riverside / Environmental Toxicology

The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two main transformation products characterized by m/z 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.
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 communities in the future. Efficie

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health
C. Allen, L. Jones, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; R.U. Halden, Arizona State University / Biodesign Center for Environmental Security; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 213M kg of phthalates are produced globally each year with end use products including food packaging, 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 DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys). As new research emerges indicating that substitute plasticizers also contribute to adverse health effects, these restrictions are likely to increase. The present project constitutes the first application of sewage epidemiology to determine phthalate exposure in an Irish population. Phthalate levels in influent, effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC-MS/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 investigation: benzylbutylphthalate (BBP), dibutylphthalate (DBP), diethylhexylphthalate (DEHP), diisobutylphthalate (DIBP), di-n-octylphthalate (DNOP), diisononylphthalate (DINP), and diisodecylphthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

MO299 Phthalates and their metabolites in the environment
L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; A. Staines, Dublin City University / School of Biotechnology and DCU Water Institute; R.U. Halden, Arizona State University / Center for Environmental Health Engineering; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates, or phthalate esters (PEs), are ubiquitous in the environment. Research has shown 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 investigation: benzylbutylphthalate (BBP), dibutylphthalate (DBP), diethylhexylphthalate (DEHP), diisobutylphthalate (DIBP), di-n-octylphthalate (DNOP), 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.

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 Environments in Ipo State, South-Eastern Nigeria, many individuals have developed different techniques for rainwater storage-harvesting for drinking water and domestic use. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage capacities commonly used by general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physicochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the levels of Al (60μg/l) in the metal drum tank based on the heavy metal content. For bacteriological analysis, the concrete underground tank recorded the presence of pseudomonas which exceeds the WHO standard stipulated for portable water. The results further explained that concrete underground tank and metal drum tank were more contaminated in terms of physicochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes. Keywords: Harvested Rainwater, microbiological analysis, physicochemical analysis, storage facilities, trace metals
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 acids.
C. Simonnet-Laprade, University of Bordeaux UMR EPOC; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; M. Capdeville, LyRE Centre de Recherche et Développement SUEZ; P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; H. Budzinski, University of Bordeaux
This study proposes to identify the origin of 30 poly- and perfluoralkyl substances (PFASs) found in wastewater samples from a French city (Bordeaux Metropolis). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted both by industrial and commercial activities were collected within the sewage network upstream typical and representative treatment plants; in addition 4 samples of runoff waters were also targeted in order to explore the input of this type of potential source. PFASs were also analyzed in the influents, the effluents, and the sludges of the 4 main wastewater treatment plants (WWTP) of Bordeaux Metropolis to quantify global inputs to the natural aquatic environment. The results highlight distinct patterns and levels of contamination between different types of samples and potential sources. Overall, wastewaters impacted by industrial inputs have the highest levels (ΣPFAS = 4.6-501.7 ng L⁻¹) with the predominance of PFOS, PFHxS, C₆-C₇ PFCA and 6:2 FTSA. High levels of 8:2 and 10:2 FTSA (> 100 ng L⁻¹) were found in wastewaters from the harbor area and a major industrial area. Domestic wastewaters have the highest levels of 6:2 diPAP (median concentration of 4.5 ng L⁻¹), probably related to its use in food packaging. Concerning runoff waters, the highest levels are found in the airport area with ΣPFAS of 227 ng L⁻¹. The comparison of the profiles with those found for WWTP influents using a principal component analysis made it possible to highlight the importance of the industrial and commercial discharges on the global contribution to WWTPs. It has been possible to quantify global fluxes of PFASs to the four WWTPs and they were estimated at about 14 g d⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only the C₆-C₇ 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-C₇ PFCA in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFAS molar concentrations.

MO301 Antibiotics and endocrine disrupting compounds in wastewater treatment plants and in receiving water bodies around the city of Rome (Italy)
Several studies highlighted the occurrence of organic micropollutants such as pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds in wastewaters and surface waters. In addition to emerging contaminants, antibiotics are of peculiar interests due to their potential adverse effects on aquatic ecosystems diversity and function and because they can act as a potential driver for dissemination of resistance genes. Previous studies show that classes of synthetic antibiotics, such as quinolones, sulfonamides, tetracyclines, betalactams and fungicides, are widely distributed in the sewage system of the city of Rome and in contaminants 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, althoughgrab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling rate (Rs) for each target compounds was determined in the laboratory with synthetic water over 14 days at 15°C. The sampling rates were adjusted for the influence of environmental factors (e.g. temperature, flow) by measuring the loss of Performance Reference Compounds (PRCs) spiked into POCIS deployed in the field. Extracts from POCIS and grab samples were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) and analysis was carried out using electrospray ionization coupled with an Agilent 1100 HPLC. Among the six herbicide target compounds, the highest maximum concentrations were observed for atrazine (1,070 ng/L), dicamba (845 ng/L) and 2,4-D (691 ng/L). The highest maximum concentrations of fungicides were for oxazystrobin (959 ng/L), myclobutanil (86 ng/L) and boscalid (74 ng/L). The rest of the fungicides and herbicides were detected at concentrations below 60 ng/L. There was no correlation between the watersheds that had the highest levels of fungicides vs the highest levels of herbicides. This may reflect differences in crops grown across the region, or differences in the timing of application of the pesticides. Overall, this study indicated that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

MO305 A Study on the Distribution and Behavior of Nonylphenol in the Suyeong River, Korea
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Nonylphenol is known, as one of Endocrine Disrupting Chemicals is the degradation product of Nonylphenol ethoxylates being used as nonionic surfactant. Nonylphenol is classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. In order to understand the current contamination and behavioral characteristics of Nonylphenol by measuring the concentration of Nonylphenol in the surface water in the downstream of Suyeong...
River of Korea, and based on that, estimating the material balance. During the survey period, the range of Nonylphenol concentration in estuary of Suyeong River had the range of 142.0 – 569.6 ng/L and the average of 271.0 ng/L. The target area was divided into 3 regions to estimate the material balance of Nonylphenol in the downstream of Suyeong River. The dissolved Nonylphenol of 282.3 g/day occurred in region 1 of Suyeong River, and Nonylphenol influx load occurred in particulate suspension of 31.8 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 of the city with highest population densities were detected from 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 risk assessment of the drugs of abuse detected was determined by calculating risk quotient (RQ). In 2012, 3,4-methylenedioxyamphetamine (MDMA) and 4-methoxyphenylcyclohexane (4-MeOCPCP) 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. Bufotenine (BUF), methadone (MET) and p-methoxyamphetamine (PMA) were found out in 3 or 4 sampling points at concentrations < 70 ng/L in 2012. Ephedrine (EPH) 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 (BECG), a metabolite of benzylocegonine, 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 4.67 ng/L, ranging 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 BECG and 11.4 (2.9–40.1 ng/L) for MET. GIS provided the spatial incidence of drugs of abuse within the Turia River Basin. Occurrence of these drugs of abuse and of the city with highest population densities corresponded to the descriptive model of territorial presence. Compounds used as drugs of abuse and prescribed as pharmaceuticals (MET, COD and EPH) were mostly detected in Valencia city and its metropolitan area where most hospitals are located. Although risk assessment showed low ecotoxicological hazard, further studies are also needed in order to assess long term toxicity.

**MO308**

**Occurrence, fate and environmental risk assessment of benzophenone-type UV filters in a tropical urban watershed**

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A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic products that are exposed to sunlight. Following use, BPs can enter ambient environments directly via commercial and indirectly from eutrophication. 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-dihydroxybenzenophenone (BP-1), 2,2',4,4'-tetrabromo-2-hydroxybenzenophenone (BP-2), 2,4-dihydroxy-4'-methoxybenzenophenone (BP-3), 2,2'-dihydroxy-4,4'-dimethoxybenzenophenone (BP-6), 2,2'-dihydroxy-4-methoxybenzenophenone (BP-8), 4-hydroxybenzenophenone (4OH-BP) and 4,4'-dihydroxybenzenophenone (4DHB)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L^-1 in dissolved phase and < LOQ to 2774 ng L^-1 in solid phases. Suspended solids in the water column contained significantly higher amount of BPs than sediments, while the concentration difference between bulk water and pore water was insignificant. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at the degradation pattern of BPs in the field. This will be followed by a preliminary risk assessment.

**MO309**

**Formation of disinfection byproducts throughout various drinking water treatment processes**

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This study investigates the formation of disinfection byproducts (DBPs) throughout the treatment processes operating in the various drinking water treatment and desalination plants and distribution system that supply drinking water to more than 4.5 M inhabitants living in the city of Barcelona and its metropolitan area. For this, DBP formation potential tests with chlorine were performed with the water entering each plant and produced after the individual processes carried out in each plant to treat the water. DBP mixtures were generated for each investigated matrix at two different temperatures (15ºC and 25ºC) and reaction times (0, 24 h, and 48 h, and also 72h in the plant effluent) so that different scenarios in the drinking water distribution network were simulated. Six different DBP classes in total were investigated in the DBP mixtures generated by means of gas chromatography coupled to mass spectrometry detection. The list included the regulated (N-nitrosamines (NDMA), trihalomethanes (THMs), haloacetic acids (HAA)) and non-regulated (halogenated acetonitriles (HANs), halogenated acetamides (HACMs) and halecetic acids (HAs)). Overall it could be concluded that the potential of the water entering the plants to form all investigated DBPs decreased throughout the treatment process, due to the removal of DBP precursors in the different treatment steps. The work performed contributed to evaluate the risk associated with changes in the water treatment process and prevent population exposure to DBPs in the event of scenarios that may alter the good performance of the whole process. Acknowledgments: C.P. acknowledges support from the Secretary for Universities and Research of the Ministry of Economy and Knowledge of the Government of Catalonia and the COFUND Programme of the Marie Curie Actions of the EU’s FP7 (2014 BP B00064). This work has been financially supported by the Government of Catalonia (Consolidated Research Groups 2014 SGR 418-Water and Soil Quality Unit and 2014 SGR 291-ICRA).

**MO310**

**Formation of N-nitrosodimethylamine during water treatment for potable use: an update**

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Nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) is the most widely detected N-nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonization or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrosamine or dichloramine and amine, b) formation of acyclic nitrosamines from typical secondary amine precursors; c) chlorination of nitrite in the presence of nitrosamine precursors; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, substances used in cosmetics, pesticides, chelating agents, amine-based polymers, etc.), but not all can be present in significant amounts in the source water. In the context of water treatment for potable use, amine-containing coagulation polymers and some anionic exchange resins constitute the main source of NDMA precursors. Although NDMA is the most prevalent nitrosamine detected, according to the surveys conducted until now, it may account for only a minor fraction of all nitrosamines formed during chloramination. More research is required in order to establish ways to avoid NDMA and other nitrosamines formation.

**MO311**

**Presence and environmental hazard of psychoactive pharmaceutical compounds in coastal waters and biota from North-Western Spain**

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Toxicology and Risk Assessment TAYER / Rey Juan Carlos University
Historically, coastal and transition waters have preferentially been used for human settlement, leading to a continuous input of wastewater effluents into these habitats. Water quality monitoring of these systems, with the goal of improving their protection under the water framework directive is highly needed. The number of studies characterizing the presence of psychoactive pharmaceuticals (PAs) in coastal waters and marine biota in Spain is scarce and limited. Our work represents the first attempt at characterizing these contaminants in the Rías 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 Rías Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citalopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citalopram (92.50 ng/L). Only 3 PAs (alprazolam, citalopram and venlafaxine) were present in the collected biota samples ( razor clam, clam and octopus) in concentrations up to 14 ng/g d.w. (citalopram), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazard quotients (HQ), calculated from the measured concentrations in water and available chronic aquatic toxicity data resulted in values higher than 1 (indicating elevated hazard and possible risk) for venlafaxine, citalopram, and sertraline. The venlafaxine concentration by glyphosate in the AMPF). Fish were fished in the Marne River (a tributary of the Seine River situated in the East part of France) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100 µL of bile was taken to 90 µL of MeOH, 6 µL of 13C-AMPF and 1 µL of 13C-AMPF added before extraction with nullIQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC-Cl) and concentrated on SPE OASIS HLB cartridge (60cc) before LC MS MS analysis. Preliminary tests were performed to establish and validate the protocol and to find the lowest limit of quantification and the best reproducibility. Results showed that glyphosate is detected in a fish sample coming from the most contaminated site by AMPF. This suggests that glyphosate is assimilated in fish and is still detectable after glyphosate has been degraded to AMPF in the water river. Glyphosate content in fish could be detected in a fish sample coming from the most contaminated site by AMPF. This work will help determine the risk posed to animals, and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

M0314 Pycoactive compounds in mussels: analytical method development and occurrence assessment
E. García, IDAEA-CSIC / Department for Environmental Chemistry; C. Pinto, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environment and Water Research IDAEA-CSIC / Department of Environmental Chemistry
It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is relevant to not only to identify the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to 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.

M0315 MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, Alfred Wegener Institute / Shelf Sea System Ecology, M. Simon, N. van Alst, K.B. Olesen, J. Vollertsen, Aalborg University / Civil Engineering Department
MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis - First development steps and future perspectives
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, Alfred Wegener Institute / Shelf Sea System Ecology, M. Simon, N. van Alst, K.B. Olesen, J. Vollertsen, Aalborg University / Civil Engineering Department
MPHunter software (MPHunter) for MP analysis which is recommended. However, analyte losses and matrix effects are attributed to ionization suppression effects by matrix compounds in mussels (e.g. pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation, we are creating a pathway for these pollutants to enter the environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from source (irrigation water), through soil and finally in plant tissue. Therefore this paper presents the analysis of relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to 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 Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)
M0312 Detection of glyphosate and AMPA in fish bile from the Marne River, France H. Blanchoud, EPHE UMR 7619; T. Ferreux, E. Alliot, EPHE / UMR Metis; A. Goutte, UMR METIS EPHE
Glyphosate is a widely used herbicide. In France, it is used during intercultural operations and to control weeds in non-agricultural areas. Glyphosate and AMPA (its main degradation product) can reach high concentrations in rivers, especially in the Seine basin including the Paris suburb (France). Although it is not bioaccumulative, the associated use of surfactants in pesticide formulations allows better assimilation in biological tissues. The aim of our study was first to develop a method to assess glyphosate and AMPA levels in biological tissues and then to determine the contamination of a freshwater fish, the European chub (Squalius cephalus) sampled in the Marne River (a tributary of the Seine River situated in the East part of Paris) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100 µL of bile was taken to 90 µL of MeOH, 6 µL of 13C-AMPF and 1 µL of 13C-AMPF added before extraction with nullIQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC-Cl) and concentrated on SPE OASIS HLB cartridge (60cc) before LC MS MS analysis. Preliminary tests were performed to establish and validate the protocol and to find the lowest limit of quantification and the best reproducibility. Results showed that glyphosate is detected in a fish sample coming from the most contaminated site by AMPF. This suggests that glyphosate is assimilated in fish and is still detectable after glyphosate has been degraded to AMPF in the water river. Glyphosate content in fish could be an indicator of environmental contamination. Further developments are needed to validate the protocol and complete the study with other organisms than bile.

M0313 From source to food: following emerging pollutants A. Garduno, The University of Nottingham; S. Pathasarathy, The University of Nottingham / Faculty of Engineering; J. Duran-Alvarez, Universidad Nacional Autonoma de Mexico / CCADET; C. Ortori, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dedworth, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering
The current global population growth is putting an increasing strain on the world’s natural resources. Water is no exception; the current situation brings a surge in the demand of water for drinking, sanitation, municipal, industrial and agricultural uses. At the same time the amount of wastewater generated is unprecedented. Given these facts, it makes sense to look for ways in which to adequately reuse wastewater thereby reducing freshwater demand. One such solution is the reuse of wastewater for agricultural irrigation. Benefits of this practice include the reduction in fertilizer use due to the high nutrient content of wastewater, the environmental benefits of reusing an unwanted resource and the economic advantage for farmers who have to pay little or nothing to use the resource. Furthermore it has been shown that wastewater pollutant load can be reduced as it goes through the environment through processes such as photolysis, biodegradation and adsorption. Using these natural processes to our advantage can reduce the costs of treating wastewater. However it has been shown that treated and untreated wastewater contain emerging pollutants (e.g. pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation, we are creating a pathway for these pollutants to enter the environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from source (irrigation water), through soil and finally in plant tissue. Therefore this paper presents the analysis of relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to 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 Pycoactive compounds in mussels: analytical method development and occurrence assessment
E. García, IDAEA-CSIC / Department for Environmental Chemistry; C. Pinto, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environment and Water Research IDAEA-CSIC / Department of Environmental Chemistry
It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is relevant to not only to identify the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to 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.

MO315 MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, Alfred Wegener Institute / Shelf Sea System Ecology, M. Simon, N. van Alst, K.B. Olesen, J. Vollertsen, Aalborg University / Civil Engineering Department
MPHunter software (MPHunter) for MP analysis which is recommended. However, analyte losses and matrix effects are attributed to ionization suppression effects by matrix compounds in mussels (e.g. pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation, we are creating a pathway for these pollutants to enter the environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from source (irrigation water), through soil and finally in plant tissue. Therefore this paper presents the analysis of relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to 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.
thousands of reference spectra in one run, is written to RAD Studio (Embarcadero Delphi IDE), an object-oriented programming environment which allows easy construction of user-friendly interfaces. As an example, an imaging dataset of 196 tiles from a 128x128 pixel FPA detector (totaling 3.2 million individual spectra) can be easily managed using the software’s features. The software calculates the Pearson’s correlation coefficient between the unknown spectra and a reference spectral library. The correlation results can be further refined to define particles. The reference spectra can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The correlation results can be further refined to define particles. Boundary potentials 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 Pimpke et al. (2017) and use it as the searching engine.

MO316 From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany
Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently being used by the JPI Ocean's project PIASS-EAN. Results show a high variability between rivers and due to the lower size fraction measured relatively high concentrations compared to the few studies conducted in surface waters of freshwater ecosystems so far. Further, our data may shed light on major pathways and sources of microplastics in freshwater ecosystems. (M. Loeder, I. Schrank and H. Imhof contributed equally to the work as first co-authors).

MO317 Analytical approach for the identification and quantification of microplastic particles in environment samples by particle analysis in combination with FTIR and Raman microscopy
D. Frecheg, Leibniz-Institut P. Polymerforschung Dresden / Analytics; A. Kaeppler, I. Muche, K. Eichhorn, Leibniz Institute of Polymer Research Dresden; S. Oberbeckmann, Leibniz Institute of Baltic Sea Research Warnemuende; M. Labrenz, Leibniz Institute of Baltic Research Warnemuende
The detection of microplastic particles in an environment sample in the wide range from 1 µm to 5 mm nearly quantitatively in a reasonable time is a challenging mission. This task should start with well derived and sources of microplastics in freshwater ecosystems. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently being used by the JPI Ocean's project PIASS-EAN. 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).

MO318 Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics
T. Storsøeth, L. Sorensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, Norwegian University of Science and Technology; O. Brakstad, A. Booth, SINTEF Ocean / Environmental Technology
Pyrolysis gas chromatography coupled to mass spectrometry (pyGC-MS) is a promising tool for identifying and quantifying trace amounts of microplastic (MP) in environmental samples. For pristine plastic samples, it has been demonstrated that polymer type and additive chemicals can be elucidated from the obtained pyrograms. However, determination of polymer type in environmental samples is currently verified by the JPI Oceans project BASEMAN. Results show a high level of competence and time-consuming. Pyrograms obtained from environmental samples are typically complicated by the presence of naturally occurring organic compounds and the presence of multiple polymer types. Furthermore, weathering processes such as oxidation and biodegradation may alter the chemical composition of the polymers, especially at the surface. In our study, an automated method for MP classification was developed. Pyrograms with associated mass spectra (m/z range 50-600) were obtained for a range of the most common polymer types, as well as for polyethylene and polystyrene microplastic samples subjected to different types of simulated environmental weathering (UV, additive leaching, abrasion, biodegradation) in the laboratory. An 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.

MO319 Marine Microplastic: Production and characterisation of realistic test materials for studying ecosystem impacts
Reports studying the possible effects of plastic litter on marine biota have almost exclusively utilised pristine plastic materials that are homogeneous in polymers, shape, size, shape and chemical composition. This is problematic for microplastics (marine litter <5mm), as collecting samples of such material from the marine environment in quantities sufficient for use in laboratory impacts studies is simply not feasible. Crucially, weathered plastics collected from the marine environment show considerable physical and chemical differences to pristine and post-production consumer plastics. In the current study, we describe the preparation and characterisation of a more environmentally realistic marine litter-derived microplastic reference material (≤5 mm) for use in fate and effects studies. Weathered marine plastic litter (351 items) was collected from the coast of the island of Texel (The Netherlands) and carefully identified and categorised (fibre-based, packaging, foam, plastic boxes and jerry cans, bottles, gloves and microfibres). A plastic metric size distribution (PSD) of the collected material was performed and the collected material, which contained 9 different polymer types. The macroplastic material was sub-sampled and subjected to a cryo-milling and sieving process to create the microplastic reference material. To confirm that the original macroplastic polymer distribution was mirrored in the generated microplastic sample, it was subjected to ATR-FTIR and the relative scattering calorimetry analysis. Particle size distribution (PSD) of the generated material showed that 68% (by mass) of the particles were in the range between 0.5 and 2.0 mm. Particle number increased with decreasing particle size fraction. Scanning electron microscopy revealed a wide range of particle sizes and shapes reflecting the properties of the different polymers. ICP-MS and ICP-OES analyses revealed the presence of a broad range of metals and other elements (e.g. Al, Cr, Fe, Mg, Pb, Zn) associated with the final sample. Many of these represent common inorganic plastic additives used as colourants, fillers and stabilisers. The additive organic chemical profile of the microplastic mixture was also determined by GC-MS analysis following extraction by ethyl acetate and ultrasound. A broad
range of plasticisers, stabilisers, antioxidants and flame retardants were identified.

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 considerations in mind, plastic bottle caps from several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). With this method, several sequential sessions of the machining processes were carried out in order to avoid changes in the physical properties of the plastics that would result from temperature increase due to due to prolonged friction. After the machining, the obtained HDPE particles were sieved using ethanol (96%) through two different mesh sizes until a final standard ranging from 0.1 to 0.850 mm size was achieved. This range was selected as it is relevant in biota ingestion risk as well as is appropriate for visual counting using microscopes. The standard HDPE microplastics used in all the extraction experiments were the same. It was thoroughly mixed previously to spiking in order to avoid differences in the identification of microplastic in sequential processes. HDPE microplastics were suspended in ethanol 96% and shook using a magnetic stirrer. An effective method for determining the particle distribution of microplastics is microscopy. In this work, two types of quantification using microscopy were used and compared: optical microscopy by visual sorting (Leica ICC50 HD, 40x lens, using a mesh for counting with sections of 3x3 mm prepared for this study) and, confocal microscopy (Zeta Instruments, model Zeta 300). The last one, included object detection algorithms (Mathematica 10) which not only allows quantification of plastic particles but also their classification into size groups.

MO321 First Report of Microplastics in Pacific-side Arctic Ocean

H. Lee, S. Kim, Incheon National University / Department of Marine Science; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science

The Arctic is one of the pristine areas that are sensitive to global environmental changes and have a relatively low environmental pollution. However, Arctic is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces/m² in surface and 2.34 pieces/m² in the Atlantic 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 with the Pacific Ocean, which is regarded as a global hot spot of plastic pollution. This area can be particularly important because it links Asian marginal seas with the Pacific Ocean, which is regarded as a global hot spot of plastic pollution.

MO322 Microplastics in Expanded Global Table Salt Product Samples and its implication

J. Kim, Incheon National University / Department of Marine Science; C. Kim, Graduate East Asia; S. Kim, Incheon National University / Department of Marine Science

Microplastic in sea salt products sold worldwide, 2) to elucidate any relationship of microplastic contamination between sea salt and seawater, and 3) to calculate the human exposure of microplastics resulting from the consumption of commercially available salt products. To do this, we purchased and analyzed the salt samples sold in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) in four continents. Each salt sample was selected in consideration of the salt production area, production method, and salt consumption degree in the target country. Total 37 salt samples were analyzed, including sea salt, lake salt, and rock salt. Each sample was duplicated (n = 2) and two blank samples were analyzed for each batch to check contamination during the analysis. Size, color, polymer, and shape of each microplastic were determined under microscope and spectroscopic analysis (FTIR). Thousands of microplastics were detected per 1 kg of the salt samples of this study, and the predominant forms were fragment and fiber, which were frequently detected in the order of PP > PE > PET. Significant correlation was observed between microplastic discharge rate via the rivers near the sea-salt production and microplastic contamination in the sea-salt. After further analysis, human exposure, characteristics of microplastic distribution, and application of sea-salt as an alternative monitoring medium will be announced.

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 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 soil supernatant (0.1—0.7% THOD), while the biodegradation did not start 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 significant leaching of elemental carbon, which increased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, ready biodegradability tests proved useful 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 applications and fate assessment. Non-invasive assessment of rubber on microbial activity was observed. PLGA as positive control in short-term tests is not encouraged due to its limited biodegradability. Future work should consider longer durations, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

**MO325**
Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (pplFER)
M. Wehrhahn, University of Vienna / Environmental Geosciences; T. Huffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences
Tire materials are common representatives of microplastics in the environment. They are introduced on the one hand as tire wear, an abrasion product, which reaches the environment via road runoff.1 On the other hand recycled and shredded tire rubber (TCR) is applied as filler material for example on turf fields.2 It was recently shown that tire materials are a substantial share (66 %) on waste that is introduced into the environment as microplastic particles.3 Tires generally consist of a matrix 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 on natural surfaces or as tire fillers. The exposure of rubber on the organic pollutants from water.4 The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (pplFERs) provide the opportunity to describe the contributions of individual molecular interactions to overall sorption processes taking into account both the physico-chemical properties of the sorbate as well as the sorbent.2 They have been successfully used to describe and predict sorption of organic compounds to various sorbents.5 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 Umwelt, 2015. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183. [3] C. Laurencot, Microplastics: Occurrence, Effects and Sources of Releases. 2015. [4] Y. R. Lin and H. Teng, Microporous Mesoporous Mater. 2002, 54, 167. [5] R. B. Stone, L. C. Coston, D. E. Hoss, F. Cross, Mar. Fish. Res. 2005, 43, 385. [6] L. Alamo-Noile, O. Perales-Perez, F. R. Roman, Desalin. Water Treat. 2012, 49, 296. [7] M. Abraham, A. Ibrahim, A. Zissimos, J Chromatogr A. 2004, 1037, 29. [8] S. Eindo, P. Grahwohl, H. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

**MO326**
Particle toxicity in the daggerblade grass shrimp (Palaeomunida pngo): microweared tire wear particulates
L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kampmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment
Acute and chronic toxicity of micronized tyre rubber to Hyalella azteca
E. Khan, L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment

An average car tire lasts for 40000 km and during its life time 30% of the tire tread will be washed into the aquatic environment. Inevitably it interacts with aquatic biota. In comparison to the wealth of research on the impacts of microplastics (MPs), there is little on microweared tire rubber (microwrubber, MR). Recent reports suggested that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHS, such as pyrene) and assorted volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aqueous environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceive to determine the toxicity of tire rubber particles to Hyalella azteca, an established freshwater model organism, over acute and chronic exposure, and to delineate particle effects from those of the leachate. The acute toxicity (48 h) of MR particles compared to the MR leachate show similar LC50s (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emergent contaminant of concern that is similar but distinct to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

**MO328**
Acute and chronic effects on Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine microweared car tire to previous data on worn car tire particles
L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kampmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment

Microwrubber (MR) from car tires constitutes a significant contribution to particulate contamination of the aquatic environment. MR is produced from driving, in the interface between tires and asphalt, and may eventually be lead out to the surface waters, possibly together with leached granulated rubber particles used in artificial turf. Although rubber particles have been detected in the aquatic environment the potential environmental impacts of this contamination are largely unknown. *Hyalella azteca* is an ecologically relevant freshwater amphipod that is also a well-established model organism in ecotoxicology. This study aims to investigate the acute and chronic effects of *Hyalella azteca* to pristine and weathered micronized and recycled tire rubber particles and leachate. The experiments indicate that, surprisingly, pristine tire both as particles and leachate is much more toxic than worn tire in acute tests. Although the main source of MR undoubtedly is worn tire, these results points towards further ecotoxicological testing of tire coatings used during manufacturing. Results from this ongoing study will be presented and discussed in relation to the microwrubber particle debate.

**MO329**
Applying nuclear techniques to study the biokinetics and toxicodynamics of
microplastics and co-contaminants in marine biota

C. Lantctot, International Atomic Energy Agency / Radioecology Lab; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; A.J. Catarino, Heriot-Watt University / Institute of Life and Earth Sciences; T. Cresswell, ANSTO Environmental Research / Institute for Environmental Research; B. Danis, Université Libre de Bruxelles; T. Mincer, Woods Hole Oceanographic Institution; F. Oheraen, P. Szwarszenki, International Atomic Energy Agency / Radioecology Lab; I. Tolosa, International Atomic Energy Agency; H.K. Karapanagioti, University of Patras / Chemistry Department; M. Metian, IAEA-EL / Radioecology Lab

Despite recent efforts in understanding the risks associated with marine plastic pollution, there remains a great deal of uncertainty regarding the potential impacts of microplastics and nanoplastics on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters over time. As such, these tools will allow us to address important knowledge gaps, including (1) the biokinetics, bioaccumulation and on their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminants in the marine environment under low exposure conditions. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO330
Aggregation kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media

z. venel, EPOC, University of Bordeaux / UMR EPOC 5805; J. Gigault, University of Rennes 1 / Laboratoire Geosciences Rennes; M. Baudrimont, Université de Bordeaux / UMR EPOC 5805

Release of plastics debris in the environment has been catching more and more attention, especially in aquatic environments. It has been observed recently, that plastics break down to produce nanoparticles by photochemical degradation in marine waters. However, there is a lack of suitable analytical methods, and the environmental fate and transport mechanisms of nanoparticles have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous medium, whereas (1) the biokinetics, bioaccumulation and on their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminants in the marine environment under low exposure conditions. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO331
Influence of biofilm composition on mercury bioaccumulation


In aquatic systems, the dominant lifestyle of microorganisms (bacteria and microalgae) is to live together interlocked in exopolymERIC substances (EPS), rather than in 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(II - 100 ppm, precisely measured) using microcosms. The first couple of biofilms was obtained using different times of colonisation e.g. 85 and 127 days whereas the second couple (bottom/surface biofilms) was obtained owing to different colonisation depth in the Versoix River (CH). Prior Hg exposure, biofilm biomass and microbial composition (chlorophyll content and DNA content of 16S rRNA gene) was determined as well as the EPS thiol and, thiolate content. The main water quality parameters (pH, concentrations of dissolved organic carbon, Hg, anion and cation) of the exposure media were also analysed. Accumulation of total Hg and non-extractable Hg (determined after a cysteine washing step) in biofilms were measured at different step times (t < 24 h) to model non-extractable Hg uptake kinetics using a non-linear pseudo first order one-compartment model. In each biofilm, non-extractable Hg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the younger biofilm was measured to 104 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.

MO332
Mercury Biogeoecologies - Fate, Effects and Policy (P)

MO333
Gaseous elemental mercury concentration and diurnal evansional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea

S. Covelli, Dipartimento di Matematica e Geoscienze / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; F. Floreani, E. Petranich, E. Pavoni, University of Trieste

Among pollutants widespread in the environment, mercury (Hg) is well recognised for its toxicity, mobility and bioaccumulation potential. In coastal areas the presence of this element generates conflicts with important resources of valuable product such as fisheries and aquaculture. The Marano and Grado Lagoon (Adriatic Sea) experienced a double Hg impact. The first is due to the mining activity conducted at Idrija (western Slovenia) for approximately 500 years, whereas the second is the result of discharge of a chlor-alkali plant effluents. Fish farming is a

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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 evasional fluxes, as gaseous elemental mercury (GEM), at the water-air interface. A C source active sampling cupola (Lunes-Ra 915a) has been used to measure GEM and to estimate the diurnal evasion flux at the water-air interface during three seasonal campaigns in four selected sites: two in a lagoon fish farm, one in the open lagoon environment highly impacted by Hg mining activities and the last one in an uncontaminated area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these measurements through the background level of the atmospheric mercury concentration determined together with the main chemo-physical parameters influencing Hg behaviour. This new insights will be of help for future estimates of Hg mass balance in one of the most contaminated areas in the Adriatic Sea. Keywords: atmospheric mercury; mercury fluxes; fish-farm; Grado Lagoon

MO335

Atmospheric mercury assessment: a contribution to global monitoring and effectiveness evaluation within the Minamata Convention

A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IA); F. Sprovieri, A. Macagno, E. Zapettii, P. Papa, G. Esposito, CNR - Institute of Atmospheric Pollution Research Italy; P. Nicola, Institute of Atmospheric Pollution Research (CNR-IA). In 2013, the Minamata Convention on Mercury was adopted by governments recognizing mercury as a pollutant of global concern for both human health and the environment. After reaching the 50th ratification the convention entered into force on 16 August 2017. According to the Article 22, the Conference of the Parties should establish of arrangements for providing itself with comparable monitoring data. The present study aimed at the evaluation of mercury concentrations in the environment as well as trends in levels of mercury and mercury compounds observed in biotic and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IA) and WHO implemented a UN Environment - Global Environmental Facility (GEP) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analyses in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS-Mercury)”. The main 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 rates and batch experiments were used to derive net reduction rates (and gross oxidation rates by difference) of mercury. The results showed that the net photo-oxidation rates for freshwater 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.

MO336

Assessment of Hg impacts on mountain river ecosystems

S. Le Faucheur, Institute F.-A. Forel, University of Geneva / Département F.-A. Forel des sciences de l'environnement et de la mer; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; C. Monbeig, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Boulellem, RioTinto Mountain rivers are high-flow systems which can experience, even daily, high water height variations due to the presence of dams along their courses. These conditions limit the use of water and sediment analyses to identify pollution point sources and to estimate the capacity for mercury analysis in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS-Mercury)”. The main 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 rates and batch experiments were used to derive net reduction rates (and gross oxidation rates by difference) of mercury. The results showed that the net photo-oxidation rates for freshwater 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.

MO337

Mercury Photo-reduction and Total PhotoReducible Mercury Dynamics in the Lakes of Kejimkujik National Park, Nova Scotia

N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science; T. Christensen, Acadia University / Engineering; S. Klapstein, Acadia University / Earth & Environmental Science; A. Loder, Acadia University; N.M. Hill, Fern Hill; N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science. The potential releases of mercury to the environment as well as trends in levels of mercury and mercury compounds in lakes are enhanced due to the presence of metal contaminated substrates or impacted biotic media and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IA) and WHO implemented a UN Environment - Global Environmental Facility (GEP) project entitled “ Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analyses in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “ Global Observation System for Mercury (GOS-Mercury)” project. The main 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 rates and batch experiments were used to derive net reduction rates (and gross oxidation rates by difference) of mercury. The results showed that the net photo-oxidation rates for freshwater were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

MO338

Influence of Avian BioVectors on Mercury Speciation in a Wetland

J. Kickbush, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; N.J. O'Driscoll, Acadia University / Engineering; S. Klapstein, Acadia University / Earth & Environmental Science; A. Loder, Acadia University; N.M. Hill, Fern Hill; N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science. The main 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 rates and batch experiments were used to derive net reduction rates (and gross oxidation rates by difference) of mercury. The results showed that the net photo-oxidation rates for freshwater were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

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The quotient (THQ) is < 1 for all fish species, meaning that the level of exposure is higher for omnivores fish species. On the other hand, demersal fish species demonstrated additional new data from fish obtained by recreati.

The concentrations of OCs and Hg between trophic levels have been frequently fish species consumed by the Spanish population had Hg concentrations lower than pelagic fish species. Finally, the target hazard quotient (THQ) is ≤ 1 for all fish species, meaning that the level of exposure is lower than the reference dose, and indicating that the daily exposure is not likely to cause any negative health effects during a lifetime in the human population.

MO341 Mercury concentrations in black bread from the Gippsland Lakes, Victoria, Australia.

L. M. Eldridge, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudey, EPA Victoria

The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aquatic ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley and the Lake at the end of the Lakes and smoke smoke from buildings and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black bread had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of fish and fish from sea bass, catfish, tilapia, red seabream and red mullet. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury over time with fish from the Lakes. These results are consistent with findings of other studies. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than as a result of increasing availability of mercury to fish.

MO342 Mercury health risks due to the substitution of fish meat with shark meat. P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiologia; L. Elizalde Ramirez, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia; H. Herrera Vill Zevallos, UAM Iztapalapa / Hidrobiologia

A previous three years study of mercury content in a variety of edible marine fish from Mexico City’s fish market (Central de Abasto) was evaluated with fish meat. The results of this study were analyzed using USEPA equations. Of the 52 “fish samples” analyzed 61.53% were identified as sharks of the following species: Chondrichthyes universal oligonucleotides in PCR were used to analyze the samples. 777 surveys were applied to obtain information regarding fish consumption habits, portion sizes and other characteristics of the population of the Mexico City metropolitan area. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than as a result of increasing availability of mercury to fish.

MO343 Mercury in trophic webs of estuaries in South-Eastern Brazil. T. H. Trevisani, Universidade de Sao Paulo / Oceanografia Quimica; M.C. Vedolin, Instituto Oceanográfico da Universidade de Sao Paulo / Oceanografia Quimica; R.C. Figueira, Instituto Oceanográfico da Universidade de Sao Paulo / Instituto Oceanográfico; C. Domit, Universidade Federal do Paraná / Centro de Estudos do Mar

The estuarine regions of Brazil are susceptible to anthropic pressures due to urban, industrial and agricultural activities. The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aquatic ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley and the Lake at the end of the Lakes and smoke smoke from buildings and planned burns.
industrial, agricultural and harbor activities, which impact the environment through the release of contaminants such as metals. Among these metals, mercury (Hg) is highlighted due to its toxicity and capacity of biomagnification. In the Paranaguá estuary, in the state of Paraná, and in the Cananéia estuary, state of São Paulo, these potentially polluting activities are present in different levels. However, these regions comprise the largest remnants of the Atlantic Rainforest ecosystem, fact that gives these areas the status of World Heritage site and biodiversity hot spot (UNESCO), therefore a environmental monitoring and conservation acts of the areas are necessary. Thus, this study investigated the concentrations of Hg and nitrogen isotope ratio (δ15N) in the trophic web composed by benthic invertebrates, benthivores fish (Stellifer rastrifer, Paralabrus brasiliensis and Isoptis parvipinnis) and marine mammals (Sotalia guianensis and Pontoporia blainvillii), to understand the trophic dynamics of Hg and compare these estuaries. Samples were taken in the summer of 2015; analyses of δ15N were carried out by Elemental Analysis - Isotope Ratio Mass Spectrometry (EA-IRMS), and mercury analyses were carried out by Optical Emission Spectrometry, Inductively Coupled Plasma with Vapor Generator Accessory (OES-ICP-VAQA), in the muscular tissue of the organisms. The results of δ15N varied from 6.4 to 13.8 % in Paranaguá and from 7.1 to 14.3 % in Cananéa, with a continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (0.02 to 5.8 mg kg−1) than in 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 δ15N, positive correlations were observed only in Paranaguá, but they were not significant, which indicates a trend of biomagnification of this element. Such a behavior is expected since trophic levels can account for Hg 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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Mercury (Hg) is a global pollutant that bioaccumulates in aquatic and terrestrial foodwebs as monomethylmercury (MMHg). Microbial activity is the main driver of MMHg production, with sulfate reducing bacteria being a major contributor. The roasting of arsenopyrite at Giant Mine in Yellowknife, NWT, has created strong environmental gradients of sulfate in lakes surrounding the area with distance from the mine. Whereas total Hg levels remain constant with increasing distance from the mine, MMHg is observed to have a relative increase in concentrations to the stack. We hypothesized that high sulfate in lakes near the mine may be responsible for elevated MMHg concentrations in those same areas. To test our hypothesis, we sampled water and sediments from lakes spanning a range of distances from the Giant Mine. We determine simultaneous methylation and demethylation rates using stable isotope analysis and characterized the microbial community structure over these gradients using 16S rRNA gene analysis. By analyzing methylmercury production and microbial community composition, we have identified sulphate as being the main driver of both final concentrations of methylmercury and microbial community structure.

MO345 Use of green tea to reduce mercury and methylmercury bioavailability in raw and cooked fish
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Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets rich in high trophic level marine species, resulting in health-related concerns through food chain. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available for absorption by human intestinal epithelium after the digestion process. On the other hand, several studies have highlighted the health benefits attributed to green tea consumption and their potential effects on reduction of bioavailability of contaminants. In this context, the aim of the present study was to assess the effect of green tea in Hg and MeHg bioavailability in raw and cooked marine fish species. Results demonstrated that total Hg/MeHg concentration in seafood does not reflect the bioaccessible fraction. Hg bioavailability in raw samples ranged between 60% (yellowfin tuna and black scabbardfish) and 37 % (European cong), while 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 wreefkish). The bioaccessibility of Hg and MeHg was also affected by the presence of green tea, decreasing the amount of these contaminants. In raw samples with tea, Hg bioaccessibility ranged between 47% (black scabbardfish) and 26% (swordfish); and between 18% (yellowfin tuna) and 7% (swordfish) after grilling. Green tea significantly decreased Hg/MeHg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, atlantic wreefkish and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioavailability, once they are relatively unstable. This work clearly reveals that green tea is able to reduce Hg and MeHg bioavailability, leading to lower the risks associated with seafood consumption. Nevertheless, a better understanding of green tea bioavailability is needed, and how its protective effect affects other contaminants. Such information is certainly useful to help consumers to wisely select their food, and to enable food safety authorities to integrate this information in risk assessment and communication activities.

MO346 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)
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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 are often loaded P/Hg towards the main lagoon channel during the tidal semi and Grado Lagoon (northern Adriatic Sea) is affected by Hg contamination, which mainly comes from historical regional mining activities (Itrija, western Slovenia) and, subordinately, from more recent industrial input related to a chlor-alkali plant. Several studies have also demonstrated the Hg contamination of saltmarsh sediments and halophyte vegetation that cover them. Moreover, saltmarshes not only trap contaminated sediments, but can act as secondary source of contamination. This work aims at determining the potential role of the tidal flat-saltmarsh (TF-S) system as a sink or secondary source of Hg in this coastal lagoon in relation to the chemical-physical processes leading their remobilisation. The main objective was to understand the role played by periodic flow of tide in a TF-S pilot site in terms of mercury accumulation and release of Hg. Tidal flows and water chemistry were measured at the mouth of a principal tidal creek which collect the waters of a dense channel network draining a 5.5-ha tidal flat-saltmarsh system. Tidal fluxes were estimated by combining discrete hourly tidal flow measurements with weighted measurements of particulate (PHg) and dissolved (DHg) mercury obtained by water samples. The highest values of DHg and PHg were recorded during ebb tide and the current. Fluxes estimated for both parameters decreased with distance from the TF-S system toward the tidal flats in ebb tide conditions. The results obtained for the PHg fluxes, in particular, are in agreement with those observed on a macro-scale at one of the lagoon tidal inlets considering an annual mass-balance of PHg performed via several water column sampling campaigns. A simple estimation provides a negative sedimentary budget for the TF-S system, which lower P/Hg towards the main lagoon channel during the tidal semi and Grado Lagoon.

MO347 Main sources of mercury releases in Armenia
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National mercury releases inventory was done with the use of UNEP’s "Toolkit for identification and quantification of mercury releases (January 2015)". The following main sources of mercury releases in the Republic of Armenia were identified: - Coal combustion and other coal use - Combustion of other types natural fuels (petrol, kerosene, diesel, liquid petroleum gas) - Natural gas - Zinc concentrate production - Copper concentrate production - Black copper converter production - Pig iron smelting - Recycling - Excess copper and other intentional use (luminescent/fluorescent lamps, thermometers, manometers and gauges, etc.) - Use and disposal of other products - Production of recycled metals - Waste incineration and open waste burning The key mercury releases here are releases to air (the atmosphere), to water (freshwater bodies, including via waste water systems), to land, to general waste, and to sectors specific products and impurities". Several studies highlighted a tendency for metal to be exported from the TF-S system due to the tidal flows in ebb tide conditions. The results obtained for the PHg fluxes, in particular, are in agreement with those observed on a macro-scale at one of the lagoon tidal inlets considering an annual mass-balance of PHg performed via several water column sampling campaigns. A simple estimation provides a negative sedimentary budget for the TF-S system, which lower P/Hg towards the main lagoon channel during the tidal semi and Grado Lagoon.

MO348 Spatial and temporal variation of mercury accumulation in Thyleryts
hispindula in the upper Felidia river basin, Colombia

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The upper basin of the Felidia River, located in the Farallones National Park of Cali, Colombia, is subject to different anthropogenic stressors, such as mercury, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in samples of the riparian fern Thelypteris hispinula, sediments and water in three streams: El Socorro, El Rato and El Pato, during the dry season, dry-rain transition and rainy season. Using non-parametric statistics (Kruskal-Wallis), significant differences were found in the HgT concentrations along the river basin. The superficial THg was 12.6 µg/L, accumulating mainly in El Socorro. The HgT in the root of the plants presented differences in distinct sampling times (p = 0.005), increasing in the rainy season. The Spearman’s bivariate correlations showed that the dynamics of HgT accumulation in the root, is directly related to the concentration of HgT in the stem (r = 0.918, p = 0.000) and leaves (r = 0.900, p = 0.000). It was also evidenced that the accumulation of HgT in the root, is influenced by the concentration of HgT in the sediments (r = 0.764, p = 0.001). These results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

MOS349
Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Delre River, northern France

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Due to several metallurgical plants along the river, the Delre River is a highly polluted site in the northern France. Previous studies showed that sediments are polluted with Cd, Pb, Zn and Hg (Vdovic et al., 2006). Moreover, intense fluvial traffic generates regular resuspension of sediments leading to diurnal variations of metals concentrations in the dissolved and particulate phases. This was previously highlighted by in situ volumetry approaches allowing to measure Pb, Zn and Cd with a high frequency data acquisition (Superville et al., 2014). However, these measurements could not be performed for Hg with such probes, while previous field deployment of DGT (Diffusive gradient in Thin films) passive sampler suggested such variations. Indeed, time weighed average concentrations were 20 times higher (20 ng/L) than those measured in grab samples (= 1 ng/L). Thus, a field campaign was conducted during 15 days to assess diurnal variations of metals and Hg concentrations (dissolved, particulate and labile phases) related to fluvial traffic in the Delre River, in the city of Aubry, downstream a metallurgical plant (Umicore). During the first week, DGT were exposed and grab samples were collected with a high sampling frequency (night and day). Then, a second set of DGT were exposed during the second week. The resuspension of particles and anodic sediment caused by fluvial traffic was highlighted by the simultaneous increase of metals in metal particles (Cd, Pb, Zn and Cu) (3 to 34 mg/L). The analysis of metals and Hg in SPM showed increases of Pb, Zn, Hg and Cd concentrations in the particulate phase. The analysis of particulate Hg after two different filtrations at two cut-off points (0.45 and 0.70 µm) showed that particulate Hg re-suspended by fluvial traffic was mostly in the coarse fraction of SPM. Furthermore, the increase of SPM concentrations was related with an increase in dissolved Hg concentrations. These results suggest that when the anodic sediment is remobilized by barge traffic, particles could be oxidized inducing a release of Hg. Moreover, since changes in redox conditions could also induce modifications in Hg speciation, further analysis will be carried out to measure Hg³⁺ and CH₂Hg⁺. Finally, the interpretation of DGT measurements will show how well DGT integrate variations of inorganic contaminants concentrations during the exposure period.

MOS350
The effect of activated carbon amendment on mercury methylation in contaminated sediment

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The conversion of elemental and inorganic mercury (Hg) to monomethyl mercury (MeHg) has been widely studied due to MeHg being more bioavailable, bioaccumulative and toxic to humans than the inorganic and elemental species. The net production of MeHg is controlled by both mercury methylation and demethylation, and a range of factors affects both processes. Sediments are known sites for MeHg production, as they are sinks for Hg, they have suitable red-ox conditions, a presence of methylating bacteria and more. Activated carbon has been much explored as a remediation tool for contaminated sediments. The carbon can immobilize contaminants, inhibiting the release to the water column and uptake in biota. Studies have shown that activated carbon also sorb Hg-species, but the mechanisms of how a carbon amendment affects the processes of Hg-methylation in contaminated sediments is not well understood. A lab trial was set up with sediment from two sites in Norway: The Gunnekleiv fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations, being low-lying during high concentrations. Bulk sediment concentrations were 22.5 and 9.5 mg/kg total mercury (THg) for GF and BH respectively. Two treatments were investigated: Activated anthracite char (AC) and activated biochar (BC). Treatments were set up for time series of 0, 1, 3 and 6 months in sealed glass jars, stored dark at room temperature. At each time series sediment and pore water was sampled. Additionally, a second set of samples was exposed during the second week. The resuspension of particles and an anoxic sediment is achieved 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.

MOS351
Bayesian Human Health Risk Assessment of Almadén Mining Area

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Almaden, with the largest and richest known mercury deposits is located in the southwest of Ciudad Real (Spain) with a population of 5,657 inhabitants (2016). This area can be considered one of the most affected by mercury in the world, both by its natural origin and by anthropogenic pollution since there are indications that the cinnabar mines of this region have been mined without interruption since before the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almadén endangers human health. Human exposure was estimated by measuring Hg concentrations in soil for different areas in Colombia. In the year 2017, as Minamata Convention includes a ban on new mercury mines, and the phase-out of existing ones, this methodology could be used to establish if mercury contamination after mercury mines closure around the world endanger human health.

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MOS352
Concentrations of mercury in two offshore skates: sandy ray and shagreen ray

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Concentrations of mercury in two heavily contaminated locations, being low-lying during high concentrations. Bulk sediment. Concentrations of mercury in muscle of Leucoraja circularis (n = 18, length = 10.5 cm total length, 157–490 m water depth) and L. illiciosa (n = 24; 28.5–100 cm total length, 130–426 m water depth) were 0.02–1.8 and 0.04–0.61 mg kg⁻¹, respectively. Concentrations of Hg increased with total length. Only the largest specimen had a concentration of Hg in muscle >1.0 mg kg⁻¹. Data were limited for specimens >90 cm long, and further studies on contaminants in larger-bodied skates could usefully be undertaken.

MOS353
EMPIR project "MereOx - Metrology for oxidised mercury"

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Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Emissions Directive (IED) 2010/75/EU, the Air Quality Directive 2004/107/EC, the Waste Incineration Directive 2000/76/EC and the Minamata Convention adopted in 2013; which is a global treaty to protect human health and the environment from the adverse effects of Hg. In addition to its elemental form Hg
also exists in oxidised forms (i.e. Hg(II)) that are reactive and can be transformed into organic Hg species such as methylmercury (MeHg), the most toxic Hg species and the one most prone to bioaccumulation in aquatic systems. Half of atmospheric Hg emissions are of natural origin whilst the rest are of anthropogenic sources, primarily from fossil fuel burning and other high temperature industrial processes (cement clinker production, waste incineration, ore roasting, steel production). Knowledge of Hg speciation both in air and in stack gas emissions is critical when validating models for predicting Hg emissions, transport, deposition and fate at the European level as well as on a global scale. Therefore, atmospheric Hg isotopic signatures that can be used to trace the origin and fate of atmospheric Hg also need metrological support and development. The overall goal of the EMPIR – MercOx project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and control of mercury and its different species in gas emission sources and in the atmosphere. The project will achieve significant improvements in the measurement comparability and uncertainty of Hg measurement results. Currently, traceable calibration methods only exist for elemental mercury, but such measurements are also needed for oxidised Hg species in order to meet the requirements of EU regulation and the implementation of the Minamata Convention. The development of reliable and direct Hg(II) measurement techniques and reliable and traceable Hg(II) standards is needed to solve the traceability problem that currently exists in the measurement of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg(II) concentration in generated elemental and oxidised Hg reference 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.

M0354

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, kidney, intestine and muscle. The changes of different biological and physicochemical parameters can be estimated from published tilapia-related studies. The partition coefficients were estimated for each tissue or organ based on the experimental data by dividing Hg burden in tissues of that in blood at specific days after Hg(II) exposure. A series of experimental data were analyzed to reconstruct the dose-response profiles describing the relationships between tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used to describe the dose-response relationships. Here we showed that tissue/organ burdens would reach equilibrium before 180 days of exposure in all six rivers. Among all exposed tissues/organs, kidney had the highest internal exposure doses of Hg(II) ranging from 0.0208 – 0.1348 μg g\textsuperscript{-1} ww. In contrast, muscle had the lowest internal exposure doses of 0.0001 – 0.0003 μg g\textsuperscript{-1} ww(Hg(II)), indicating that Hg(II) in muscle will be well below the reported at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) was in gill of 0.0115 (95% CI: 0.0007 – 0.1907). The effective Hg(II) burden in tissue/organ at 50% mortality for liver, gill, and muscle were 10.410 ± 1.047, 6.307 ± 0.756, and 2.839 ± 0.575 μg g\textsuperscript{-1} ww, respectively. A further 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 more practical 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.

M0355

Mercury in fish, fish intake and fish consumption recommendation

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Fish consumption is recognized as an important component in the human diet, due to the high-quality protein content and n-3 fatty acids, however, it is also considered the main route of mercury (Hg) exposure from ingestion of contaminated seafood. Hg is released into the environment by natural and anthropogenic sources and is 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\textsuperscript{-1} bw \textsuperscript{-1} week\textsuperscript{-1}, whereas USEPA pointed a lower value of MeHg intake, setting the RfD at 0.1μg kg\textsuperscript{-1} bw \textsuperscript{-1} day\textsuperscript{-1} (equivalent to 0.7μg kg\textsuperscript{-1} bw \textsuperscript{-1} week\textsuperscript{-1}).

Recently (2012), PTWI suggested by JECFA for MeHg was revised by the European Food Safety Authority (EFSA) to 1.3 μg MeHg kg\textsuperscript{-1} bw \textsuperscript{-1} week\textsuperscript{-1}. This study, presents a brief review of the Hg concentration present in the muscle of commercially valuable fish species caught near the mid-Atlantic ridge (Azores Archipelago) where fish consumption is relatively high (…..) and compares these Hg concentrations with the maximum levels of Hg for certain contaminants in foods established by the European community, evaluates the human exposure to Hg, using the Hg concentration quantified in scalp hair and related with fish consumption using a food frequency questionnaire and establishes isocurves pointing the maximum number of fishmeal per week without exceeding the MeHg RfD (USEPA RfD), by combining number of meals (per week), amount of fish ingested (by meal) and levels of MeHg in fish. The Hg concentration found in the hair indicates that individuals with higher fish consumption per week generally have higher concentrations of Hg and in order to meet the USA dietary guidelines, which recommend a consumption of 227g; only fish with MeHg concentrations below 0.34 μg g\textsuperscript{-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\textsuperscript{-1} (for most of the fish species) or the concentration of 1.0 μg g\textsuperscript{-1} (“exception list”) is allowed for fish consumption.

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

M0356

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. The results for 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.

M0357

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 for harmful effects. Recent developments in mechanistic effect modelling provide the possibility to extrapolate results from standard studies to different species or use 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. Most 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 the predicted two conditions, fish do not change their initial parameter values used for the standard DEB model. This indicates that the model can be used in ERA for the four fish species analyzed here to predict effects of compounds that act on feeding inhibition without any adaptation. The differences in the organism-level response to low food conditions / feeding impairment between the four species can be explained by differences in their model parameters. The standard DEB model can be extended to account for effects of low food even further. We suggest the model adaptations needed in such case, and discuss how the model can be used in risk assessments for weight-of-evidence in tier-1 and tier-2 as suggested by EFSA.

M0358
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 Lemma sp. and other species and also mesocosm studies including different macrophyte species are available. Since it is not possible to explore the effect variability in the frame of a single experiment 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 Lemma 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 water temperature and light conditions as well as density dependence. 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 chronic exposure scenarios were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure patterns on the growth of Lemma. 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 show that short-term pulses were not a limiting factor for survival at the exposure concentration here considered will have, with a high probability, not lead to unacceptable effects on macrophytes. This project demonstrates the usefulness of modelling as additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

M0359
TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish
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Species sensitivity distribution (SSD) analysis can be used in higher tier risk assessment to describe the variation in sensitivity of a group of species to a certain contaminant. Contrary to the standard procedure in which toxicity endpoints are derived by considering only effects at the end of a constant exposure experiment, this method has the potential to additionally make use of time-variable exposure and organism response over time. Here, changes in SSD (and the corresponding HC5, HC10, HC90 etc.) within scenarios with different substance 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's that were subsequently used as input provided the SSD calculations. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HC5s 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 HC5 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 HC5s. These findings infer that SSD strongly depends on the exposure scenario, and reveal the irrelevance 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.

M0360
RIFCON EasyGUTS: Ready-to-use and freely available software for TK/TD modelling of survival
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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 novel EasyGUTS package in detail and gives an insight on the sensitivity of the model to initial parameter values and the influence of different distributions used for the individual tolerance model.

M0361
A new test design to inform TKTD models on species sensitivity
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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 population assessment for plant protection products for aquatic organisms in edge-of-field surface waters uses the GUTS model 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 basis. Particularly for TK/TD models for aquatic invertebrates exposed over long time periods (week to months), which makes these experiments costly, time consuming and which limits the number of non-standard species to be investigated, as these species - in the absence of appropriate husbandry and test methods and due to complex biology - are particularly challenging to test reproducibly in chronic set-up’s. Here we will present an approach using the GUTS model (TK/TD model for survival) informed by specifically designed peak-exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatment levels of an insecticide, in combination with several observation time points for 5 aquatic insect species and 3 crustaceans. The outcome of these experiments will inform the GUTS model and will allow for a suitable calibration, after which it will then be possible to construct pattern-specific species sensitivity distributions to be used in acute effect assessments for time variable exposure patterns like FOCUS scenarios. Moreover, the approach may also provide further insights whether peak exposure experiments in an acute study design can be used to investigate sensitivity differences also on a longer-term time scale, by concurrently preventing the pitfalls and potential artefacts arising from not yet developed, adequate long-term husbandry- and test protocols for non-standard species.

M0362
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 H50, from species sensitivity distributions (SSDs). Therefore, data from acute toxicity tests are ranked using cumulative distribution. Apparent toxicity occurs, such as the LC50s, have been reported to depend on ambient temperature and participate in aquatic invertebrates and fish species and if comparing species sensitivity the results might be biased by the experimental conditions. It has been demonstrated that changes in physiological rates with different temperature regimes can be described by the Arrhenius function. Part of this study is to examine if the Arrhenius function is also able to predict TK/TD 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 Chlorpyrifos.

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 management consists of assessing single-species data on metal toxicity and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effects on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (*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 context, the adapted population model for *A. transmontanus* contains some inherent assumptions which need further fine-tuning. By investigating the mortality profile (i.e. mortality over time) in depth, the mortality sub-model could be improved further, increasing predictability of the model. Additionally, investigating population density-dependent effects on the survival of age-0 individuals could increase accuracy as well. This study shows that population models could be used as more ecologically-relevant tools in metal risk assessment.

MO366 Comparison of toxic effects on *Daphnia magna* between a metal, a pesticide, and a PAH, in a toxicokinetic-toxicodynamic framework
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaene, Ghent University / GhEnToxLab; P. Van Sprang, ARCHE; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Modelling techniques are becoming more prominent in the risk assessment of chemicals. Mechanistic models, such as individual-based models (IBM) with a foundation in the dynamic energy budget (DEB) theory, are increasingly promoted as alternative tools in ecological risk assessment. In this context, lethal toxicokinetic-toxicodynamic (TKTD) models are often used to describe (sub-)lethal effects on the life cycle of the modelled organism. Inherently, the mode of action will differ between compounds (i.e. compounds will affect different physiological processes). The current study compares TKTD parameters of three different compounds, and examines their influence on the dynamic energy budget (DEB) of the *Daphnia magna* population model for copper, anthracene, and a poly-aromatic hydrocarbon (pyrene). The TKTD model was calibrated for each compound based on life cycle experiments with *Daphnia magna* effects of the three compounds. During life cycle experiments (21-days), growth, reproduction and survival were monitored at different concentrations for each of the compounds. Using all three endpoints, the modes of actions and the TKTD parameters were estimated for copper, endosulfan, and pyrene. Combining the TKTD model with DEB-IBM, effects on physiological processes can be translated to the organism level.

MO367 Defining predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model
A. Greedel, A. Barausse, L. Grechi, L. Palmeri, University of Padua / Department of Industrial Engineering
Health and environmental risks posed by perfluoroalkyl acids (PFAAs) have been a focus of research and regulation throughout the world, as these substances are ubiquitous and persistent in the environment. The Po river, the most contaminated world area, is a case study of this process. Perfluorooalkyl substances are known to bioaccumulate in high concentrations in human tissues. The establishment of safe ecological thresholds such as Predicted No-Effect Concentration (PNEC), based on procedures incorporated in the REACH regulation and Water Framework Directive and in related guidelines. These policies offer three methodologies for deriving PNEC: use of assessment factors (AF), species...
sensitivity distribution (SSD), and results from model ecosystems and field studies whose task is to extrapolate single-species data to ecosystem-level responses. Although AF and SSD methods are described by strict guidelines making them commonly applied, they do not consider the effects of ecological interactions between species on the assessed risk level, which is potentially not-negligible since population dynamics in polluted environment are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing the ecological risk of chemicals considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to test a pathway strategy 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; G. Underhill, Western Washington University; A. Beretka, Western Washington University / Environment Institute; E. Long, Western Washington University / Environment Institute; L. Wallis, Western Washington University / Institute of Environmental Toxicology; C. Cakir Kieffer, Western Washington University / Environment Institute; G. Young, A devastating change in the world of pets and farm animals: an innovative strategy with first in vivo proof. An additional drawback is the high diversity of chemicals and metabolites that can be present in a single sample, which complicates the identification of the active molecules. A knowledge of the mechanism of action (MechoA) of substances is a crucial first step in risk assessment approaches, especially when using in silico models to predict (eco)toxicity. Mechanisms of Action are similar to Molecular initiating events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechoAs. Consequently, a new method to predict MechoAs with high accuracy and with simple rules was developed, using a set of 6 general MechoAs including 23 detailed MechoAs. The MechoAs are given mainly for mammals and fish but information on other species was also included. We used a training set of 301 molecules, and validation set of 491 molecules. Our method was built as a linear decision tree composed of 62 decision rules. This method achieved 92.8% correct classifications for the training set and 92.3% for the validation set. 6% of the predicted classifications were slightly different from the literature MechoAs for the training set (3.4% for the validation set) and 1% of the training set was misclassified (4.3% in the validation set). Finally, only 1% was out of the applicability domain for the training set while no molecules from the validation set were unclassified. This model is both simpler and performs better than the previous model that was developed (Bauer et al 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enoch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be constantly enhanced with the addition of new rules and minor corrections as needed.

MO369 Modeling and monitoring the effects on the central nervous system of a chronic exposure to low dose of pollutants: an innovative strategy with first results T. Claudiaire, URAPFA-INRA / URAPFA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine / URAPFA INRA; M. DELANNAY, URAPFA-INRA / URAPFA INRA; A. E Huit, T. Osier, C. Malaplate, Université de Lorraine / URAPFA INRA; N. Tran, Université de Lorraine / URAPFA INRA; N. Tran, Université de Lorraine / URAPFA INRA; Y. Yen-Potten, C. Feidi, Université de Lorraine / URAPFA INRA; F. Bauer, KREATIS; P.C. Thomas, CEHTA SAS / Toxicology and Risk Assessment

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. Brændt, 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, algaecides and fungicides are added to the materials. Nevertheless, active ingredients leach from the treated facades, if contacted with wind-driven rain. Especially in suburban residential areas a large fraction drains directly to soil, e.g., flowerbeds, gravel strips or the lawns surrounding the houses. Consequently, the soil in areas with biocide-treated buildings is exposed to rain runoff water highly polluted with biocides. In the present study, the degradation rates of eleven biocides in soil were determined in laboratory microcosms. Degradation half-lives ranged from rapidly degrading ($T_{1/2} < 10$ d) to compounds with higher persistence ($T_{1/2} > 120$ d). For two selected biocides (terbutryn and octylisothiazolinone) a set of transformation products were quantified in the microcosms as well. This showed that the mass balance for terbutryn could be closed with nine analysed transformation products for the entire incubation period (120 d), revealing that relative persistent metabolites are formed. In contrary, the mass balance including transformation products for most of the other biocides was not closed, as transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio fischeri than the
MO372
Biocides in façade coatings: Influence of pigments on the phototransformation of biocides
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Biocides are common additives in façade coatings to protect the materials against biological deterioration. In addition to their fungicidal and insecticidal effects, they are often used to combat the spread of odours. The deposition of biocides on façades, however, may lead to a significant amount of degradation products being released into the environment. In order to assess the environmental risk posed by biocides in façade coatings, a study was conducted to measure the phototransformation of biocides in different types of façade coatings. The study was conducted using a combination of field studies and laboratory experiments. The results showed that the phototransformation of biocides in façade coatings is influenced by the type of pigment used. Additionally, the study highlighted the importance of considering the phototransformation of biocides when assessing their environmental risk.

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. Amth, S. Hardt, DR. KNOELL CONSULT GmbH
Rodenticides as biocidal products are regulated according to Regulation (EU) No 528/2012 (BPR). In both frames - evaluation of active substances as well as authorisation of biocidal products – a risk assessment needs to be carried out for biocidal products entering the environment. The latter is based on Altogether, 6 emission scenarios (ESD) 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 watercourses has been established, whereas the waste dumping into the main stream scenario from the original ESD for PT14 has undergone minor adaptations. When exposure of the terrestrial compartment is considered the transport of biocidal active substances to aquifers and groundwater has to be allowed for. In case of rodenticide application an appropriate approach for estimation of local concentrations in groundwater is newly included in the revised ESD for PT14. The risk assessment for primary and secondary poisoning of non-target organisms was revised in order to provide a more generic approach, i.e. identifying focal non-target organisms. Furthermore, guidance already provided for plant protection products has been considered. The presentation aims at providing an overview of current developments in environmental emission and exposure estimation of rodenticides as biocidal products.

MO374
New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage
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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 the Evaluation 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 facilitate 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 group of pigments. Using a prioritisation concept for biocides a worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.

MO375
Monitoring of Biocides in German Sewage Treatment Plant Effluents - First Results
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Due to a widespread use, biocidal active substances and their transformation products are expected to be found in the environment. Projections show that there will be an increase of biocide entries in the environment, mainly in urban areas due to an increased use of e.g. disinfectants and especially masonry preservatives. Biocidal substances enter the environment through numerous entry pathways. One main entry path is through sewage treatment plants (STP). Therefore, the German Environment Agency (UBA) initiated a project where the effluent of 29 public STPs from all over Germany will be investigated over a period of one year, starting in November 2017. Additionally, selected samples from influents as well as from sewage sludge emissions will be in the focus. Using a 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
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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 that demonstrates safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the 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 parent compounds. The approach is a strategy routinely applied in environmental risk assessments, however, most often do not coincide with the factors that determine the meta SPC structure. Instead, other grouping strategies are more fit for purpose. The risk envelope approach is a strategy routinely applied in
plant protection product dossiers. It entails that - for each area of risk assessment - the key parameters driving that risk assessment are identified. Subsequently, the uses are grouped and ranked according to these key parameters. As such, one or more worst case or ‘critical’ uses can be identified. If it can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental risk assessment for a BPP 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.

MO377
Are biocide emissions into the environment already at alarming levels? Recommendations of the German Environment Agency (UBA) for an approach to study the impact of biocides on the environment
K. Pohl, German Environment Agency (UBA) / Section Biocides; C. Meier, German Environment Agency (UBA) / Biocides; M. Ahting, I. Noeh, German Environment Agency UBA / Biocides
More than 40,000 biocidal products were registered on the German market, including disinfectants, preservatives, pest control and antifouling products. All biocides act as intended on living organisms and the use of these biocides can result in altering impacts on the behavior of bio-hazard substances and thereby individual findings of only a few substances, or in particular water surface. However, an exemplary picture of the actual pollution of the environment with biocides – one that goes beyond such individual findings – is not available, since there is no biocide-oriented, systematic environmental monitoring in Germany to date. To tackle this problem, the German Environment Agency (UBA) has developed recommendations for an environmental monitoring programme for the biocides based on the results of a research project and two international workshops. These recommendations contain a prioritization concept for biocidal substances as well as a proposal for a systematic monitoring programme. At first, we established a database containing information relevant for the environmental risk assessment according to the Guidance on Biocidal Products Regulation (BPR) for all biocidal substances currently available on the market. A multi-criteria prioritization approach was applied to prioritize substances based on their 1) emission relevance, 2) environmental effect data, and 3) environmental persistence. Thereby creating lists of high-prioritized biocidal substances and relevant transformation products that are of particular concern for the environment. Instead of monitoring individual entry pathways, our approach aims at monitoring the entry pathway of relevant biocidal substances. Therefore, we developed different entry path scenarios (work packages), which represent the different use pattern and entry paths of particular biocidal products. Based on the obtained prioritised substances and the different entry paths a systematic monitoring strategy is suggested for a German wide inventory of biocides in the environment. This will provide on one hand better knowledge on the environmental impact of specific biocides and their impact on the environment. On the other hand, these monitoring data could help to support a more comprehensive risk assessment of biocides by providing a basis for risk mitigation measures or for the exclusion and substitution of environmentally hazardous active substances.

MO378
A case study on exposure assessment of biocides in PPCP using exposure assessment models
M. Kim, H. Kwon, KIST Europe / Environmental Safety Group; Y. Seol, University of Science and Technology; J. Kim, KIST Europe; E. Choe, Korea Institute of Industrial Technology; S. Kim, KIST Europe / Environmental Safety Group
Several accidents caused by the use of chemical products created a need for risk assessment of chemicals used in Pharmaceuticals and Personal Care Product (PPCP) in Korea. CMIT/MIT which is a mixture of 5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl-2H-isothiazol-3-one is used in PPCPs as preservative and antifouling agent. Despite of its high toxicity, this substance has been used as humidifier disinfectant from the 1990s without considering its exposure route and caused a lot of victims to suffer from its adverse effect. In this study, the aim is assessing the exposures of CMIT/MIT in PPCP and comparing different levels of consumer exposure tools. ECETOC TRA.3 was used as tier 1 model which is basic and simple but conservative calculations and ConsExpo was used as tier 2 as it can be more precisely refined and covers more specific estimations. The gap of estimated exposure values which have been derived from these two different model was identified. It is concluded that difference between exposure calculation equations and input values affects the results. And each level of model has its strengths and weaknesses. Several improvements are needed to apply European models assessing in reflection of Korean exposure scenarios.

MO379
Hazard evaluation of biocides and its metabolites for the aquatic compartment
D. Hernandez-Moreno, INIA / Environment; M. Blazquez, INKOA SISTEMAS / RTD; O. Andreu-Sánchez, Xenobiotics; A. Bermejo-Nogales, M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment
The BIOCOMBASE 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, has been used to generate four compounds (PPCP) in Korea. CMIT/MIT which is a mixture of 5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl-2H-isothiazol-3-one is used in PPCPs as preservative and antifouling agent. Despite of its high toxicity, this substance has been used as humidifier disinfectant from the 1990s without considering its exposure route and caused a lot of victims to suffer from its adverse effect. In this study, the aim is assessing the exposures of CMIT/MIT in PPCP and comparing different levels of consumer exposure tools. ECETOC TRA.3 was used as tier 1 model which is basic and simple but conservative calculations and ConsExpo was used as tier 2 as it can be more precisely refined and covers more specific estimations. The gap of estimated exposure values which have been derived from these two different model was identified. It is concluded that difference between exposure calculation equations and input values affects the results. And each level of model has its strengths and weaknesses. Several improvements are needed to apply European models assessing in reflection of Korean exposure scenarios.

MO380
Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015
M. Schøyen, Norwegian Environment Agency UBA / Biocides; C. Meier, German Environment Agency UBA / Biocides
Several accidents caused by the use of chemical products created a need for risk assessment of chemicals used in Pharmaceuticals and Personal Care Product (PPCP) in Korea. CMIT/MIT which is a mixture of 5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl-2H-isothiazol-3-one is used in PPCPs as preservative and antifouling agent. Despite of its high toxicity, this substance has been used as humidifier disinfectant from the 1990s without considering its exposure route and caused a lot of victims to suffer from its adverse effect. In contrast, CMIT/MIT was detected in toothpaste and the products containing the mixture were recalled in 2016 even though its toxicity via oral route is not known. The aim of this study is assessing the exposures of CMIT/MIT in PPCP and comparing different levels of consumer exposure tools. ECETOC TRA.3 was used as tier 1 model which is basic and simple but conservative calculations and ConsExpo was used as tier 2 as it can be more precisely refined and covers more specific estimations. The gap of estimated exposure values which have been derived from these two different model was identified. It is concluded that difference between exposure calculation equations and input values affects the results. And each level of model has its strengths and weaknesses. Several improvements are needed to apply European models assessing in reflection of Korean exposure scenarios.
in reducing imposex in _N. lapillus_ and have re-established some of the populations. Low levels or significant downward long-term and short-term trends for TBT in common periwinkle (_Littorina littorea_) and blue mussel (_Mytilus spp_) substantiate this.

**MO381 Risk assessment issues for algacides under BPR**
C. Durou, M. 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 parameters, 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 any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocidal activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk assessment real world issues e.g. assessing the leading behaviour. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algacide applied in swimming pools. The poster will focus on following key 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 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

Typically chemical risk assessment framework adopted in Europe for veterinary medicines or as pesticides. Administration of a pesticide containing an active substance is often intended to achieve an effect in the environment that is different from that intended in the intended use. The environmental risk assessments consist of information on exposure assessments will be evaluated. 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) inmission standard” which is the amount of nitrogen per Hectare spread on or into the field. Both ERAs propose a default value of 170 kgN Ha⁻¹ which is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZs are measured, and in total 23 substances actually detected in several zones higher thresholds of N inmission 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 administration procedures of VMPs and FAs, are sufficiently accurate to protect soil and groundwater from contaminants. Alternatives are using long-term ecotoxicity, an effective in-user 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 any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocidal activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk assessment real world issues e.g. assessing the leading behaviour. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algacide applied in swimming pools. The poster will focus on following key 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 including new studies and risk management measures.

**MO383 Are currently-adopted European guidelines on veterinary medicine product and feed additive risk assessment sufficiently cautious?**
A. Di Giardia, 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. 

**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. With a quick scan, we investigated the potential contamination of water to environmental organisms, three anthelmintics and one pathogenic bacteria. 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 that becomes available for other purposes, including prioritization. We also see that current monitoring schemes is not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. We further noted that the origin of a detected compound cannot always be properly traced back to the original veterinary use only. We noted that veterinary 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 from chemical, fate and hazards assessments of 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 original veterinary use only. We noted that veterinary 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.

**MO386**

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SETAC Europe 28th Annual Meeting Abstract Book
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387 Recommendation on Steamer Cracker allocation for the sake of comparability of petrochemical products datasets used in LCA studies
G. Castelan, PlasticsEurope / LCA; P. Salinger, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different market products, including ethylene, propylene, toluene, xylene, and more. They are all basic building blocks of many chemicals and polymers used in nearly all products and sectors. Thus LCA data of steam cracker products directly influence a huge amount of further downstream products. It is therefore important that LCA data for steam cracker products are modelled consistently, enabling a reduction of uncertainty and a better interpretation by LCA experts, particularly in perspective of comparability in LCA studies of these downstream products. Based on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensus 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main “products” fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same product names will have slightly different LCI results depending on different amounts of products derived from the steam cracker. Such a collaborative work towards streamlining should be engaged for all chemicals, and should be applied within all database both to background and foreground parts, like for example in the European EF compliant database.

MO388 Actual versus default uncertainty in ecoinvent database
F. Bellizario, L.A. Oliveira, Institute for Technological Research IPT; M.R. Saade, V. Gomes, University of Campinas UNICAMP; M.G. Silva, Federal University of Espirito Santo; G. Moraga, Universidade Federal do Rio Grande / NORIE; A.B. Passuello, Federal University of Rio Grande do Sul; V.M. John, University of São Paulo USP; O.S. Yoshida, Institute for Technological Research IPT

Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecoinvent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecoinvent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance; 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations. CML 1-A method and ecoinvent v.3.2 “Rest of the World” datasets for upstream processes. Results show that the sample weighted average and the geometric mean differed significantly. Therefore, using the sample weighted average as a proxy for the lognormal geometric mean may overestimate impacts, in our case by approximately 10%, considering only the effects of the concrete block production process flows. Since existing datasets may have followed this approach, this may have an effect on the geometric mean uncertainty values which are significantly lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecoinvent might contain inconsistencies and leads to 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, Unilever University / Copernicus Institute of Sustainable Development; M. Beuse, ETH Zurich / Energy Politics Group, Department of Humanities, Social and Political Sciences

The penetration of renewable electricity has greatly increased in the past decade. Battery is a key storage technology to balance supply and demand and to facilitate the world’s transition towards a sustainable energy system. However, having a comprehensive overview of batteries’ life cycle environmental performance still remains a challenge, because battery technologies are of various kinds and the applications of batteries vary. These applications are different from each other in terms of required power and energy size as well as number of cycles. Due to these different requirements by applications, the same battery technology needs to be operated differently and sized accordingly. Numerous studies in the past investigated the life cycle environmental performance of batteries; however, most of them are focused on the application of batteries in electric vehicles, considering a limited number of lithium-ion battery technologies, while the stationary applications of batteries were less explored in limited studies. In addition, these studies are mostly conducted based on diversified sources of life cycle inventory data, without harmonizing the assumptions that are not necessarily different. Peters et al. have recently applied in real scale the application of nanomaterials as adsorbents, but they are compared without considering the applications. Another study by Baumann et al. considers the applications of battery in the assessment, without addressing the country of application, which results in partial understanding of contributions in the life cycle emissions. This study therefore addresses these challenges, by considering six battery technologies for five storage applications in three representative applications in Europe. One of the results of the 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 Earth Resources 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 (Fe2O3@SiO2-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are compared at different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of the adsorbents, it also results in a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to assess the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H2SO4), ammonia, ethanol, methanol, DCC (N,N'-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of a t-test comparing the impacts between MGO-NH-SH and Fe3O4@SiO2-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change; 16% more energy use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis were employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethan 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, SETAC Europe 28th Annual Meeting Abstract Book
Radboud University Nijmegen; H. King, Unilever; H. Hendriks, Unilever RD Colworth; R. University, Radboud University Nijmegen / Department of Environmental Science

Life Cycle Assessment (LCA) has been used as a tool for environmental footprinting of a wide range of household cleaning activities. Even though differences in the way household activities are performed by consumers may alter the results of LCA, the variability in consumer behaviour is generally ignored in LCAs, which use the average behaviour as a basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle of showering. The daily frequencies of showering were modelled in 4 countries namely Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country behavioural, climatic and infrastructural differences as well as intra-country variation in consumer behaviour are crucial for determining the variability in the life cycle environmental impacts. Inter-country variability - the ratio between the highest median footprint and the lowest median footprint over the four countries- in the 4 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.5, 2.2, 1.4 and 5.8 respectively. Intra-country variability - the ratio between the 95th percentile and the 5th percentile of the distribution- was typically higher than inter-country variability and ranged between factors of 5 and a factor of 20 depending on the country and indicator considered. Sensitivity analysis showed that consumers’ reasoned choices - particularly heater type and shower flow rate- and their habitual behaviours - particularly shower duration-, are the dominant sources of variabilities. Reductions in the water and energy related impacts of showering through changing of reasoned choices are achievable by one-off decisions such as buying an energy efficient water heater. However, reducing the impacts through changing of consumers’ habits could be challenging and needs more systematic approaches as consumers tend to keep their old habits.

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

MO394

Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments
K. Schleich, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; M. Kraas, 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. Hund-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 may lead to a significant input of NF and also to the exposure to the public through drinking water. However, there are other scenarios like the exposure of the terrestrial environment via runoff. Therefore, our aim was to investigate the ecotoxicity and fate of 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 to the top 20 cm of lysimeter soil. In addition, CeO2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Subsamples of the soil were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere induce Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammoxidizing bacteria and substrate-induced respiration) was observed over around 3 years in the lysimeter study. However, there was no effect at the lower Ag-NM concentration. The long-term 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 a hazard assessment based on data from laboratory tests is acceptable.
difference in the toxicity of the AgNMs. A realistic exposure scenario was chosen. The five test materials NM-300K, previously sulfidized NM-300K, a nanoparticulate Ag$_2$S, and bulk Ag$_2$S were added with an influent concentration of 1 mg/L and AgNO$_3$ with an influent concentration of 0.5 mg/L into the denitrification of a simulated STPs continuously for 10 days. The sewage sludge of each treatment was dewatered and the biosolids were mixed with soil. After 0, 60, 120, 180, and 360 days, soil samples were collected (15685) and the substrate induced respiration (SBR, OECD 217) were observed. In addition, after 60 days of aging of the AgNM in the test soil a sub-sample was taken from each treatment and a chronic plant test was carried out (Avena sativa) and both the roots and the shoots were examined for an uptake of the Ag. We found an increasing inhibition of the ammonia oxidizing bacteria (AOB) from day 60 until day 360. The inhibition of these bacteria in the presence of the AgNMs was mainly comparable throughout the test. In the first test the bulk Ag$_2$S had no effect on the activity of the AOB. Surprisingly, in the second test we found an effect of the bulk Ag$_2$S on the AOB, whereas all other results were in good agreement with the first test. The substrate induced respiration (OECD 217) occurred to be a less sensitive test system to determine the effect of the different test materials on the soil microbiota. Effects were observed only after 180 days of the test due to the silver nitrate (70% inhibition) and the nanosized Ag$_2$S (30% inhibition). There were no effects on the emergence or plant growth of Avena sativa over 8 weeks in the chronic plant test. An uptake of a low Ag concentration into the roots of the plants was observed.

MO397 Influence of soil type on the toxicokinetics of Ag and Ag$_2$S nanoparticles and ionic Ag in soil invertebrates  

C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science 

The rise of nanotechnology and the increased use of nanomaterials in consumer products may lead to an increased emission of nanoparticles (NPs) to the environment. Since NPs may leach from products during use, waste water treatment plants (WWTPs) may be an important sink but also an important source of NP emission to the environment. The use of sewage sludge in agriculture may, for example, be an important sink but also an important source of NP emission to the environment. The usefulness of terrestrial isopods as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

MO398 Energy reserves and respiration rate in the earthworm Eisenia andrei after exposure to zinc in nanoparticle or ionic forms  

Z.M. Swiatle, Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Sciences; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation 

The energy budget is an indicator of the organisms’ overall condition and the changes in the energy reserves and/or energy consumption rate have been used as biomarkers of toxic stress. To understand better the effect of different forms and concentrations of Zn and possible costs connected with the effective Zn regulation by the earthworm Eisenia andrei, we examined whether ingestion or direct intravenous injection of ZnO-NPs to Eisenia andrei (250 μg Zn g$^{-1}$ soil) will lead to an increased emission of nanoparticles (NPs) to the environment. The use of sewage sludge in agriculture may, for example, be an important sink but also an important source of NP emission to the environment. Since NPs may leach from products during use, waste water treatment processes taking place in the WWTP, Ag may give more information into the possible effects these particles may have. This study was supported by the National S

MO399 Evaluating the Cellular & Humoral Immune Responses of the Terrestrial Isopod, Porcellio scaber, to Gold Nanoparticles  

C.A. Mayall, University of Ljubljana, Biotechnical Fac. / Biotechnical Faculty; D. Grob, University of Ljubljana / Department of Biology 

Gold nanoparticles are popular due to their stability, the ease with which they can be synthesised and the myriad of potential uses they could have, which includes drug delivery systems, cancer therapy and biosensors. It is inevitable that these nanoparticles (NPs) will find their way into the environment and therefore the possible effects they could have need to be evaluated. In particular, it is anticipated that organisms may recognise NPs as "foreign" and respond by modulating their immune system. To date, only a few studies have dealt with this issue. The aim of this study was to investigate the immune response of terrestrial isopods to gold NPs. 

This study was supported by the National Science Centre, Poland (2015/17/N ZN 8/01576).

MO400 Terrestrial isopods as models to assess the biotransformation of nanoparticles inside the organisms: an example with silver and gold nanoparticles  

A. Jemec Kokalj, University of Ljubljana, Biotechnical Fac. / Department of Biology

This study aimed at assessing the influence of soil type on the bioavailability of Ag and Ag$_2$S NPs to enchytraeids (Enchytraeus crypticus) and springtails (Folsomia candida). Four soils with different pH (4–7), organic matter (2–17%) and clay contents (3–13%) were used. An uptake and elimination kinetics approach was taking in, in which the animals were exposed to a single concentration (nominal 10 mg Ag/kg dry soil) for 14 days (uptake phase), after which they were transferred to clean soil for a 14-day elimination period. A first-order one-compartment model was used to calculate uptake and elimination rate constants. Results for the enchytraeids showed k1 values for the uptake of Ag ranging between 0.009 and 0.057 g soil/g animal/day for Ag$_2$S and of 0.107–0.671 g soil/g animal/day for AgNO$_3$. These data suggest a lower availability of the Ag from the Ag$_2$S NPs than from the ionic Ag. The k1 values for the Ag$_2$S NPs were comparable to different soil properties for Ag$_2$S and soil. Where lowest availability was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for AgNO$_3$, but not for for Ag$_2$S. Elimination rate constant values (k2) ranged between 0.057 and 0.365 per day, and were not dependent on soil type or Ag form. Tests on the springtails are still running.
hemoctopus, 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 hemoocyte numbers to return to pre-injection levels. The total number of cells, viability and the proportion of hemoctye 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

Determining the comparative ecotoxicity of Cd/Ti quantum dots with three different functional groups in three species of soil dwelling organisms

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Soil is a natural resource that is important for a number of ecological reasons relating to ecosystem and biosphere processes. These processes include plant production, nutrient cycling of organic matter, presence of water and carbon, and richness of pathogens in agricultural crops. Pore water is the interstitial 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 nanoparticles 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 Cd/Ti QDs three different functional groups (COOH, PEG, NH2) were used for soil ecotoxicity studies. The earthworm Eisenia andreii, pot worm Enchytraeus albidus and soil nematode Caenorhabditis elegans were used following OECD and ISO protocols to determine the impact of nanoparticles. The nanomaterial distribution is soil was determined by using a flow through system combined with microwave digestion and ICP-MS where nanomaterials were pored onto soil as well as homogenously mixed and eluted using ultrapure water. It was found that a predominant amount of metals were found within the eluted interstitial water and that NH2-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 NH2 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 NH2 group only. The nematodes showed a significant decrease in their population number, bioaccumulation occurs within 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 model nematode Caenorhabditis elegans

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Much of the work conducted to-date in nanotoxicology has focussed 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 transformation on the toxicity of selected nanomaterials on the nematode Caenorhabditis elegans was also assessed. Investigated were 4 types of silver (25 and 50 nm, uncoated and PVP), 5 types of polystyrene (50 nm unfunctionalised, amine (+ charge), carboxyl coated (- charge) and 100nm, 300nm unfunctionalised), 4 types of TiO2 nanoparticles (uncoated, 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 uncoated 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 sulfidised 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 potential of nanoparticles (NPs) to assess the potential ecotoxicological risk in soil, water and air. Silver nanoparticles (Ag-NPs) have the highest degree of commercialization due to their high thermal and electric conductivity, high catalytic activity, and powerful antimicrobial properties. Eisenia fetida is a model species in soil toxicity studies and has been broadly used due to its sensitivity to different toxicants at different levels of biological organization. The main aim of the present in vivo study was to understand the effects produced by Ag-NPs (5.08±2.57 nm sized and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO3) at molecular level in coelomocytes of E. fetida at different exposure times. E. fetida were in vivo exposed to different concentrations of Ag-NPs and AgNO3 (0.05 and 50 mg Ag/kg soil) through OECD artificial soil for 1, 3 and 14 d. Then, the transcription levels of selected genes associated to oxidative stress (Catalse) and metal detoxification (MTs-metallothioneins) were determined in coelomocytes extruded from exposed earthworms. In addition, the enzymatic activity (Catalse) and protein content (MTs) were quantified. The responses varied significantly among days, exposure concentration and Ag form. Exposure to Ag-NPs led to
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO₃ induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTs at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in coelomocytes that precede other responses at higher levels of biological organization. The responses in transnational level in D. feida tissues were according. The study indicates the importance of using integrative biomarkers for the evaluation of the potential risk of Ag NPs in soils.

MO404
Effects of Cerium Nanoparticles with deferent surface-charge in coelomocytes of Eisenia fetida
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With the rapid development of nanotechnology and its broad applications, a wide variety of engineered nanoparticles are used in commodities, pharmaceuticals, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂-NPs) are used in textiles, food and cosmetic products as corona stabiliser, 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)), diethylaminoethyl dextran to confer a positive charge (DAD-CeO₂ (1)), and methyl 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 transcription levels of genes associated with stress (catalase and heat shock protein 70) were determined by q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DDA-CeO₂ (+) were more toxic that negative and neutral CeO₂-NPs. The results show that initial surface chemistry had a profound impact on the toxicity of CeO₂-NPs to coelomocytes.

MO405
The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure
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It is expected that most nanoparticles (NPs) which reach the soil will not be in their primary state but will instead be transformed by the environment (e.g. sulsidisation of Ag in waste water treatment processes). This will greatly influence the form of NP to which soil organisms are exposed and their ultimate bioavailability. The bioaccumulation of NPs inside the organisms can govern their ultimate fate and transformation in the environment; and uptake studies can give insight into how organisms act as sources and sinks for NPs in food webs. Most data currently available are for pristine Ag NPs, and consequently the difference in the bioavailability of the aged forms, predominantly Ag2S, is uncertain. The aim of this study is to compare the uptake kinetics of Ag NPs, both pristine (PVP coated Ag NPs, 20 and 50 nm) and aged (Ag2S, 20 nm), in the crop species, wheat, Triticum aestivum. Wheat plants were exposed from seed to each of the NPs at two nominal concentrations of Ag, 3 and 10 mg Ag/kg, in the soil Lufa 2.2. Samples were collected at five time points over the 42 day post-emergence exposure period. The growth rate, Ag accumulation and the translocation from root to shoots were determined. The toxicokinetic parameters of the Ag uptake in the roots and shoots were calculated using total soil concentration and soil pore water concentrations as metrics of exposure. Pore water was collected at all sampling points and at the end of the exposure period pore water was ultra-filtered as a measure of the dissolved Ag in the pore water. The accumulation of all silver forms was greater in the roots, with only a small fraction transported to the shoots. The uptake of Ag2S was lower compared to pristine Ag particles but there was no difference between the uptake of the two pristine Ag particles. This study shows that environmentally relevant forms of Ag NPs are bioavailable to plants and show different uptake kinetics than the pristine forms.

MO406
In vitro effects on Dendrobaena veneta coelomocytes of Ag and TiO₂ nanoparticles before and after wastewater treatment processes
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The majority of nanomaterials (NMs) used in commercial applications are likely to enter the wastewater stream and reach wastewater treatment plants. In many countries, wastewater effluent and sewage sludge are discharged in aquatic environments or re-used on agricultural land, however, the transformation of the particles and the potential hazards they pose have not been well understood. Recent studies have shown high association of NMs with sewage sludge, therefore soils can be a sink for NM pollution making terrestrial organisms vulnerable. The main aim of the study is to understand the transformation of NMs during wastewater treatment processes and to evaluate the potential environmental hazard of aged particles compared to pristine one. 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, nanoComposition) and TiO₂ particles (uncoted anatase, nominal primary size of 5 µm, 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 single particle measurement of uptake and intracellular localisation are evaluated with TEM and sp-ICP-MS.

MO407
Differential biomarker responses of Daphnia magna to pristine and wastewater borne silver nanoparticles
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The long-term use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs (PristAgNPs and WWTP-AgNPs) on the ecotoxicological and metabolic effects of dispersant to daphnids. Daphnids were analysed for changes in acetylcholinesterase (AChE), glutathione S-transferase (GST), catalase (CAT), lactate dehydrogenase (LDH) activities, and lipid peroxidation (LPO). Results showed a significant increase of CAT activity in effluent or in ASTM medium. The dispersant control was significantly different from ASTM and WWTP, 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 respectively to ASTM control, thus suggesting induction of oxidative stress by effluent. During wastewater treatment processes and to evaluate the potential environmental

MO408
Outlining the behaviour and ecotoxicology of biomedical nanoparticles in natural environments
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Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidently. 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 such as nanomedicine. In this study, we investigated five biomedical NPs, namely polymeric polystyrene (PSNH), europium-doped-cerium oxide (CeO$_2$@Eu), carbon dot-doped silica (Si/C), bare and polyethylene glycol-functionalized silica (SiO$_2$-B and SiO$_2$-PEG), 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 SiO$_2$ NPs. In fact, SiO$_2$ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PSNH, CeO$_2$@Eu and Si/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 stability of suspended NPs in the two media. SiO$_2$B and SiO$_2$-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected form suspensions after 24 h. On the contrary, no such difference was observed for PSNH, CeO$_2$@Eu and Si/C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrophotometric assays. SiO$_2$-based NPs bioaccumulation studies were performed in benthic organisms, which were subsequently analyzed by transmission electron microscopy (TEM) imaging, while PSNH maintained an intact structure in NRW and NSW. Finally, algal growth inhibition tests were performed using freshwater and marine microalgae (OECD, 1994). PSNH and CeO$_2$@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 PSNH and CeO$_2$@Eu NPs 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.

As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify read-across from ionic silver to silver nanoflours. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoflour with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comparing the effects of this silver nanoflour with silver nitrate using the following internationally standardized aquatic ecotoxicity tests: Toxicity to the algae, Pseudokirchneriella subcapitata (OECD Test Guideline No. 201). Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoflour was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional dissolved silver (0.45 μm membrane filtered) and ultrafine dissolved silver (3 kDa centrifuge filter) were measured by ICP-MS (for the silver nanoflour only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level using the Zetasizer Nano equipment. In addition, the dissolution rate of the test particles for silver nitrate and silver nanoflour in OECD synthetic freshwater media was measured. NPs remained suspended in freshwater, reaching micrometric sizes after 24 h. In order to address dissolution phenomena, normalized derived count rates (DCR) were used to estimate the stability of suspended NPs in the two media. SiO$_2$ and SiO$_2$-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH, CeO$_2$@Eu and Si/C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by spectrophotometric assays. SiO$_2$-based NPs bioaccumulation studies were performed in benthic organisms, which were subsequently analyzed by transmission electron microscopy (TEM) imaging, while PSNH maintained an intact structure in NRW and NSW. Finally, algal growth inhibition tests were performed using freshwater and marine microalgae (OECD, 1994). PSNH and CeO$_2$@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 PSNH and CeO$_2$@Eu NPs 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.
liquid effluents 0.03 - 6.74 and 0.003 – 0.26 µg/L for Si and Ag NPs respectively. Environmental exposure models have shown that soils and sediments can provide important reservoirs of these nanomaterials, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are one 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 conditions in which ENPs can be transferred through the ecosystems 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 hyporexic copepod species and less related with DOM concentrations. The hyporexic 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 DOM sources are relatively constant, biogeochemical processing within the hyporexic zone resulted a DOM pool that is temporarily dynamic regarding its composition and concentration. In this study we evaluated how DOM concentrations and water hardness are related with the acute ecotoxicity of Si and Ag NPs on the survival of Microcystis aeruginosa a widespread hyporexic species. Toxicity of AgNPs was related with DOM concentrations and showed a non-significant Beta for water hardness. On the contrary, for SiNPs, DOM and water hardness quantitative relationships were negatively correlated with ecotoxicity on this freshwater invertebrate.

**MO413**

**Long-term exposure of ZnO nanoparticles to freshwater microalgae cultivated in batch and semi-continuous mode**

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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. A group of nanoparticles was 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 water 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 were investigated with the microalgae Scenedesmus rubescens was selected as model microorganism since it is a common freshwater microalgae. S. rubescens exposed to ZnO NPs concentrations were estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%I) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of S. rubescens was greater in the presence of ZnO NPs, and the lipid content was higher.

**MO414**

**Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms**

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Sunscreens represent one of the main source of engineered TiO2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of NPs extracted from three different commercial sunscreens on freshwater and marine organisms: microalgae (Pseudokircheriella subcapitata; Dunaliella tertiolecta) and crustaceans (Eisenia fetida; Microcystis aeruginosa) as bioindicators for growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the maximum inhibition concentration (IC50) and the growth inhibition rate (%I) 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. Georganopoulou, Norwegian Institute for Water Research; N.W. J. Farkas, SINTEF Ocean / Environmental Technology; K. A. M. Mian, Norwegian Institute for Water Research; P.A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology; A. Macken, NIVA / marine pollution Silver and titanium nanoparticles are used in numerous consumer products and applications and they are likely to enter wastewater streams, reach wastewater treatment plants and aquatic systems through wastewater and effluent discharge. Nanomaterials undergo transformations in different matrices altering their fate, behaviour, bioavailability and toxic potential that could differ greatly from the pristine counterparts. There are challenges on the detection and quantification of nanomaterials at environmentally relevant concentrations in complex media and matrices such as whole organisms. Moreover, studies on uptake and effects of transformed particles on marine species is largely lacking. The aim of the present study is to better understand the transformation of Ag and TiO2 NPs in wastewater and assess the uptake, bioaccumulation and subsequent developmental effects of pristine and transformed particles on the marine organism Tisbe battagliai. In this study the harpacticoid copepod Tisbe battagliai was selected as a relevant marine species and the effects on the naupliar development was assessed over an exposure period of 6 days. The mortality and the developmental stage of the organisms was assessed daily. Initial investigations focused on the study of Ag (prepared in 5 nm, nanoComposix) and TiO2 particles (nominal primary size of 5 nm, NM-101, JRC) and their mixture. Moreover, the particles were aged in synthetic wastewater (for 4 hours under stirring conditions) and the effects of “aged” particles on the uptake, bioaccumulation and naupliar development was assessed. Extensive characterization studies on the particles in synthetic wastewater, seawater and exposure media were performed with dynamic light scattering (DLS), ultraviolet–visible spectroscope (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 both the particles types were stable in seawater. Moreover, initial investigations focused on the study of Ag (prepared in 5 nm, nanoComposix) and TiO2 particles (nominal primary size of 5 nm, NM-101, JRC) and their mixture. Moreover, the particles were aged in synthetic wastewater (for 4 hours under stirring conditions) and the effects of “aged” particles on the uptake, bioaccumulation and naupliar development was assessed. Extensive characterization studies on the particles in synthetic wastewater, seawater and exposure media were performed with dynamic light scattering (DLS), ultraviolet–visible spectroscope (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 both the nanoparticles 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 on freshwater and marine organisms: microalgae (Pseudokircheriella subcapitata; Dunaliella tertiolecta) and crustaceans (Eisenia fetida; Microcystis aeruginosa) as bioindicators for growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the maximum inhibition concentration (IC50) and the growth inhibition rate (%I) 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**

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The relatively recent development of engineered Ag nanoparticles has expanded silver’s applications considerably. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Ampolipids, 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 pellets (approximately 200 mg kg-1). P. hawaiensis organisms (8 months) were placed individually into a plastic container (100 mL of reconstituted saline water) and fed on alternate days with control, AgNP, or AgCl amended feed pellets. After 1 hour of feeding, each organism was washed and placed into a new plastic container with clean salt water to ensure that the exposure was only via food. The amphipods were fed during 7, 14 and 28 days. After exposure, the haemolymph was collected using a thin glass capillary, weighted and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a Graphite Furnace Atomic Absorption Spectrometry (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 mg g-1, in comparison to 3.7±1.0 mg g-1 for AgCl at the longest exposure time. The increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable to P. hawaiensis as AgNP than when it is in its salt form. Data strongly suggest that nanoparticles were uptake by the gut and distributed in the
haemolymph causing this increase in Ag content. More studies are required to verify the Ag form present in the haemolymph and how it will induce damage in the exposed organisms.

MO417

Toxic effects of multi-walled carbon nanotubes on bivalve of the estuarine and coastal lagoons environments. A. M. Fresegna, D. Cavallo, Italian Workers Compensation Authority INAIL / Occupational and Environmental Medicine, Epidemiology and Hygiene; C. Ursini, R. Maiello, M. Bonomi, Department of Veterinary Medicine, Epidemiology and Hygiene.

The use of carbon nanomaterials (CNMs) has increased rapidly in the last years, mainly due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmacokinetics. Currently, carbon nanotubes (CNTs) are one of the most important and commercially used CNMs. CNTs are hollow graphene cylinders that are microns to millimeters in length and can be divided in single-walled (SWCNTs) with a diameter of 0.7 to 3 nm, and multi-walled (MWCNTs) with a diameter of 10 to 25 nm. CNTs are engineered with a wide variety of core structures and surface functionalizations that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available 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. For this reason, an exposure (28 days) to unfunctionalized MWCNTs (Nf-MWCNTs) in comparison with functionalized MWCNTs (f-MWCNTs), by introducing polar groups such as carboxyl groups (-COOH) in order to achieve better dispersibility in water, were evaluated in the Manila clams Ruditapes philippinarum, one of the most important bivalve of the estuarine and coastal lagoon environments. Alterations induced in clams’ oxidative status, neurotoxicity and metabolic capacity were performed. The results obtained clearly showing that both Ni-MWCNTs and f-MWCNTs were able to generate oxidative stress in the exposed clams and were also responsible for changes in organisms’ metabolism (expressed in alteration of energy reserves) and neurotoxicity induction in R. philippinarum, however greater impacts were caused by f-MWCNTs. The results demonstrated that the use of metal-coated CNTs can be safer than unfunctionalized ones.

MO419

Transformations of engineered nanomaterials during wastewater treatment: the role of engineered surface coatings and the impact on environmental fate. M. Surette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering; R. Kaege, Eawag - Swiss Federal Institute of Aquatic Science and Technology.

Previous research has highlighted the importance of particle-particle interactions in controlling the environmental fate of engineered nanomaterials (ENMs). Yet our ability to accurately predict the outcome of these interactions within environmental systems is still limited. One obstacle is the inherent complexity of these interactions which depend on several factors, including the properties of the ENM. However, the properties of the ENM are dynamic and can be altered via myriad transformation processes (e.g., over-coating via natural macromolecules, surface coating displacement, etc.). When considering the pathways by which ENMs may be released to the environment, wastewater treatment plants (WWTPs) not only act as gateways controlling the release of ENMs but they may also serve as reactors adjusting the properties of the ENMs. Therefore, to improve our understanding of ENM interactions within environmental systems we must first understand the extent to which ENM properties are altered within WWTPs. ‘In the objective of this research is to develop a protocol that simulates the transformations or ‘aging’ ENMs experience within a WWTP. The initial focus is on the effect of the dissolved components within the wastewater medium and whether ENMs with initially dissimilar properties will have similar properties after aging. To accomplish this, 12 commercial gold nanoparticles (AuNPs) with different engineered surface coatings were selected as model ENMs. A series of batch reactors, each containing a sample from a different stage in a WWTP, were used to assess the impact of each stage on the ENMs. Each wastewater sample was first filtered to remove suspended solids and then dosed with a single type of model ENMs. Each reactor was mixed and aliquots were collected over time. The aliquots were then analyzed by a variety of techniques to investigate the effect of the media on the properties of the ENMs, including size, surface charge, stability/aggregate structure, and hydrophobicity. In future work we will investigate the impact of the suspended solids and the overall effect of the transformations on the aggregation behavior of the ENMs upon their introduction to different environmental mediums (e.g., surface water). In simulating the discharge of aged ENMs into the environment, it will allow us to test the transformations induced by a WWTP on the aggregation behavior of the ENMs will be evaluated. Ultimately, this will help refine our understanding of ENM environmental fate.

MO420

Freshwater sediments as an environmental reactor: defining biologically relevant fate parameters to provide context for nanomaterial bioaccumulation. R. Cross, University of Exeter; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; T.S. Galloway, University of Exeter / Biosciences.

As the field of nanotoxicology matures there is a call for the research focus to progress from hazard identification to more ecology-relevant assessments. To determine the risk that engineered nanomaterials (ENM) pose as they undergo a range of transformations in the environment. This will require test designs prioritising environments most at risk of contamination, and which not only measure ecologically relevant endpoints, but also characterise the fate, transformations and behaviours of particles within the test system, providing the context for differences observed between treatments. Freshwater sediments present an ecosystem in need of further research, as these are predicted to be major sinks of ENMs entering the aquatic environment though waste water treatment and terrestrial pathways during material production, use and disposal. Whilst freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of ENMs within these sediments. We present a simple separation method to isolate the colloidal (<200 nm) and dissolved (<1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO2-NP) and silver nanoparticles (AgNP) as model ENMs, we report that these materials in the freshwater sediment dwelling worm Lumbriculus variegatus. By following the fate of these particles in the solid bound, colloidal and dissolved fractions of the sediment, we provide context to explain differences in both the route and extent of uptake of these materials by the worm. This poster presents the successful application of this method to investigate the implications different surface properties have for the fate of ENMs in freshwater sediments.
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 water 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 be conducted that are surface-chalcophosphate electrodes to confirm our findings with Fresnel lenses to increase the irradiation intensity and solution temperature. The relationships between these molecular-level surface properties and the extrinsic properties of the TiO2 NPs will be 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 reduction (photodynamic activity), and thiosulfate conversion (ROS generation). Ultimately, changes in the properties of the TiO2 NPs will be compared to larger scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

MO422 Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles
A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering, Particle Lab; A. Voegelin, R. Kaegi, Eawag - Swiss federal Institute of Aquatic Science and Technology

Organic matter (DOM) is a common and important environmental nanomaterial (ENM) that 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 CuO NPs that are surface-chalcophosphate electrodes. In order to date, our knowledge on the influence of DOM on the kinetics and mechanisms of this transformation reaction are very scarce. For copper oxide nanoparticles (CuO NPs), the sulfidation reaction and its kinetics have been described in detail. However, the influence of DOM on this reaction has not been investigated, yet. Due to their high content of bisulfide (HS-), wastewater systems represent major sulfidizing environments, where CuO NPs may remain coated with humic acids and humic substances. In this study, we therefore selected three organic model compounds (Bovine serum albumin (BSA), model protein), Alginate (model polysaccharide) and Polyacrylic acid (natural organic matter analogue)) and investigated their influence on the sulfidation of CuO NPs. All experiments were conducted in solutions buffered to pH 8 at concentrations of 1.3 mM CuO and 4 mM HS-. Variable amounts of the organic compounds were added to reach final concentrations of 10, 100 and 1000 mg L-1. Reacted CuO NPs were collected at selected time points and characterized using Cu K-edge X-ray Absorption Spectroscopy (XAS). Selected samples were characterized using analytical electron microscopy. XAS analyses revealed that at a concentration of 10 mg L-1, none of the selected organic compounds affected the sulfidation rate and observed reaction products. However, at BSA concentrations ≥ 100 mg L-1 a reduction of the reaction rate was observed. In addition, at these high concentrations, BSA hampered the recrystallization of amorphous CuS to covellite. Electron microscopy also showed that in the presence of BSA, amorphous CuS was the dominating particle type. Our results show that at high concentrations, proteins such as the aquaporins and 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
M.D. Montaño, University of Vienna / Environmental Geosciences; B. Gerstmann, A. Laycock, N. Tepe, T. Hofmann, F. van der Kammer, University of Vienna / Department of Environmental Geosciences

The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanotechnology, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NPNs) and 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-MS (spICP-TOF-MS) into routine environmental analysis is critical 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, NPNs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique and its utility for routine analyses, several multi-element and multi-isotope nanoparticles were analyzed using traditional spICP-MS (with quadrupole mass filtering) and with spICP-TOF-MS. The precision and accuracy for particle sizing and counting were evaluated for each technique for a range of elements to explore the advantages and potential limitations of these techniques as the apply to environmentally and geochemically relevant systems. To illustrate the advances made in multi-element monitoring by time-of-flight, single particle analyses were performed on both a quadrupole ICP-MS and an ICP-TOF-MS, and using 3ms and 100µs dwell times on both instruments. Particles analyzed consisted of mixtures of well-defined AuAg core-shell NPs with Au and Ag only NPs, polydisperse ceramic NPs with well-defined chemical compositions, and environmentally relevant colloidal suspensions containing ENPs. These systems were analyzed over a range of hydrodynamic diameters, providing a unique opportunity to explore the efficacy of spICP-TOF-MS as a characterization technique. spICP-TOF-MS demonstrates considerable advantages over traditional spICP-MS and has the potential to examine the geochemical realm on an individual particle basis. The further development of this technique may also lead to a better assessment of ENP exposure in test systems and nature, improving on environmental risk assessment and gaining a better understanding of ENP interactions with naturally occurring colloids.

MO424 Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy
D.L. Windell, University of Exeter / College of Life and Environmental Sciences; J. Moger, The University of Exeter / College of Engineering, Mathematics and Physical Sciences; M.J. Winter, The University of Exeter / College of Life and Environmental Sciences; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Nanotechnology applications have increased dramatically in recent years including in the pharmaceutical sector. The unique properties of nanoparticles have been exploited in medicine in both drug development and drug delivery. Their small size and capability for manipulation and functionalisation allows for great improvements in drug efficacy. Nanomedicines can cross a wide range of biological membranes and barriers (including the blood brain barrier facilitating the diagnosis and treatment of life threatening diseases such as cancer. Although nanotechnology may help to reduce the toxicity and side effects of drugs, the actual carriers themselves may also have the potential for inducing toxic effects, depending on their composition. This raises the need for safety evaluations of these drug delivery systems both in patients, but also with respect to their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their carrier systems into the environment, although some studies have begun to investigate the potential toxic effects of various nanoparticle shapes and coatings in aquatic organisms. Using various sizes of gold nanoparticles (between 10 and 100nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebrafish and light sheet microscopy. We have constructed a light sheet system based on the OpenSPIM platform, (SPIM - Selective Plane-Illumination Microscopy) which allows us to create 3D images and 4D videos in real-time. Using this rapid image acquisition technique we showed a size selective uptake of the nanoparticles into the kidney and minimal uptake in other organs. Depuration studies indicate a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

MO425 SETAC Nanotechnology Interest Group
C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology

Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)
MO426

Effect of ageing on polycyclic aromatic hydrocarbon composition of biochar
G. Sigmund, Technische Universität München / Chair of Analytical Chemistry and Water Chemistry; T. Bucheli, Agroscope ART / Environmental Analyses; I. Hilber, Agroscope / Environmental Analyses; T. Hüffer, M. Kah, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The influence of ageing on biochar properties has been investigated by comparing the PAH compositions of biochars naturally aged by either H2O thermal oxidation or horseradish peroxidase enzymatic oxidation. In addition, a field-aged counterpart for one of the biochars was recovered from an agricultural field site, four years after application. Biochar bulk properties showed only minor changes following both artificial and field ageing, indicating high biochar stability. Concentrations of the 16 US EPA PAHs were measured in all of the biochars and a contaminant trap was used to investigate the effect of ageing on their bioaccessibility. The concentrations of total and bioaccessible PAHs ranged from 4.4 to 22.6 mg/kg and 0.0 to 9.7 mg/kg, respectively. Concentrations of the 16 US EPA PAHs decreased following field ageing, but the proportion of low molecular weight PAHs increased. The observed changes in PAH composition with field ageing can partially be explained by uptake from the surrounding soil. In addition, size discriminatory intra-biochar transfer processes also contributed to the changes in PAH composition. To better understand changes in PAH composition with ageing, an additional broad range of alkylated PAHs was also analyzed in selected samples. Our results show that the tested artificial ageing protocols are unable to approximate the changes in PAH composition resulting from field ageing. Nevertheless, total and bioaccessible PAH concentrations decreased for both artificially and field-aged biochars, indicating that PAH release decreases with ageing. Therefore, well-produced biochars that meet European Biochar Certificate (EBC) and International Biochar Initiative (IBI) quality thresholds for total PAH concentrations are unlikely to present a risk with regard to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO427

Field testing of a new calibration approach for silicone passive samplers: Comparison of the concentration ratio method using samplers of different thicknesses with the PRC approach
H. Fuchte, Institut für Umweltforschung / Institute for Environmental Research BioV; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; K. Smith, RWTH Aachen University / Institute for Environmental Research

Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often silicone samplers have to be used in kinetic mode and sampler calibration is unavoidable. Most commonly, exchange kinetics are derived from the release rates 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 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).

MO428

Use of biochar for hexachlorocyclohexane sorption: a mechanistic approach
L. Silvan, g. cornelissen, s.e. hale, Norwegian Geotechnical Institute

Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: α-HCH, β-HCH, γ-HCH and δ-HCH, which differ for their tridimensional structure. Commercial HCH in technical grade is a mixture of these isomers. HCH has been extensively used as a pesticide despite the fact that only γ-HCH (lindane) has insecticide properties. HCHs’ toxic, carcinogenic, teratogen and neurotoxic effects have been reported in humans; and the HCHs have a clear tendency to accumulate in the environment. For these reasons, HCHs are contaminants of worldwide concern, but the concentration removal mechanisms in the environmental matrix have not been extensively studied. 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 (BCa), from greenhouse tomato waste (BCb) and from durian shell (BCc), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 - 328.6 m2 g-1), pore volume (5.1 - 186.6 cm3 g-1), pore dimension (1.05 - 5.85 Å), pyrolysis temperature (400 – 700 °C) and surface properties (including iron content). Batch isotherm tests were carried out in deionized water with the same isomers and the mixture of α-, β-, γ- and δ-HCH. The HCH concentration was ranged between 1 and 500 µg L-1 in the monocomponent isomers and between 5 and 2000 µg L-1 (total concentration) in the mixture isomers. Polyethylene (PE, 262.5 cm2 g-1) and BC with 1.00 mg Fe g-1 used as a passive sampler, for assessing the HCHs concentration in water. The sorption performances of the biochars is related to physicochemical properties. Preliminary results have shown the adsorption performances are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429

Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers
M. Renninger, RWTH Aachen / Bioi; T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Geosciences

Frequently, the total PAH sediment concentration reported for a sample has been based on 16 individual priority pollutants according to the U.S. EPA Method 8310. For pyrogenic sources of PAHs (e.g. incomplete burning processes), the parent PAHs are the predominant species. In contrast, PAHs from petrogenic sources (e.g. crude oil) are dominated by alkyl PAHs. Therefore, the U.S. EPA narcosis model approach and the calculation of PAH toxic units (TU) are not applicable to predict PAH risk in marine and limnic sediments. For this reason, the total PAH concentration has been measured in many studies. The actual available free (bioavailable) PAH concentration used in the bioavailability assessment is the most appropriate parameter for the risk assessment. This work investigated the total and bioaccessible PAH concentrations at the Palos Verdes Superfund Site. Extractable concentrations were determined using PDMS coated fibers. The results were compared to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

**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, CIMAR; M. Larsson, Orebro University / Man-Technology-Environment research centre (MTM); M. Lam, RWTH University Aachen; H. Vries, Technical University of Denmark / Environmental Engineering Department; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); J. Giesy, University of Saskatchewan / Department of Plant and Environmental Sciences; A.D. Redman, Exxon Mobil 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 Rimello association

Petroleum substances are examples of UVCBs (substances of Unknown or Very Limited Commercial and Biological Data) and are considered to be ‘potentially toxic’. This study shows the presence of 16 priority compounds (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seaboard. These data are in line with the production/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography—mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (Σ216PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/dl in the suspended fraction and ≈ 10 μg/dl in the dissolved fraction. Among total aryl hydrocarbon receptor (AhR) agonists in soils from historical contamination sources and weathering processes in the enviro

**MO432**

Occurrence of availability and 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. Giesy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Kingwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Joio Rocha, ICBAS – U.Porto

In risk assessment of hydrophobic chemicals that are strongly associated to the soil/sediment organic matter, freely dissolved concentrations (C_diss) are more representative than total concentrations (C_tot) 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.

**MO433**

Automated Solid Phase Microextraction (SPME) for measuring freely dissolved concentrations of hydrophobic chemicals in soils, sediments and other solid matrices C. Vitale, University of Insibria; K. Knuusmark Sjöholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; A. Di Guardo, University of Insibria / 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_diss) are more representative than total concentrations (C_tot) 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.

**MO434**

New approaches for determining solubility of volatile liquid chemicals H. Birch, DTU Environment / Department of Environmental Engineering; L.N. Trang, Technical University of Denmark / Environmental Engineering; P. Linder, Technical University of Denmark / Department of Environmental Engineering

Water solubility is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals in the liquid state, the main challenge is to establish equilibrium between the pure liquid phase and the water phase within a reasonable time frame, while droplet formation. The first approach uses passive dosing from a saturated silicone oil droplet. A slow-slit method for solubility measurements has previously been developed for this purpose, however it is time consuming as it requires weeks to equilibrate. In this work, two new approaches were used for solubility determinations. Both methods were originally developed for toxicity testing at the saturation level. Both approaches avoid direct contact between the pure substance and the water, thus minimizing the risk of droplet formation. The first approach uses passive dosing from a saturated silicone polymer in order to saturate the water, while the second approach equilibrates the water with the pure phase liquid through the headspace. Equilibrium time in the range of minutes to hours is expected for the two methods. Four liquid hydrophobic
chemicals within the logKow range of 4.4-8.6 will be included in the study, and results from both methods will be compared.

MO437 Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals
L. N. Tran; Technical University of Denmark / Environmental Engineering; S. N. Sørensen; Technical University of Denmark / Department of Environmental Engineering; M. HOLMSTRUP, Aarhus University / Department of Bioscience; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

Constant and well-defined exposure is crucial for the toxicity testing of liquid organic chemicals, which have 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 alkane in toxicity experiments. The headspace passive dosing method applies a liquid partitioning donor placed in the headspace of the closed test vial for controlling exposure while avoiding direct contact and introduction of pure phase micro-droplets. Passive dosing from the pure liquid compound was applied for toxicity testing exactly at the solubility limit, and a dilution series of test chemicals prepared in purified vegetable oil served as donor for dose-response testing. The terpenes S-(-)-Limonene and a(+)-Pinene were tested in both the algal growth inhibition test and the springtail test. In addition, n-nonane, n-undecane and n-dodecane were tested on the algae, while iso-octane, iso-dodecane and n-dodecane were tested on the springtails. Our first results demonstrated that (1) the headspace passive dosing method is a simple yet effective way to control exposure to volatile hydrophobic organic chemicals and (2) that the method is straightforward to apply in algal growth inhibition and springtail toxicity tests. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity.

MO438 Application of biomimetic solid phase microextraction to characterize aquatic hazard of petroleum substances
L. Campana; ExxonMobil Petroleum and Chemical; A. D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; D. LETINSKI, ExxonMobil Biomedical Sciences Inc; E. VAIOPOULOU, European Petroleum Refiners Association

Environmental hazards of petroleum substances differ in response to variable substance composition. In this study, CONCAWE has initiated a comprehensive analytical program to extend analytical characterization of petroleum substances to further support hazard classification within and across petroleum substance categories. As part of this work, SPME and toxicity data for newly characterized substances (n=139), across approximately 10 major categories, were compared to historical data. New compositional data were used as input to PETROTOX to predict LC50 and LC50on the algae, while LL50 were predicted for the algae and LL50 on the algae, while LL50 were predicted for the algae and LL50 were predicted for the algae and LL50 were predicted for the algae. Therefore, in this study, the extracts were dosed into seven cell-based bioassays covering cytotoxicity, activation of metabolic enzymes (binding to the arylhydrocarbon receptor, AhR), specific, receptor-mediated effects such as estrogenicity (ERa); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were positive for the AhR. In one of these cases, the AhR was by far most responsive and showed a distinct pattern across the sampling locations. The other three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between C\text{bio} vs. C\text{est} will enable assessing the actual risk (C\text{est}) vs. the potential hazard of those chemicals that might be released in future scenarios (C\text{bio}). The presented work calls for more detailed studies at specific sites and testing of additional endpoints with the aim of obtaining a complete picture of mixture effects caused by the freely dissolved and total concentrations of hydrophobic organic chemicals in sediments.

MO441 Bioaccumulation of hydrophobic organic compounds in aquatic biota: addressing current challenges for in tissue passive equilibrium sampling
E. Rojo-Nieto, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research / UFZ GmbH / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; J. Koschorreck, Umweltbundesamt; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; J. Koschorreck, Umweltbundesamt; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology

For assessing the bioavailability of hydrophobic organic 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. The bioavailability of hydrophobic compounds in such 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.
lipid), have been selected to optimise silicone-based PSDs for sampling in lean tissues. For this study, silicone is used as common reference phase, with sampler relocations across the homogenized samples along the sampling period, as has been proposed by Rusina et al. [1], in order to avoid the local depletion of the sample in direct contact with the silicone, and both, kinetic and equilibrium approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 135, 153, 180) have been selected as target compounds, covering a log Kow range from 5.66 to 7.15. Reference: [1] Rusina TP, Carlsson P, Vrana B, Smedes F. 2017. Equilibrium passive sampling of POP in lipid-rich and lean fish tissue: Quality control using performance reference compounds. Environ. Sci. Technol., DOI: 10.1021/acs.est.7b03113.

MO442 Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malagae in the northern Gulf of Mexico S. Chiasson, Loyola University / EEB; E.K. Grey, Governors State University / Division of science, mathematics, and technology; D.A. Grimml, Tulane University / Coordinated Instrumentation Facility; C.M. Taylor, Tulane University / Ecology & Evolutionary Biology

The blue crab, Callinectes sapidus, is an ecologically and economically important invertebrate species in the northern Gulf of Mexico (NGOM). The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab malagae 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 be a target of interest in blue crab samples, with 4-nonylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tertbutylphenol (DTBP), NP is an alkylphenol known to impair endocrine function and concentrations detected in malagae 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 has a marine pollutant potential but exhibits low toxicity. All these compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in malagae over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crab across the NGOM suggests that management strategies of alkylphenols in the environment should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

MO443 Real-time visualization and quantification of perylene bioaccumulation at single cell level x. guo, School of Environment, Beijing Normal University; X. Jin, Beijing Normal University; F. Bai, Peking University

Hydrophobic organic chemicals (HOCs) are of special ecotoxicological concern because they can be directly incorporated and bio-accumulated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and ecological impact is considered poorly understood. Perylene (P), 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 higher cell-to-cell heterogeneity.

MO445 Ecotoxicology faces the challenge of monitoring the levels of an increasing number of chemicals on biota. While persistent pollutants have been largely studied, several pollutants are metabolized, especially by vertebrates. Despite the higher toxic potential of metabolites compared to their parent compounds, little attention has been given to metabolites. Several persistent micropollutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and metabolisable ones (Polycyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants was characterized in muscles and their metabolites in bile and liver using gas chromatography (GC-MS / MS) and high performance liquid chromatography (HPLC-MS / MS) coupled to a mass spectrometer. Body burdens of pollutants in chubs were then explained according to the environmental (water surface and sediments) contamination and individual parameters (age, body length, health status and parasitic load). Despite restrictive legislation, persistent pollutants (OCP, PCB) were found in all environmental matrices and fish tissues. Phthalates were the most abundant chemicals, with concentrations in fish muscles in the range 41.6-2200 ng.g⁻¹. Positive correlations were detected between the environmental pollution and the levels of persistent pollutants (PCB, OCP) in chubs, but not for the metabolizable chemicals, likely due to their rapid degradation and excretion. No correlation was found between micropollutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Marné hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were less contaminated. In the study, 60% of POP in chub 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.

MO446 Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish) M. Giovanni, University of Insubria (Como) / DiSTA; A. Buffo, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNRM; R. Perna, University of Insubria; S. Pololesco, Water Research Institute- CNR / Water Research Institute; S. Valcicchi, Water Research Institute - Italian National Research Council IRSA-CNRM; R. Bettinetti, University of Insubria / DiSTA. Lake Como, a subalpine lake (Northern Italy), is an oligomictic lake, with complete water mixing occurring after particularly windy and cold winters. It presents a typical shape of an upside “Y” where a western, eastern and northern basin can be identified. In more detail, the western branch is distinctly separated from the rest of the lake by an underwater ridge, where the highest depth is measured (425 m at

MO444 Impregnation factors of freshwater fish by organic micropollutants in the Marne Hydrographic network N.F. Molbert, UPMC UMR METIS 7619 / Biogeochemistry; M. Cheveuill, EPHE / UMR METIS 7619; F. Alliot, EPHE / UMR Metis; R. Santos, HEPIA; J. Mouchel, UPMC UMR METIS CNRSUPMC; A. Gouze, EPHE / UMR METIS

Ecotoxicology faces the challenge of monitoring the levels of an increasing number of chemicals on biota. While persistent pollutants have been largely studied, several pollutants are metabolized, especially by vertebrates. Despite the higher toxic potential of metabolites compared to their parent compounds, little attention has been given to metabolites. Several persistent micropollutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and metabolizable ones (Polycyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants was characterized in muscles and their metabolites in bile and liver using gas chromatography (GC-MS / MS) and high performance liquid chromatography (HPLC-MS / MS) coupled to a mass spectrometer. Body burdens of pollutants in chubs were then explained according to the environmental (water surface and sediments) contamination and individual parameters (age, body length, health status and parasitic load). Despite restrictive legislation, persistent pollutants (OCP, PCB) were found in all environmental matrices and fish tissues. Phthalates were the most abundant chemicals, with concentrations in fish muscles in the range 41.6-2200 ng.g⁻¹. Positive correlations were detected between the environmental pollution and the levels of persistent pollutants (PCB, OCP) in chubs, but not for the metabolizable chemicals, likely due to their rapid degradation and excretion. No correlation was found between micropollutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Marné hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were less contaminated. In the study, 60% of POP in chub 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.
Argen), and does not present an outlet, resulting in a longer real water renewal time. On the other side, waters of the eastern branch are encouraged to flow towards south directly through the Adda River, which is also the main inlet in the northern branch. Western and eastern branches also present different level of trophic status. In the present work, we investigate if these main morphological features can lead to differences a) in zooplankton density and biomass, b) in the interactions between zooplankton and phytoplankton and c) in levels of pollution between the pelagic areas of the two branches, evaluated along a seasonal sequence. Preliminary data tell that the taxon composition of the pelagic planktonic communities is the same in the basins but differences in density and biomass are highlighted. These differences are found in levels of contamination of legacy compounds (DDT, PCB) while there are no differences between the two branches in concentrations of perfluoralkyl substances (PFAS).

MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain
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 spp.), and copepods (Osculinaea sp.). The study used a gas-tight perspex system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-24 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-24 hour time intervals, then approached study-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared to those in phytoplankton and high molecular weight PAHs (PA and PY) were found at significantly higher levels in phytoplankton, indicating that plankton might have selectivity towards PAHs. In principal component analysis (PCA), the plankton could be separated significantly into phytoplankton and zooplankton. Parts of the PAH accumulation found in rotifers and copepods were similar, demonstrating that PAH composition in plankton might be affected by trophic levels. All PAHs demonstrated significantly linear relationships between bioconcentration factor (BCF) and PAH hydrophobicity (K ow) in plankton, however the dynamic linear regression slopes of log BCF and log K ow in phytoplankton, rotifer and copepod, suggested that the plankton have different pathways of PAH accumulation.

MO449 Do weathered multiwalled carbon nanotubes influence the distribution of the biocide triclocarban in a sediment-water system?
L. Benner, L. Politowski, P. M. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Centre for Nanotoxicology and Chemistry of Nanomaterials
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 load. Such processes can impair their environmental impact of MWCNT in the water phase is very short; due to agglomeration and aggregation processes they preferably settle down in sediments, which represent a potential sink for carbon-based nanomaterials. Nevertheless, during their stopover in the water phase they may interact with water dissolved xenobiotics, and thus alter the fate of these substances. Due to the lack of information on the influence of MWCNT on organic chemicals in aquatic ecosystems, proactive research is needed to estimate potential risks, especially for sediment-dwelling organisms as a part of the 'Trojan Horse' effect. In the present study MWCNT were irradiated by simulated sunlight (300-400 nm) for 90 days. The weathered MWCNT (wMWCNT) were used to investigate their influence on fate and distribution of the biocide triclocarban (TCC) in a sediment-water system. This substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in environmental pathways of PAH accumulation and distribution of polycyclic aromatic hydrocarbons (PAHs) to fresh water organisms from natural aquatic systems
L. Teunen, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the target chemical compounds are analyzed in environmental samples. However, in the case of highly hydrophobic compounds, their very low water solubility precludes direct measurement in water, and thus alternative monitoring strategies are needed. Accordingly, the WFD has formulated biota quality standards (BQS) which refer to concentrations of compounds that have to be monitored in fish and invertebrates. In the present study we are investigating the reliability and relevance of BQS by studying the relationships between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being established to construct the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule
B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA
Exposure 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 ow 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 experimental results more subject to imprecision. Due to analytical difficulties, parameters such as water solubility and K ow 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 ow 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 ow 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 system are to be conducted, however considering the technical difficulties to analyse the molecule, and the route of environmental exposure, it may be necessary to define a category of molecules for which some of current regulatory requirements could be waived related to their chemical properties. A proposal for an appropriate risk assessment will be provided.

MO451 Effect of environmental characteristics on the bioavailability of hydrophobic organic compounds to fresh water organisms from natural aquatic systems
L. Teunen, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the target chemical compounds are analyzed in environmental samples. However, in the case of highly hydrophobic compounds, their very low water solubility precludes direct measurement in water, and thus alternative monitoring strategies are needed. Accordingly, the WFD has formulated biota quality standards (BQS) which refer to concentrations of compounds that have to be monitored in fish and invertebrates. In the present study we are investigating the reliability and relevance of BQS by studying the relationships between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being established to construct the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO452 Personal care products (PCPs) in the southeastern coast of Brazil: Characterization of the method and environmental occurrence
T. Combi, Instituto Oceanográfico de Universidade de São Paulo / Instituto Oceanográfico; R.C. Montone, Universidade de Sao Paulo / Oceanographic Institute
The use of large amounts of personal care products (PCPs), flame retardants, and others) threatens water, as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.
have been recently detected. Consequently, their study has become a priority among the main bodies responsible for protecting public health and the environment, such as the European Commission and USEPA. However, the current knowledge about the occurrence and fate of PCPs is still scarce, especially in less developed or developing countries as Brazil. Thus, this study aims to evaluate the occurrence of PCPs in surface sediments of selected areas along the southern and southeastern Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained from surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyzes (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHMCh) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction solvents and clean-up procedures to improve the detection and quantification of these compounds. The final results of this work will provide the first extensive dataset on the occurrence, levels and fate of PCPs in the Southern Atlantic which will not only contribute with new and rather scarce data but also with valuable information for regional and global inventories.

**MO453**
IFRA Environmental Standards and RIFM Safety Assessment Program Advances Update for 2018
A. Łapczynski, RIFM / Environmental Science; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; C. Gonzalez, IFRA

To assure safety of fragrance ingredients in consumer products, International Fragrance Association (IFRA) established 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 evaluated. Risk refinement in an effort to provide greater transparency to the IFRA Environmental Standards, RIFM reports the most recent results of these additional tests (for both risk and hazard assessments) at both the annual SETAC NA and Europe meetings. These studies include persistence testing (ready biodegradation tests and die-away studies), bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented.

**MO454**
Comparison of different sampling techniques for the identification fire effluents from low-density polyethylene burning
A. Badjah, King Fahad Security College / Forensic Science Department; A.A. Stec, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing; Y. Badjah-Hadj-Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing.

High amounts of various polymers are being used in many fields with numerous benefits. However, their great ability to ignition and rapid flame spreading make these materials dangerous for human life and properties due to the release of highly toxic combustion products. The present work aims to investigate several methods of sampling and analysis of 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, tedar 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 tedar 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**
Pb/Tk modelling of super-hydrophobic chemicals
W. Lutisch, K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry

It is a widespread opinion that super-hydrophobic chemicals are not taken up by fish [1–3]. But so far, we haven’t seen sufficient evidence why they should not cross membranes or aqueous boundary layers, although these processes might be kinetically slow. Super-hydrophobic chemicals are very challenging for controlled exposure experiments. Here we use the few existing data points of a fish feeding study with Dechlorane (log Kow (estimated) = 11.6) with our recently published Pb/Tk model, Tk-fish, to shed more light on this issue. We first validated the oral up-take pathway in our model and found that facilitated transport via albumin and bile micelles through the aqueous boundary layers must accounted for, while hydrophobic chemicals such as HCB in order to get correct results. Subsequent simulations with the super-hydrophobic chemical Dechlorane revealed that for an oral uptake route the diffusive transport through aqueous boundary layers in the gastro-intestinal tract and in the blood is indeed the limiting process. Good agreement of the predicted model results with measured values indicates that there is no principal hindrance for the oral up-take of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Ellsberry C, Perdu-Durand E, Demmerle S, Cravedi J-P. 2008. In vitro biotransformation of surfactants in fish. Part I: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakurutani Y, Noguchi Y, Kobayashi K, Yamada J, Nishiura T. 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J. Environ. Biol. 29:89—92. 3. 2016. Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.11: PBT/vPvB assessment Draft Version 3.0,European Chemicals Agency, Helsinki. https://echa.europa.eu/documents/10162/23047722/fr_csa_r11_pbt Peg_en.pdf/dd ac9031-aa44-995-e8c7-373816ba4e8

**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. 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. Banks, VETAGRO-SUP / Toxicology

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

**MO459**
Main scientific gaps 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 on knowledge of deliberate poisoning to [migratory] wildlife globally
M. Odlin, Independent Environmental Services Professional

**Big data analysis in ecotoxicology: how to get new information out of existing data? (P)**

**TU001**
Holistic evaluation of long-term field effect earthworm studies with the fungicide Bosalcid
F. Staub, BASF SE; S. Roembeke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF SE; S. Braeker, BASF France S.A.S.

In order to place a plant protection product on the market, the product and its active substances need to demonstrate an acceptable risk to earthworm communities. The current European risk assessment scheme follows a tiered approach using worst case environmental concentrations and endpoints from earthworm reproduction laboratory studies in tier 1. For the active ingredient Boscalid no risk to earthworms has been identified based on the chronic laboratory studies provided by BASF to EU registration authorities. However, for one of the formulated products containing Boscalid the tier 1 assessment did not allow to exclude a potential
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set under the hypothesis that operating putting representativeness/comparability of examined earthworm communities, site- and soil properties of the different locations as criteria in the analysis. Based on these criteria a statistical assessments of representative and comparable earthworm communities in relation to the field exposure were conducted. The assessment revealed that – using data from representative and comparable study sites - there was no concentration related effect of a five-year use of the product regarding diversity and abundance of different earthworm communities.

TU002 Contextualising statistically significant differences observed in mesocosm studying 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, being demanded by regulatory authorities. Therefore, the results of a single mesocosm study can be challenging. One option is to contextualise the experimental results from a single study using available historical control data; this is an approach often used for laboratory studies performed under standard conditions. It is, therefore, proposed that this approach can be extrapolated to mesocosm studies, given that they are also performed under standardised conditions as much as possible.

Cambridge Environmental Assessments (CEA) have a wealth of control data from historical mesocosm studies, with samples collected in spring, summer and autumn, thus capturing the variability in population and community dynamics over multiple years and seasons. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU003 Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantic 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 specific autecological preferences and ecological niches. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU004 ECOTOX Knowledgebase: New tools for data visualization and database interoperability
C. Elonen, U.S. EPA/ORD/NHEERL; J. Olker, C. LaLone, U.S. EPA / Mid Continent Ecology Division; D. J. Hoff, U.S. EPA ORD / Mid Continent Ecology Division; S. Erickson, M. Skopinski, S. Casey, A. Pilli, K.A. Fay, CSRA, Inc. The ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated database of single chemical toxicity effects data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX Knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemical substances for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 1000 fields. Study details such as species, taxonomic hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, 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 new tools will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.

TU005 Edaphostat - A web application for automated and interactive meta-analysis of environmental data from the Edaphobase data warehouse
L. Hassen, RWTH Aachen University; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research
A steadily increasing number of databases in ecotoxicology and ecology combine and merge data from different studies and research programs. Usage of these databases promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automated analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from different regions of the world and take into account the variability and specificity of soil organisms. The database promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automated analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from different regions of the world and take into account the variability and specificity of soil organisms. The database promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automated analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/).

TU006 Deriving USEtox aquatic freshwater toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program
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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” ([3], EU). The potential impact of these recommendations on the European chemicals sector was assessed by the authors of the European Chemicals Industry (ECHA) and the European Chemicals Industry Federation (CEFIC). This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer effects. For PEF/LCA, those data are required for thousands of chemicals using the most up-to-date information [4,5]. The EU commission Joint Research Centre has obtained from the chemical agencies (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 chemical groups, were established 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 properties - Chronic 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 data: needs for thousands of chemicals using R-Studio program software
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Product Environmental Footprint (PEF) and Organisational Environmental Footprint Assessment Tool (OEFT) are 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. The toxic properties are measured for cancer and non-cancer effects. For PEF/CA, those data are required for thousands of chemicals using the most up-to-date information. The EU commission Joint Research Centre has obtained from the chemical agency (ECHA) for more than eight thousand chemicals data regarding physico-chemical properties (166‘926 test results, as of March 2017) available in the IUCLID 5.5 database. These data have been processed to automatically derive accurate values for six of the physico-chemical properties required by USEtox for fate modelling. Kow, Koc, vapour pressure, water solubility, Henry law constant and 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 Klimasch scores), purpose and study type. Moreover, other specific criteria were defined for each properties according to the method used, such as experimental condition (temperature and pH). Geometric mean and the coefficient of variation, for their reliability evaluation, of the consistent data selected was performed. A correlation analysis of the results with values previously included in USEtox and with values obtained with computational methods (QSR@Tox and PROTER) 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. schiaivo, ENEA CR; s. manzo, ENEA / SSPT-PROTER-BES Nanotechnology is a rapidly expanding field of research continuously producing novel materials with nanoscale properties (nanomaterials, NMs), as result, it is inevitable that NMs will enter the aquatic environment. Usually the ecotoxicological approach is generally based on a battery of bioassays with organisms belonging to trophic levels, which is the approach to estimate the endpoint for each species. While these endpoints, taken individually, can indicate the presence of a potentially deleterious effect, it is often difficult to combine these effects into an assessment of the overall status for the selected environment. Therefore is necessary to integrate all results to evaluate the risk for NMs. To synthesize the results obtained with a battery of ecotoxicological tests, different approaches were tested, such as Toxicity test battery integrated index (TBI). This index has the advantage to put in evidence the differences between the samples. However there are still some open issues and TBI integration procedure needed to be modified according to testing sample or substance in order to represent the test sensitivity towards the matrices. In particular, when NMs are investigated also different physico-chemical behaviour and interaction with organisms should be taken into account. Therefore, the aim of this work is to study the suitability of TBI procedure for the NM to determine the needed modification for tailoring the data integration. In particular, we considered metal bearing nanoparticles (NPs) such as TiO₂, SiO₂ and ZnO and a battery of toxicity test with organisms of different biological complexity and representative of different trophic levels with the aim to establish a unique toxicity ranking. From the analysis of the results integration with TBI it could be highlighted that to define the hazard associated with NPs is necessary to tailor the index parameters on specific NMs physico-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009 Historical analysis of the use of plant protection products in apple orchards (1970-2014): Combining handwritten farmers records with electronic data
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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, but also the potential impacts on 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 and correct errors in the indicated dosage or field size. Finally, a dataset of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-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 first digitise handwritten data, before the digitalisation process can be performed. 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 The long-term majority of research regarding neonicotinoids (NNs) has been focused on pollinator species; however, little work has been done to investigate the potential long-term impacts of these pesticides on other taxa, such as farmland birds. Birds can be directly exposed to NNs via two main exposure routes: ingestion of NN-coated grain, or seedlings germinated from coated grain. With bird abundance data, NN usage records and UK cropping data, a poisson log-linear generalised mixed model was used to investigate whether there are any impacts of NN use on farmland bird populations over a period of 21 years. Specifically, the main objectives of this study were to 1) establish whether there is a relationship between species population growth and NN usage in the UK, 2) establish whether species traits, such as body weight and home range are correlated with any effect of NNs on species population growth, 3) examine whether NNs (direct) were 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 variable. 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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We characterized spatial patterns of surface sediment concentrations of seven polychlorinated biphenyls (PCBs), seven polycyclic aromatic hydrocarbons (PAHs), three chlorinated pesticides and five metals in Norwegian waters and Skagerrak. In total, we analysed 5,036 concentrations of 22 chemical substances that were measured between 1986 and 2014 at 333 sampling sites by means of generalized additive models (GAMs). We found that GAMs with organic carbon content of the sediment and latitude and longitude as covariates explained ca. 75% of the variability of the contaminant sediment concentrations. For metals, a predominantly hotspot-driven spatial pattern was found, i.e. we identified historical pollution hotspots (e.g. Sørfjord in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated and industrialized 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-evolving bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

TU012 Application of a ‘weight-of-evidence’ model for assessing sediment quality and associated hazard with offshore gas platforms discharging produced water

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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 size and industrial regions. In the Kattegat study, a multidisciplinary approach including chemical analyses, grain size analysis and bioassays on marine sediment, together with bioaccumulation and biomarker investigations 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 sampling was centered on Adriatic region 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 composed by two Vibrio species (V. fischeri; Donaliella teres, D. 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 size and industrial regions, bioaccumulation and bioassays 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 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

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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 as malaria vector control agent is still allowed. This practice is not without controversy and reports on ecological and human health effects are increasing. The Phongolo River floodplain in the sk malaria area where DDT is used as vector control or monitoring along with more traditional indexes. DDT and DDT metabolites are 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 (chelatase, superoxide dismutase, malate dehydrogenase, 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 - Hydrocyon vitatus and Mudfish - Oryzias latipes) display a higher DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-Hexachlorocyclohexane, were included in the analysis, significant relationships with cytochrome P450 and lipid energy reserves were observed. The result therefore indicated that biological responses were not related to DDT but rather to HCH exposure.

Microbial community ecotoxicity in environmental risk assessment and ecosystem monitoring (P)

TU014 Identifying bacterial indicator taxa along an urbanization gradient in stream ecosystems

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The extent of high throughput sequencing (HTS) enabled microbial e(cotoxic)ologists to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microorganisms led us to focus our analyses mainly at the community or phylum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we track the move beyond bacterial communities to explore the highest DDT 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 Xanthobacteraceae (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 occurred at very low levels of urbanization patterns and explored the full potential of microorganisms to urbanization and the potential of bacteria to be used in bioindication or monitoring along with more traditional indexes.

TU015 Diuron sorption in freshwater biontms: determination of isothersms

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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 Kjelrerp 2013) because of its great potential to integrate contaminants, bioavailability and display a toxic response. 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 concentration, suggested that pesticide uptake by microorganisms was not proportional to contaminant concentration in the water. For this experiment, we supposed that diuron absorbed by microorganisms and, in order to confirm this hypothesis, bioaccumulation and toxic impact were simultaneously assessed at the equilibrium. To that aim, mature biofilm previously grown on glass slides

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during one month was exposed in channels at 6 increasing concentrations of diuron: 0, 1, 5, 10, 25 and 50 µg.L⁻¹ for two hours, with a flow velocity of 2 cm.s⁻¹. Then, Langmuir isotherm equation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µL.g⁻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 adsorption in a biofilm of 1.0375 g.L⁻¹, and an equilibrium constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlighted a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium for the maximal capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about metabolism behaviour and impact in periphytic microorganisms.

TU016
New insights into the biotransformation of sulfurluramid: role of ammonia oxidizing bacteria and community shifts
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Emerging organic contaminants (EOCs), such as perfluoralkyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and humans. N-ethyl perfluorooctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide, Sulfluramid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated the biotransformation in laboratory microcosm, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-EtFOSA. This study used Allylthiourea (ATU), an inhibitor of ammonia monoxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Potrochlamydia increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU017
How can three herbicides impact the fatty acids of the freshwater diatom Gomphonema gracile?
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Fatty acids are essential elements for the structure of biological membranes and for the storage of metabolic energy. They are used as a source of energy by metabolism at each trophic level, making fatty acids biochemically and physiologically important compounds (Neves et al. 2015). In the trophic chain, many fatty acids are only synthesized by microalgae and bacteria before being transferred via herbivorous invertebrates to fish and ultimately to humans (Arts et al. 2001). For example, highly unsaturated fatty acids (HUFAs) such as eicosapentaenoic acid (EPA; C20:5n3), can not be synthesized de novo or in insufficient proportions by animals on their diet, but have to be transferred via the diet to study trophic interactions in food chains. Generally, microalgae with a high proportion of EPA, such as diatoms, are an excellent source of fatty acids for both humans and the excretion of these different fatty acids can vary according to the stage of growth of the organism and according to different environmental parameters including pesticide exposure (Brett et al. 2006, Robert et al. 2007, Burns et al. 2011, Finazzi et al. 2016). Moreover, for several years, the intensive use of pesticides has caused many problems to the environment, making pesticides major pollutants of aquatic ecosystems (Aydinlap and Porca 2004). The aim of this study is to investigate the impact of 3 pesticides on diatoms’ fatty acids. To address this issue, a model freshwater diatom (Gomphonema gracile) was exposed to three herbicides, with three different cellular targets, at environmentally relevant and higher concentrations (diuron and S-metolachlor, C1= 1 µg/L and C2= 10 µg.L⁻¹; glyphosate, C1= 5 µg/L and C2= 50 µg.L⁻¹). After a 1-week exposure, fatty acid compositions of diatoms were determined by gas chromatography. In comparison with control samples the percentage of 1 polyunsaturated fatty acids (PUFA) decreased with S-metolachlor contamination (C2); 2) saturated fatty acid (SFA) and monounsaturated (MUFA) decreased with diuron and glyphosate exposure (C2). The decrease of PUFA is a direct impact and can be explained by the mode of action of S-metolachlor which inhibits elongases. Concerning diuron and glyphosate, the decrease of SFA and MUFA can reflect an indirect effect, which can be explained by the mode of action of these two pesticides which respectively blocks electron transfer in photosynthesis, and inhibits the synthesis of aromatic aminocids.

TU018
Effects of Nickel on cell cycle progression, growth and antioxidant enzymes of green algae C. reinhardii
M. Saenz, PRIET CONICET, National University of Luján; k. Bisova, Laboratory for the Study of Plant Cell and Developmental Physiology; D. M. Di Marizio, CONICET-PRIET / PRIET

Freshwater ecosystems received industrial and domestic sewage discharged and natural chemical compounds as a result of anthropogenic activities. Heavy metals released in the environment have increased over the last decades causing environmental and human health problems worldwide. The known biological adverse effects of metals include growth disorders, disturbance of mitochondrial and pigments synthesis pathways, induction of oxidative stress, mutagenic effects, among others. Among aquatic organism, microalgae have an important role in aquatic system as they are a key component of food chains. So, that is crucial to has early assessment tools to evaluate effects of metals at the cellular level. In the present study effects of Nickel was evaluated on cell cycle progression, growth and antioxidant enzymes kinetic of the green algae C. reinhardii. Synchronized cultures of this multiple fission dividing algae were used for the study. Aliquot from growing cultures were taken hourly during 36 hours. The attainment of commitment points (CP) was evaluated by transferring hourly aliquot into aerated tubes at 50 °C in the dark. Analysis of cellular division, nuclear division (DAPI stain) changes in cell size, were performed. The proportion of mother cells and daughter cells were assessed at the end of the cell cycle. Toxicity of metal was assessed by algal growth inhibition test, estimating toxicity endpoints, growth rates, protein, antioxidant enzymes activities of catalase, guaiacol peroxidase, ascorbate peroxidase, glutathion reductase and concentration of chlorophyll a, chlorophyll b and carotenoids at the end of 96 h of exposition. Nickel provoked a block of cell cycle at the highest concentration tested. At lower concentrations, cell cycle progression was observed with different pattern of attained CP, depending the exposure concentration. Antioxidant enzyme activities were inhibited at concentration above 0.05 and 1 mg/L. The effects of metal on pigment concentration was less evident than the effects on growth rates, indicating a lower sensitivity of these parameters. Nickel provoked severe damage on algal cell division, cell cycle progression, and metabolic processes as well as modulation of antioxidant enzymes activities. An integrated analysis is done discussing the consequences on population performance in natural environment after metal discharged from different anthropogenic sources.

TU019
Use of BioligEcoPlateTM to evaluate the effects of ZnO nanoparticles on soil microbial communities
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Nanoagrochemicals seem to be the new frontier in modern agriculture due to their increased environmental efficiency and to the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used as nanofertilizers as their increased efficacy, durability, and to the reduction of the amount of applied fertilizer. Zinc oxide nanoparticles have increased use in agriculture due to their binding properties and their nanoscale size. Zinc oxide nanoparticles have been largely used as nanofertilizers as their increased efficacy, durability, and to the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used as nanofertilizers as their increased efficacy, durability, and to the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used as nanofertilizers as their increased efficacy, durability, and to the reduction of the amount of applied fertilizer.

Effects of Nickel on cell cycle progression, growth and antioxidant enzymes of green algae C. reinhardii
M. Saenz, PRIET CONICET, National University of Luján; k. Bisova, Laboratory for the Study of Plant Cell and Developmental Physiology; D. M. Di Marizio, CONICET-PRIET / PRIET

Freshwater ecosystems received industrial and domestic sewage discharged and natural chemical compounds as a result of anthropogenic activities. Heavy metals released in the environment have increased over the last decades causing environmental and human health problems worldwide. The known biological adverse effects of metals include growth disorders, disturbance of mitochondrial and pigments synthesis pathways, induction of oxidative stress, mutagenic effects, among others. Among aquatic organism, microalgae have an important role in aquatic system as they are a key component of food chains. So, that is crucial to has early assessment tools to evaluate effects of metals at the cellular level. In the present study effects of Nickel was evaluated on cell cycle progression, growth and antioxidant enzymes kinetic of the green algae C. reinhardii. Synchronized cultures of this multiple fission divide algae were used for the study. Aliquot from growing cultures were taken hourly during 36 hours. The attainment of commitment points (CP) was evaluated by transferring hourly aliquot into aerated tubes at 50 °C in the dark. Analysis of cellular division, nuclear division (DAPI stain) changes in cell size, were performed. The proportion of mother cells and daughter cells were assessed at the end of the cell cycle. Toxicity of metal was assessed by algal growth inhibition test, estimating toxicity endpoints, growth rates, protein, antioxidant enzymes activities of catalase, guaiacol peroxidase, ascorbate peroxidase, glutathion reductase and concentration of chlorophyll a, chlorophyll b and carotenoids at the end of 96 h of exposition. Nickel provoked a block of cell cycle at the highest concentration tested. At lower concentrations, cell cycle progression was observed with different pattern of attained CP, depending the exposure concentration. Antioxidant enzyme activities were inhibited at concentration above 0.05 and 1 mg/L. The effects of metal on pigment concentration was less evident than the effects on growth rates, indicating a lower sensitivity of these parameters. Nickel provoked severe damage on algal cell division, cell cycle progression, and metabolic processes as well as modulation of antioxidant enzymes activities. An integrated analysis is done discussing the consequences on population performance in natural environment after metal discharged from different anthropogenic sources.
was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiologEcoplate approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TJ020 Environmental factors-regulated disease dynamics of tilapia lake virus (TilTV) transmission in farmed tilapia ponds

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BACKGROUND: Outbreaks of tilapia lake virus (TilTV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TilTV 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 TilTV 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 TilTV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explore the TilTV highly artificial environmental conditions, optimizing some of the environmental conditions, the experiment was conducted. The mortality-susceptible-infectious-mortality (SIM) model was applied to describe cumulative mortality data to estimate mortality rate (α), transmission rate (β), and basic reproductive number (R₀) for Nile tilapia posed by TilTV under treatment of colibactin.

RESULTS: In toxicity assay, LD50 estimate of Nile tilapia infected by I.P. injection with different TilTV dosage was 5712.7 TCID50 mL⁻¹ and the TilTV sensitivity to CuO remained at a similar level in the standard OECD medium (EC₅₀), and cyanobacterium, that has the smallest cell of the four tested species, was differed over orders of magnitude in ANW (EC₅₀) for Nile tilapia posed by TilTV under treatment of colibactin.

CONCLUSIONS: TilTV transmission could be affected by environmental factors such as temperature and aquaculture density. Results of toxicity assay and disease epidemiology could provide insights into aquaculture management of TilTV disease by controlling potential factors in tilapia ponds. Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

TJ021 Natural organic matter alleviates TiO2 and CuO nanoparticle toxicity in four algal species

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Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted in TilTV highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoated CuO (CuSO₄ as toxic control) and TiO₂ NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-adjusted natural water (ANW) and the OECD201 standard medium, using four freshwater species from three major algal groups: green algae (Chlorococcales species), diatoms (Chaetoceros tenuissimus) and cyanobacteria (Synechocystis sp). Metal toxicity on both parameters at 72 h was reduced in ANW in all algal species except the cyanobacterium, presumably because of natural organic matter (NOM) binding to the NPs and solubilized ions. The biofilm-forming diatom was most resistant to NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO₂ at concentrations up to 100 µg/mL. CuO, significantly inhibited biomass production of both green algae in the standard medium (EC₅₀ 143-41 mL/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 ultrastructural heteroagglomeration. Overall, Fv/Fm was a less sensitive toxicity endpoint than biomass, but the two parameters were strongly correlated (Spearman’s r=0.6-0.9) when toxicity was evident, again proving Fv/Fm as a rapid method for toxicity detection. The observed discrepancies in toxicity indicate that using different model organisms, experimental endpoints and conditions could provide valuable information about the behavior of emerging contaminants in the environment, thus improving the quality of risk assessment. Research was funded by IUT23-5.

TJ022 Chlorinated solvent contaminated groundwater: a glimpse inside the environmental microbial communities and their potential for bioremediation

P. Pretto, R. Ricci, Biosearch Ambiente; T. Lettieri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Chloroethenes are among the most frequent pollutants affecting groundwater in Northern Italy due primarily to their extensive industrial use and release into the environment. As many contaminants released in the environment because of inadequate disposal, they accumulate and persist in the ecosystem posing a threat for human and environmental health. Degradation of such harmful xenobiotics can occur thanks to the activity of autochthonous microbial communities able to break down the more chlorinated compound to lesser chlorinated ethenes which need to be detoxified as well. Bacteria able to metabolize such toxic substances are indeed well known as well as many of their metabolic pathways, but still an efficient and complete detoxification process is hard to achieve. The understanding of the microbial activity underlying the whole process is crucial especially during a bioremediation process where microbes are stimulated through the amendment of nutrients in order to obtain the complete detoxification. The huge impact of metagenomics, and other molecular biology techniques for the comprehension of microbial composition and activities in different environments, is helping to shed light for the comprehension of the critical apparatus behind the detoxification process but we are still at the beginning. During the present work, two microbial populations inhabiting a chlorinated solvent polluted groundwater, with and without nutrient amendment, have been analyzed after whole genomic DNA extraction and sequencing. The data analysis, together with the chemical ones, will help to enlighten the differences between the two populations in terms of genes expression and potential of biochemical pathways for pollutants’ biodegradation in relation to the chemical and geochemical parameter characterizing the specific site. Metagenomics of polluted sites is a powerful tool that could help in the future to define the best strategy to employ in order to obtain a complete environmental detoxification. This approach will be useful both for companies operating in soil and water recovery and for policy makers.

TJ023 Impact of the antihistamine fexofenadine on structure and functioning of less acidified microbial communities in a microcosm study

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Efficacy of pharmaceuticals and personal care products (PPCPs) in aquatic ecosystems is being investigated, due to the complex nature of their mixtures. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to estimate microbial communities’ structural or functional composition. Although antibiotics and fungicides are 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 fungal and bacterial diversity. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to analyze total organic carbon. After 15 days of exposure, there was a tendency towards reduced decomposition of black alder leaves (~40%) in both fexofenadine treatments, while after 30 days, decomposition in the 200-µg/L treatment was increased by ~45% (but both not significantly different from the control). On the contrary, the decomposition of hay tended to be increased by fexofenadine exposure after 15 days. After 30 days no differences could be observed among fexofenadine treatments for hay, while generally more hay was decomposed than black alder. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure led to phylogenetic differences to an increased proportion of microbially-derived DOC. These observations suggest that the microbial communities’ structure and/or functional composition differ between the two tested substrates as well as among the antihistamine treatments. Moreover, potential implications in carbon and nutrient fluxes in exposed systems are indicated as the detected alterations in DOC quality may affect planktonic decomposer communities that are involved in DOC’s mineralization in surface waters. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing variables related to microbial community structure and functioning.

TJ024 Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project I N T C A T C H

M.D. Seriemshaw, Brunel University / Institute for the Environment; S. Marchegiani, Italian Institute of Health ISS / Environment Health; M. Caere, Italian Institute of Health ISS; O. Tcheremenskaia, Italian Institute of Health ISS / Department of Aquatic Sciences and Assessment
Microbial communities provide a large range of ecosystem services such as primary effects on ecosystems, it is essential to consider higher levels of ecological tolerance measurements to pinpoint specific effects of metals at the community level. Interestingly, tolerance measurements to copper were strongly and positively associated with the fact that microbial communities in sediments support the concept by measuring the inhibition of bacterial secondary production and the community composition. Moreover, tolerance of microbial communities to copper contamination, ranging from 30 to 350 mg kg\(^{-1}\), was determined according to the pollution gradient by heavy metals in lake Geneva. Sediments such as copper, zinc or silver can accumulate in lake sediments, which represent a 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 different environmental factors. Even though biofilms are highly dynamic, stresses are frequently 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 xenobiotics, differences in community tolerance towards herbiticides 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 OECD Test. Focusing on the phototrophic part of the biofilm communities, we investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photossynthesis) 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.

Until 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, F. Larra, Helmholtz Center for Environmental Research - UFZ GmbH; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology. C. Anlanger, U. Risse-Buhl, M. Weitere, Helmholtz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmitt-Janson, UFZ - Helmholtz Cite Environm. Research / Department of Bioanalytical Ecotoxicology Biofilms in rivers are complex communities built of bacteria, fungi, algae and protozoa embedded in a matrix of extracellular polymeric substances (EPS). They are important hotspots for biogeochemical processes in aquatic systems. A variety of stressors can potentially affect the structure and function of biofilms. Therefore, their tolerance to one stressor may be influenced by former exposures to another stressor. Community composition and physical structure is influenced by different environmental factors. Even though biofilms are highly dynamic. The impact of stressors that are 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 xenobiotics, 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 OECD Test. Focusing on the phototrophic part of the biofilm communities, we investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photossynthesis) and 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.

Since T027 Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf decomposition -? A case study using species-specific qPCR assays N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, N. Roedig, University of Koblenz-Landau / Institute for Environmental Sciences; M. Kowalschak, University Koblenz-Landau / Institute for Environmental Sciences; L. Binsvik, University Kassel; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology; M. Krueger, University of Koblenz-Landau / Institute for Environmental Sciences; M. Krueger, University 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 impact of a model fungicide mixture to the growth of 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 (Aloatospora acuminata, Heliscella stellata, Neocentria lagunensis and Tetracladium marshallianum), was exposed to the model fungicide mixture. Although the fungicide mixture contained different substances with different modes of toxic action (four sum concentrations ranging from 5 to 2500 μg/L and a fungicide-free control, n=5; N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 μg/L resulting in significantly reduced abundances. Interestingly, only the two tolerant species (i.e., N. lagunensis and T. marshallianum) were capable of decomposing leaf material to a significant degree. Moreover, abundances of single species within the model communities as well as their functioning were governed by dominance interactions (e.g., one species outcompeting the other), probably as a result of competition for leaf substrate. Despite the species composition interactions, interactions...
resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species

Bioaccumulation levels of Cu in the young biofilm (20 days) were similar between the colonial, 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 that the dissolved Cu concentrations at different times of the experiment and after 20 and 40 days in the different fractions of the biofilm. The results showed constant dissolved Cu concentrations (5 µg/L). Species-specific qPCR assays proved to be a valuable tool for assessing ecotoxological effects on well-defined ecological interactions within aquatic hypertrophic environments. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring.

TU029
Cyanobacterial Bloom in the Lake Varese: Characterisation of Microbial Communities by Metagenomics analysis

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The increasing anthropogenic eutrophication and climate changes are contributing to the intense proliferation of cyanobacteria in waterbodies so causing a phenomenon known as bloom which may compromise the quality of drinking and recreational water. The dynamics of bloom events are not yet fully understood, however it is scientifically accepted that external factors such as water temperature, nutrient concentrations and light intensity, may influence the potential of a bloom. Our study focuses on the relationship between environmental factors and the composition of the microbial community of the lake Varese (Italy) for a period of several weeks before and after the bloom event. Sampling campaigns were performed on a weekly basis. Water samples were collected from the depht region of 0.5 m from surface depth (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCHI). The samples were characterised for their chlorophyll a content, nutrients, cyanotoxins and genomic DNA was extracted for metagenomics. Purified DNA samples were subjected to 16S sequencing (variable region V3-V4) and for shotgun analysis. All 16S samples were MiSeq sequenced as 2x250bp paired reads, the corresponding shotgun samples as 100bp paired reads. Shotgun analysis was performed for sample collected from 31/8/2016 until 5/10/2016 and only for EPI and 2.5x SECCHI. The results showed that a peak of cyanobacteria was observed around 14/9/21.9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the EPI samples. For the other environmental parameters, chlorophyll b was also observed for proteobacteria and actinobacteria. Our result suggests that the major differences in bacterial community composition during the bloom are concentrated in the SECCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanotoxin data although comparison with 18S based results would be recommended in order to discard a possible contribution of phototrophic eukaryotes.

TU030
Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope

A. Dabrin, Irstea / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP); J. Gahou, Irstea Lyon-Villeurbanne; m. masson, c. brosse, Irstea Lyon; B. Volat, Irstea Lyon-Villeurbanne; C. Bonnineau, Irstea Lyon; S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; M. Coquery, Irstea Centre de Lyon - Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP)

In small streams, microbial communities form river biofilms attached to solid substrates by producing extracellular polymeric substances (EPS). This matrix may act as a protective layer by limiting cellular contact with surface water contaminants. Thus, several studies have suggested that during biofilm growth, biofilm and EPS matrix thickness could limit cellular bioaccumulation. To test this hypothesis, a study on the biofilm development of the overlying community composition was also observed for proteobacteria and actinobacteria. Our result suggests that the major differences in bacterial community composition during the bloom are concentrated in the SECCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanotoxin data although comparison with 18S based results would be recommended in order to discard a possible contribution of phototrophic eukaryotes.

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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 Compositional and Functional Shift in Biodiesel vs. Petrodiesel Contaminated Soils
D.L. Carr, Texas Tech University / Biological Sciences; M. Dong, Texas Tech University / Biological Science

The spill of petrodiesel on land can irreversibly damage the soil ecosystem, and there are limited studies comparing petrodiesel and biodiesel impacts on soil microbial communities. Biodiesel has been considered as a viable substitute for petrodiesel, however, biodiesel which is biodiesel is more microbial friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolog EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesel were not statistically different from petrodiesel in terms of their adverse impacts on soil microbial communities. In conclusion, our results suggested that biodiesel should not be automatically understood under different pedo-climatic conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green algae was sensitive to alkalinity, SO4 2- and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green algae responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbamazepine/ibersartan/valsartan induced growth inhibition of N. palea and N. pelliculosa, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidasoa. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).

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

TU035
Can post mortem data be used to monitor population health in response in the barn owl?
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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) physiology (e.g. heart rate, respiratory rate, haematology) 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 expanded or contracted would indicate if the ratios for recently captured adult and first-year birds could be considered collectively. For many indices males and females needed to be studied separately due to sexual dimorphism. Females had significantly heavier mean body weights than males (287g vs 258g) but there was extensive overlap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat deposits were 23.65% and 28.75% for females and males, respectively. The level of kurtosis within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.

TU036
Identifying suitable marine biomonitor in South Africa: Mussels vs Whelks
C. Sparks, Cape Peninsula University of Technology / Conservation and marine science; W. Samuels, Cape Peninsula University of Technology / Department of Conservation and Marine Science; E.D. Potter, NERC Centre for Ecology and Hydrology / Lancaster; R. Shore, Centre for Ecology & Hydrology (NERC)

Over the last three decades there has been a significant decline in marine pollution monitoring-related studies in South Africa. Very little research has been conducted to assess the prevalence of imposex in whelks and also very few studies have been conducted on comparisons between contaminants in different marine invertebrates at the same sites. The current study was conducted in July 2017 to compare metal bioconcentration between mussels (Mytilus galloprovincialis) and whelks (Bancapna lageneria) as well as measure imposex prevalence in B. lageneria at Bloubergstrand, Granger Bay and Green Point, Cape Town, South Africa. This was done in order to identify suitable bioindicators of ecotoxicity by determining whether the mussels and whelks bioaccumulate metals in the same way and to assess imposex prevalence in whelks (as an indicator of tributyltin contamination). The bioconcentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Cu, Ni, Mg, Cd and Pb) were measured in intertidal sediment, M. galloprovincialis and B. lageneria and imposex prevalence recorded in B. lageneria. Results showed that the highest prevalence of imposex in whelks and metal concentrations were recorded Granger Bay, an area of high boating activity. The most important result was that the whelks had higher bioconcentrations of metals than the mussels at all sites. Identifying biomonitor should be linked to purpose of investigation before selection of species, and mussels have been considered ‘ideal’ bioindicators of contamination in South Africa. Given the ubiquitous distribution of B. lageneria along the South African coast, which is not the case for M. galloprovincialis which only occurs on the west and south east of the country, the proposal is made that B. lageneria could be considered as alternative bioindicators of ecotoxicity of contaminants in the region.

Recent developments in environmental risk assessment for pollinators (P)

TU038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (bombus terrestris)
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinson, University of Oslo / Department of Physics; K. Boga, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Biosciences

Bees are increasingly facing multiple and interacting threats. One of the threats that have received increased attention lately is neonicotinoids: a group of systemic, neuro-active pesticides that disturb the transmission of signals in the insect’s nervous system. In just a few years neonicotinoids have become the most widely used insecticide in the world, and protect a variety of crops against invertebrate pest. Despite being used in relatively small quantities, several studies have shown substantial effects of neonicotinoids on bee health and behaviour. In recent years, tests of neonicotinoids in field-realistic does. However, ecological and physiological traits vary among bee species and studies on honeybees may not provide satisfactory predictions for negative effects on other bee species. Using bumblebees, Bombus terrestris, the present study developed a new experimental method to quantify how chronic dietary exposure to the neonicotinoid imidacloprid affects learning, locomotor activity and consequently the ability to forage and thus pollinate in a non-Apis species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (sugar water), ranging from field realistic.
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (rewarding) and yellow water-filled (non-rewarding) artificial flowers were tested systematically in a flying arena. The bumblebees were tracked by cameras, allowing for analysis of the flowers choices, locomotor activity and all the flowers visited during numerous, simultaneous foraging bouts. This study shows the successful application of a new method to track bumblebee behaviour. Further, the study shows that learning and locomotor activity are negatively affected, in a dose-dependent manner, when bumblebees are exposed to imidacloprid. Moreover, we show that field-realistic doses of imidacloprid have negative effects on bumblebees.

Tu039 Sensitivity of honeybee larvae to PPPs and impact analysis based on EFSA Bee GD * R. Becker, BASF SE Agrarmarkt Limburgerhof; J. Lueckmann, Rikon 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. Does assessing all brood cells of a hive reduce uncertainty and increase sensitivity of the assessment? In case solitary bee risk assessments under realistic field conditions* is an ability of the scheme to correctly identify compounds of potential concern and consequently screen out those of low concern. The aforementioned analysis follows the principles described in the ECPA impact analysis (Miles and Alix 2013) and compared the first approach with the outcome based on laboratory studies. In...
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 terestris) versus honeybee (Apis mellifera) acute oral and contact toxicity - Preliminary results of ECPA company data evaluation - A. Dinger, Crop Science; K. E. Kuehn Institute; S. Alix, Dow AgroSciences / Risk Management; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; P. Campbell, Syngenta / Environmental Safety; M. Miles, Bayer CropScience UK / Environmental Safety; E. Pilling, Dow AgroSciences / REGULATORY Sciences; N. Ruddle, Syngenta Ltd / Product Safety; A. Sharples, FMC Agricultural Solutions; G. Weyman, ADAMA; L. H. N. Cardoso, ECPA

A preliminary data evaluation was conducted by ECPA companies to compare the sensitivity of bumblebees (Bombus terestris) 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 ECPA data evaluation of LD50 values indicates lower or similar contact sensitivity of bumblebees vs. honeybees. Similarly, lower or similar oral sensitivity of bumblebees vs. honeybees was determined with one exception for an insecticide that indicated higher acute oral bumblebee sensitivity compared to honeybees. For this insecticide, higher tier data indicates no negative impact on bumblebees at the maximum intended use rate. Overall, the ECPA company data evaluation indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

TU045 Bumblebee (Bombus spp.) 10 day feeding laboratory test design: First results from an ICP-PR ringtest - N. Exeler, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, Envigo; H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; A. Molitor, Eurofins AgroSciences GmbH; S. Vinall, Mambo-Tox Ltd; K. Amsel, BioChemagrar GmbH; S. Haupt, IBA/CON GmbH; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology

A decline in some pollinator species has led to an increasing pressure on political decision makers and regulatory bodies and resulted in a changing of existing risk assessment paradigms and testing approaches. The published and already revised EFSA GD on the risk assessment of PPP on pollinators includes apart from the honeybees also bumblebees and solitary bees. In the need to address long term effects on bumblebees the ICP-PR Non-Apis working group designed a ring test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honeybee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity test guideline OECD 247 a 10 day feeding test was set up using dimethoate as reference substance. The response of adult Bombus spp. workers to the test chemical Dinethoate EC-400 (Perfekthion) was evaluated within a 10 day acute feeding laboratory test. The test item was provided as 50% liquid for a period of 10 days. During the exposure phase bumblebees are kept individually in cages – “single housing”. Bumblebees do not share food via trophallaxis and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen-less BB workers) potentially introducing mortality. Mortality and behavioral abnormalities in the test groups were observed and recorded daily and compared to the untreated control groups. The endpoints calculated were: LC50 (median lethal concentration) and LD50 (median lethal dietary dose) values after 10 days and if possible the NOEC (no observed effect concentration) and NOEDD (no observed effect dietary dose). First results indicate that with this method reproducible results were obtained. The mortality in the control groups seem not to exceed 15 % (evaluation currently ongoing) and the overall food consumption allowed for a proper evaluation of the intended endpoints.

TU046 Standardization of method to test toxicity on stingless bees - T. R. O. Mascarenhas, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Biology; R. Nocelli, UFS/Car / Departamento de Ciências da Natureza Matemática e Educação; O. Malasina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais Brazil is the country with the greatest diversity of bees in the world. The Brazilian bee fauna consists of 5 families: Andrenidae, Apidae, Colletidae, Halictidae, and Megachilidae. Within the Apidae family 19 tribes, among them the Meliponini, commonly known as “stingless bees” (Meliponinae). The family Apidae consists of 19 tribes, among them the Meliponini, commonly known as “stingless bees”. The family Apidae comprises 3 subfamilies: Xylocopinae, Nomadinae, and Apinae. The subfamily Apinae comprises 19 tribes, among them the Meliponini, commonly known as “stingless bees”. However, several species have been included in the list of endangered animals and there are many reports indicating a decrease in the abundance of all native species. To ensure protection of this huge diversity and continued growth of agriculture, it is important for Brazil to have a system to evaluate which compounds are safe for bees and efficient in agriculture. Current toxicity studies in bees are carried out with the Apis mellifera, but stingless bees present a very different behaviour and biology. The oviposition process, the internal care of the hive, the feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to European honeybee for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we use a modified LD50 of OECD (214) where the test substance were kept in 250 mL cages (ten bees were placed per cage, such that each treatment contained thirty bees from three colonies), fed in groups through microtubes (1.5 mL) punched in extremities, and kept in a chamber of biochemical oxygen demand (BOD) at 29 ± 2 °C, relative humidity of 70 ± 10% and in constant darkness. The diet used was composed of 50% (w/v) aqueous sugar solution. Our observations show that to perform the Acute Contact Toxicity Test for stingless bees some adaptations in OECD (214) are necessary, like to adjust the temperature of the incubator (29 ± 2 °C instead of 25 ± 2 °C), anesthesia should be done by cooling and the time should be adequate for each species. The development of these tests will allow the development of safer strategies for the protection of biodiversity and, at the same time, support the expansion of agriculture, which is an important socio-economic activity in the region.


The recently updated EFSA draft honey bee Guidance document also specifies other hymenopteran pollinators, like solitary bees and bumble bees, as groups to take into consideration when assessing the risk of plant protection products to pollinators. However no validated test protocol and consequently no extensive data set is available to compare sensitivities of other relevant pollinators to those of honey bees. Within the current project of the ICP-PR Non-Apis working group a study was made to develop a first-tier acute oral test for Osmia spp. bees. Based on the honey- and bumble bee guidelines OECD 213 and OECD 247 an acute oral test was designed using dimethoate as reference substance. Osmia bicornis and Osmia cornuta were housed individually and fed a known amount of test volume per dosage. First results indicate that with this method reproducible results were obtained. In these tests, control mortality never exceeded 12 percent. Furthermore, regarding sensitivities of O. cornuta and O. bicornis appeared to be rather similar, although O. cornuta showed a slightly less sensitive response, (which might be) due to its larger bodyweight. Hence, the LD50 values after 96 hours ranging from 2.6 – 7.1 ug a.i./bee indicate that a validated and workable methodology has been set up and a guideline is within reach.

TU048 2 Years of Solitary Bee Semi-field Ringtesting and Final Conclusions (ICPR Non-Apis Working Group) - S. Knuebe, EAS Ecotox GmbH / Ecotoxic Field; N. Exeler, Bayer AG, Crop Science Division; L. Franke, J. Fricke, Eurofins AgroSciences Ecotox GmbH / Ecotoxicology Field; M. Frommberger, Julius Kuehn Institut; T. Jitte, Julius Kuehn Institute; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology; O. Klein, Eurofins AgroSciences Ecotox GmbH / Ecotox Field; J. Lueckmann, Rifcon GmbH; H. Giffard, Testap; A. Rossbach, Tier3 Solutions GmbH / Field team; C. M. Schneider, BASF SE; A. Schnurr, BioChemagrar GmbH

The publication of the proposed EFSA risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set-up. The ringtest design was based on the EFSA guidance document, OEP/EPPO Guideline No. 170 and reports from discussions regarding the testing of solitary bee hives at the workshops of the ICPR non-Apis working group in 2015, 2016 and 2017 followed by a workshop in 2017 to harmonize methodology. Ringtests were conducted with two representatives of a solitary bee species (Osmia bicornis L. and Osmia cornuta Latr.; Hymenoptera, Megachilidae). These species are polylectic and can forage on a diverse spectrum of flowering crops. They are nesting in cavities. Both are common species in Europe commercially available and are widely used for pollination services. Several laboratories participated in the higher-tier ring tests. 8 semi-field tests were done in 2016and 9 in 2017. Two treatment groups were always included in the ringtest: an untreated control and dimethoate as a toxic reference item (optional other i.e. brood affecting substances (fenoxycarb)). In the study design adult bees were exposed in the tunnels during their reproductive period. Adult bees, as well as their offspring, were exposed to the treated pollen and nectar during development. Relevant endpoints for this study design are observations of the flight activity in front of the nesting units, nest occupation (i.e. number of nesting females), the production of complete cells and cocoons per female, the brood
terminating rate during the larval development as well as the success of emergence of their progeny (F1-generatation) 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  
T. Pamminger, BASF SE, Agrarzentrum Limburgerhof / Ecotoxicology; N. Heier, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE, I. C. Becker, New York State Dept. of Environmental Conservation / Biology; M. Bergtold, BASF SE  
Plant protection products (PPP) play a vital role in modern agricultural practice. Nevertheless, their potential off-target effects on managed (e.g. *Apis mellifera*) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In current risk assessment A. *mellifera* is often exposed to residues in pollen and nectar, leading to concerns about potential adverse effects of PPPs on non-Apis bee species. However, as robust and scientifically sound information regarding the sensitivity of non-Apis bee species are scarce the validity of this approach has been challenged. As a first step to address this question we have compiled a comparative data set of the *Acetylcholine Esterase* (*AChE*) inhibitors sensitivities of 21 bee species, covering five families of bees. Method validation and data set compilation on information on bee bodyweight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to *AChE* inhibitors and confirms that *A. mellifera* is particularly sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to *AChE* inhibitors, especially when concerning for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TT050** New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experience  
M. Persiashl, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH  
With the growing concern for insect populations and an increased awareness of the importance of pollinators in the public opinion as well as in the regulatory context related to PPPs, new approaches are required to measure exposure to 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 of pollinators to neonicotinoids and the methods discussed for the detection of residues as part of (semi-) field studies with bees in pollen, nectar and honey, studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home and garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TT052** Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees  
F. Viana-Silva, C. Dias, L. Borges, K. Cham, C. Tonelli, R. Oliveira, A. Alves, IBAMA / DIQUA CGASQ; R. Rebelo, IBAMA / CCONP  
Globally there are increasing concerns about possible decline in pollinators which requires that efforts be made in the direction of identifying its possible causes and in establishing policies for protecting pollinators. The Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) is responsible for environmental assessments in the context of pesticide registration in Brazil. Since 2011 IBAMA is implementing the risk assessment of pesticides in Brazil and one of the main aspects of this risk assessment is the establishment of appropriate risk assessment, their behaviors and their procedures to protect pollinator insects against pesticides effects. In this context, it was published in February 2017 the Normative Instruction 02 (NI 02/2017) that establishes procedures to risk assessment of pesticides to pollinators. This is the first Brazilian specific regulation based on a risk approach, and in July 2017 IBAMA published a Manual of Environmental Risk Assessment of Pesticides to Bees which explains in an accessible way how the normative should be applied. NI 02/2017 is widely based on US/Canada’s approach, which means that it focuses on *Apis mellifera* data; the models used for screening are Bee-Rex and AgDrift; tests required for tier 1 are the same and there is one scheme for foliar applications and other for soil/seed/trunk treatments. But there are few modifications: 4 tiers, the last one being post-registration monitoring; use of a safety factor of 10 for non-Apis bees; residue trials must be performed in Brazil and for tier 2 a crop grouping is considered. With this normative IBAMA expects that pesticides be used efficiently without incurring unacceptable risks to bees. Although IBAMA has a full framework for risk assessment established for honeybees there are still gaps in knowledge and research needs for ensuring that procedures to protect bees can be improved, especially regarding native bees. Hence, a matrix of selection for Brazilian bee species was proposed for selecting native species for use in pesticide risk assessment. This matrix provided the basis for selecting meliponines (stingless bees) as a priority group. In the near future IBAMA intends to assess the need of changes in the risk assessment procedure, eventually including a stingless bee as a representative species.

**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 and Institute (IBAMA) and comprises two steps: Hazard Potential Assessment and Environmental Risk Assessment. The Hazard assessment has been established since 1990 but the Risk Assessment, although required since 1996, only started to be implemented by IBAMA in 2012 and has been developing further since then. Due to numerous global discussions on the decline of pollinators, in February 2017 IBAMA published the first ruling (“normative”) to establish guidelines, requirements, and procedures for a systematic risk assessment scheme of pesticides for pollinators in Brazil. Further guidance for the scheme was issued later in 2017. The Brazilian overall approach is similar to EPA, but there are nuances in the Brazilian scheme regarding which active ingredients must be tested, and additional considerations for future which must be understood. Using hypothetical data from a mixture and a single substance we will show how the Brazilian risk assessment (“normative”) works for two use patterns, foliar and soil application, considering the main aspects of Tiers 1 and 2 of the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil.

**TT054** An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan  
Y. Kameda, Chiba Institute of Technology / Creative Engineering; E. Fujita, K. Tachta, Chiba Institute of Technology / Creative Engineering  
Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, acetamiprid, thiacloprid, clothianidin, dinofeturan, thiamethoxam and Nitenpyram 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. Therefore it is necessary to recognize the occurrence, their behaviors and their ecological risk in Japanese environment. Especially, there is little known about the exposure and ecological risk of neonicotinoids to wild bees in Japan though these neonicotinoids 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 neonicotinoid pesticides in foods are much higher than those in EU and the US and that some news have been reported that losses of wild honeybees occurred recently in Japan. The aim of this research is to reveal ecological risk assessment of honeybees including colony survival in Japan by ELISA analytical methods. The exposure assessment is conducted by neonicotinoids residue concentrations in adult honeybees, pupae, pollen and honey. These samples were collected from beekeepers around in Japan. Information about condition of colonies was also collected from beekeepers. Wild 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 of honey bee samples than those reported by previous reports in Europe, Canada and America. All colonies where adult honeybees were exposed by high concentrations were evaluated as abnormal condition such as CCDs, massive fatallies and sickbrood disease. Moreover, possibility of abnormality of colonies was strongly dependent on residue concentrations in adult honeybees. It was very interesting that EC50 values of colony abnormality, derived from this epidemiological research, were not much different from LC50 of adult bees. The values and the ELISA screening techniques could be one of easy warning values for beekeepers which indicate possibility of colony abnormality.

**TT055** Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation  
N. Rudlle, Syngenta Ltd / Product Safety; H. Thompson, Syngenta Ltd / Pesticide Residue Risk Management; J. Crowder, Syngenta Crop Protection, LLC / Environmental Safety; C. Elston, Syngenta Ltd; M.A. Feken, Syngenta / Ecological Risk Assessment; S. Bocksch, Eurofins AgroScience Services Ecotox GmbH / Ecotox Honeybees; P. Thoerbeck, Syngenta / Environmental Safety; M. Hill, Eurofins AgroScience Services Inc  
 Colony feeding studies were originally developed to directly assess the insect growth regulating properties of neonicotinoids and designed to determine mode of action rather than effect levels. More recently there has been regulatory interest in conducting colony feeding studies to determine the pesticide level in nectar substitute (sucrose solution) which leads to colony-level effects, thereby allowing
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 similar regardless of the control, confirming the NOEL as 50 µg/kg. The NOEL was determined to be 37.5 µg/kg. To assess the potential risk to honey bees from exposure to thiamethoxam and metabolite CGA322704 (clothianidin) residues in pollen and nectar, the NOEL and NOAEL can be compared to measured residues in treated or untreated crops. In a treated oilseed rape-exposure study (Pilling et al., 2013) the maximum thiamethoxam residues found in pollen and nectar were 1.0 µg/kg and 3.0 µg/kg, respectively. The residues of CGA322704 were below the 1.0 µg/kg LOQ. In an on-going study, residues in pollen and nectar in untreated succeeding crops of sugar beet were also found to be low. The maximum thiamethoxam residues in pollen and nectar were 2.6 and 0.55 µg/kg, respectively. A maximum CGA322704 residue of 6.3 µg/kg was detected in pollen, while residues in nectar were less than the 1.0 µg/kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of crops to levels of thiamethoxam in pollen and nectar of seed treated crops that are an order of magnitude lower than the no effect level observed in this study.

TU056
Alternation of the alternative splicing pattern in honeybees' nervous system gene as a tool to test pesticides toxicity
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 pattern of the Dscam (Down syndrome cell adhesion molecule) genes, which have an important role in the formation of neuronal system. Elav encodes proteins commonly used as neuronal markers in metazoans, which has action on post-transcriptional regulation and is required for differentiation and maintenance of the nervous system. Whereas that, Dscam gene can suffer alternative splicing from a 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 in brain tissue. For this purpose, we used primers 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. (Fasedp: 2015/222368-5).

TU057
Non-uniform distribution of treated sucrose solution via trophallaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates
L. Jehle, J. Steffen, Swiss Bee Research Center / Agroscope; Y. Christen, University of Applied Sciences and Arts Northwestern Switzerland
We compared the impact of the feeding regime group dosing with 10 bees versus group dosing with two bees per cage on the variability of the homing success rate, gene expression and mortality. Based on our own observations and the recently published publication (Brodtschneider, R. et al.)<sup>27</sup> 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 managed parameters among group members, replicates and treatments. For homing success rate and gene expression endpoints, bees were orally exposed to different sub-lethal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/beep, 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/beep, 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/beep, was significantly lower with ten bees compared to the two bees approach. A large variability of success rates and gene expression during treatment runs, replicates and treatments. We therefore highlight that feeding in smaller groups of honeybees should be considered and discussed 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>

TU058
Modelling and validation of honeybee foraging behaviour for the pesticide risk assessment
M. Wang, WSC Scientific GmbH / Dept Efate  Modelling; C. Dietrich, WSC Scientific GmbH
Recent years a number of population models have been developed for honeybees and some have been used for pesticide risk assessment. While the in-hive development of honeybees is relatively well understood and can be validated relatively easily in models, the accurate estimation of exposure is more complex and more difficult to validate. In particular, foraging behaviour, which is included explicitly only in very few models, plays an integral role for exposure, since it determines to what extent foragers collect nectar or pollen from treated or untreated crops and other habitats, or if they find alternative food sources. Foraging behaviour is also tightly related to weather. We therefore evaluate how foraging behaviour can be implemented and validated in a honeybee model simulating natural conditions, with particular focus on the risk assessment of pesticides and on the protection goals formulated in the recently published honeybee guidance.

TU059
Automated waggle dance decoding
M. Wang, WSC Scientific GmbH / Dept Efate  Modelling; J. Kleinmann, A. Görlisch, WSC Scientific GmbH
In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 90th exposure percentile is met. Practically, it is challenging to confirm where honeybees actually foraged. In recent years a variety of methods have been developed and tested to establish a kind of foraging maps, based on waggle dance observations analyses, harmonic radar or RFID chips. Most of these, however, can realistically be used only based on relatively few individual bees. We therefore explored options for an automated analysis of waggle dance in honeybees. The system should facilitate the use of standard hives and should be usable without a computer in the field. We evaluate the reliability of the method.

TU060
How to increase test power and understand risk in refined honeybee trials
A. Görlisch, WSC Scientific GmbH; M. Wang, WSC Scientific GmbH / Dept Efate  Modelling
For honeybee semi-field and field studies EFSA defined SPGs (specific protection goals) in its latest guidance document on the risk assessment of plant protection products (PPP) on bees. Detrimental effects on colony size as a result of PPPs should not exceed a 7% threshold to not endanger the fulfillment of the ecosystem service provided by honeybees. The measurement of effects on colony size as small as 7% is often difficult to achieve due to high uncertainty and variability both reducing the test power. By applying a modified field methodology and test design the test power can be increased substantially thus allowing to conduct field studies that are able to reach the SPGs. For the semi-field study colonies with sister queens of equal strength were used. From these a subset of colonies was selected based on higher foraging activities, which started approximately four weeks prior to exposure, by selecting those colonies that would be similar during the exposure phase. During the whole study the colony strength was assessed by photographing all bees in hives (all frames and walls). Additionally, to include also the number of foragers in the assessment, hives were weighted with and without bees. To avoid an influence of the time of the day on the number of foragers counted with photography all colonies were photographed at a parallel at the same time of the day. All frames of all hives were also photographed to assess brood development and to obtain a full overview of the condition of each hive at each time point. It is shown that by applying a refined, new field methodology and test design for field studies on honeybees the
test power referring to the number of adults can be increased. Assessments of complete hives, including adults and all cells, make it possible to gain a detailed insight into the development of colonies and hive parameters over the course of time. Environmental factors and their influence on different hive parameters can be assessed and used to explain how these parameters either alone or in conjunction with plant protection products have an impact on the strength and development of honeybee colonies.

TU061 The potential for immune activation and possible consequences for bees upon exposure to microbial pest control agents

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Microbial pesticides are unlikely to cause disease in non-target insects due to a lack of specific pathogenicity. However, simply exposing the insect to a microbe has the potential to activate subclinical responses that can lead to colony level effects. For example, injection with a non-pathogenic, microbial immune elicitor induces a massive antimicrobial peptide response in bumblebees and honey bees. This immune response lasts several days and is costly to maintain. These costs are demonstrable through trade-offs between immunity and other life-history traits such as learning and longevity. In addition, immune activation alters many aspects of normal colony functioning, such as changes in foraging activity, decreased queen attendance, modified feeding behaviour, increased production of sexuals and forced ejection. Crucially, many of these effects only become apparent in the colony, and show specificity between bumblebees and honey bees. The established paradigm uses laboratory trials as a ‘worst-case’ scenario before progression to higher tier field trials, which may mask the downstream immunological impacts on endpoints such as longevity. Evidence exists for immune activation in insects via oral exposure with non-pathogenic bacteria. We therefore propose the need to establish whether oral and cuticular contact with microbial pesticides can induce the immune system in bees. Should immune activation be confirmed in the laboratory in the absence of lethal effects, further field trials may be required to reveal the consequences within the colony.

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

TU062 Assessment of Levels of Some Heavy Metals in the Organs of West African Dwarf Goat and Beef Cattle in Ogbomoso, Nigeria

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The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso metropolis, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of two breeds of cattle and West African dwarf goats. Raw and cooked samples were digested and analysed using the method described by the Association of Official Analytical 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 buck and Doe. There was a major reduction in the results of history-based dosed samples when compared with raw samples for all the metals analysed. From the various data obtained, it can be concluded that all the five metals are present in all the samples analyzed and their average concentrations are significantly high in most of the samples. Cooking lowered the amount of the potentially toxic metals in the meat samples.

TU063 Assessment of metal bioaccessibility, bioavailability and toxicity in soil using the earthworm

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Simultaneous contamination of ecosystems by various substances sets a challenge as regards to environmental assessment. One of the aspects is appraisal of pollutant bioavailability. Such an analysis was performed on a mixed contaminated site. The earthworm Eisenia andrei was exposed to different soils according to a contamination gradient. An integrated approach including a suite of biomarkers and chemical analyses was adopted to determine site toxicity. Parameters of the antioxidant system (catalase [CAT] and superoxide dismutase [SOD] activity), an enzyme of detoxification cation metabolism (glutathione S-transferase activity [GST]) as well as acid phosphatase (AP) activity and lysosomal membrane fragility of coelomocytes (neutral red retention time, NRRT) were used as tools. Overall toxicity endpoints (lethality, body weight change, reproduction) were assessed. Lethal effects were detected in some soils whereas chronic endpoints significantly decreased. A significant response of time-growing extent and consistency was recorded for SOD from to 2-28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 days and was correlated to the metals currently to the toxic effects of metals. 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 biaccessibility 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 has a detrimental effect on reproduction of white suckers collected in a reference 17.5 mg Bi/kg and 0.005 mg bioaccessible Bi/kg. Bismuth had little effect on phagocytic efficiency of adult earthworm coelomocytes. After 28 days, Bi concentrations in earthworm tissue increased up to 21.2 mg Bi/kg and reaching a stationary state at 212 mg Bi/kg of soil.

TU064 Assessment of subcellular metal-binding ligands in white suckers (Catostomus commersonii): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins

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Metal exposure may lead to accumulation and toxicity in aquatic species. Once metals enter living organisms, they can penetrate into their cells and cause deleterious effects. Alternately, metals can be detoxified by binding to molecules designed to sequester them and prevent them from exerting their toxic effects, such as metallothioneins (MT) and metallothionein-like peptides (MTLP). MT and MTLP are mainly found in the cytosolic fraction, generally obtained after homogenization, differential centrifugation and heat-denaturation steps. It is normally hypothesized that metals present in the HSP fraction are detoxified. To confirm this hypothesis, the nature of the metal-binding ligands found in the HSP fraction needs to be determined. Thus, the aim of this work was to investigate the ligands binding metals (As, Cd, Cu and Se) in the HSP fraction from hepatic cells of white suckers collected in a reference 17.5 mg Bi/kg and in a lake subject to multi-metallic contamination. After isolation of the HSP fraction, we used size exclusion chromatography coupled to an inductively coupled plasma mass spectrometer (SEC-ICP-MS) to separate biomolecules present in the HSP fraction and to quantify the associated metals. For each metal, higher concentrations were measured in the HSP fraction of the exposed fish than in the control fish, but overall, metal-handling strategies did not vary between the reference and exposure fish, with the exception of As. For Cd and Cu, a major peak was observed after a retention time of 16 minutes, corresponding to the retention time of MT, suggesting that these two metals were reasonably well detoxified and regulated in these fish by binding to MT. In contrast, for Se, a major peak was observed at 27 min indicating that Se was not bound to MT but rather to a biomolecule with lower molecular weight. Finally, regarding As, two major peaks were observed in the reference fish (25 and 27.5 min), whereas in exposed fish a major peak was identified at 29.5 min, suggesting the potential induction of a specific ligand to bind As in exposed white suckers. For future work, the identification of the Se and As binding biomolecules would be of great interest to determine if these metals are detoxified or if, conversely, the biomolecules are metal-sensitive and their binding to Se or As represents a threat for the health of fish.

TU065 Assessment of Toxicological Impact of Anthropogenic activities on Onitsha Stretch of River Niger in 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>Cd>CrNi. The HPI and MI values were far above the critical values. Results also showed EDTs to include PAH, phthalates, PCDDs, PCDFs, PBDEs, bisphenol A and PCBs. This study established that Onitsha stretch of River Niger contains varying concentrations of heavy metals and EDCs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. Thus, there need therefore to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

Tu066 Bioaccumulation, DNA damage and metallothionein expression in plants grown on heavy metal contaminated soil supplemented with sewage sludge M. Jaskulak, Czeszotowa University of Technology / Institute of Environmental Engineering; A.O. Murtuza, Czeszotowa University of Technology / Department of Infrastructure and Environment; A. Grobelak, M. Kacprzak, Czeszotowa University of Technology / Institute of Environmental Engineering

Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Concentration 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 present study was to evaluate the effects of fertilization of contaminated with HM soil by sewage sludge on the genotoxicity levels and the expression of metallothioneins in plants shoots and roots. The toxicity assessment was conducted using selected measurement endpoints: germination index, roots length, the severity of DNA damage, chromosome aberrations and the expression level of metallothioneins. Sinapis alba L. was chosen as a model plant for this experiment. Plants were grown for 28 days in a growth chamber where they were exposed to soil contaminated by HM from metallurgical activities and to contaminated soil amended with different concentrations of sewage sludge. The study showed the effects of sewage sludge on the level of genotoxic effects caused by heavy metals as well as on MT expression. As such, a significant increase in the expression level 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.


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 directly applied to predict the effects of Ni on the surface waters (hard water in general), which have different water chemistry from Japan (soft water, in general). Since water chemistry parameter (e.g. Ca, Mg, Na, K, pH, natural organic carbon) highly influence on metal toxicity, we should check applicability of the existing BLMs on Japanese surface waters or develop our 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 Windemere Humic Aqueous Model (WHAM7) for speculation calculation. Ni toxicity were predicted using the existing chronic Ni bioavailability model for C. dubia established by De Schamphelaere et al. (2006). Except for uncontaminated upstream samples, the daphnids demonstrated typical toxic symptom of Ni (delayed lethal toxicity) and reproduction inhibition levels were correlated with Ni concentration suggesting that Ni is the representative toxicants in the collected samples. However, in several stations, other metals (such as Zn) may also contribute the toxicity thus we should carefully interpret the mixture toxicity.

Tu068 Comparing metallic elements in corals from South Africa and the Maccarese Basin V. van der Schaff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwet Yive, University of Mauritius / Chemistry; H. Bouwman, North-West University / Unit for Environmental Sciences and Management

Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in skeleton and tissues of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WIO). Fragments of four soft- and five hard coral genera were collected from five sites in the WIO. Sodwana and Alivai Shool constitute the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Maccarese basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected coastal sampling sites. Eight to 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 Maccarese 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. ‘We been earth to analyse such different organism of both hard corals. Soft corals contained relatively higher concentrations of most of the post-transitional metals that were analysed. Sinularia is the coral genus with the most elements at the highest concentrations. Pocillopora from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WIO than in certain regions in the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in Sinularia (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

Tu069 Cytochrome P450, fat and ageing: new insights into metal toxicology N. Rai, Orebro University / The Life Science Centre, School of Science and Technology; P. Olsson, Orebro University / The Life Science Center-Biology; L. Ljungman, Orebro University / The Life Science Center-Biology

Most of the elements tested had lower concentrations in the WIO than in certain regions in 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.

Tu070 Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers R. MEDRANO, University of the Baqque Country; M. Abdou, UMR5805 EPOC / Geochemistry; M. Soto, University of the Baque Country / Zoology and Animal Management
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 because study metal species are widely play an important role in fish activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microtubes (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (435/685 nm). In the first experiment, the microalgae was exposed for 72 hours to each metal using three different types of culture medium, OECD medium modified OECD (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalgae was exposed in a simplified test medium (destilled water buffered with MOPS and NaOH) only for 6 hours, as nutrients available for algae were limited. In the first experiment condition, the EC50 after 72hrs 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 6hr were 150, 189 and 88 μg/L for Cu, Pb and Zn, respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.

TU07 Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico. M. Munoz-Najera, G. Barrera Escorcia, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; P. Ramirez Romero, V.A.M. Iztapalapa / Hydrobiology Human population has seen the deterioration of resources derived from the 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, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites where that over time were declared protected natural areas. Pulpav/(n) settlements on its banks to make use of the water, as well as of the organisms linked to these aquatic bodies, which represents economic sustenance for the inhabitants. On the other hand, it is common to use the water for various purposes, many of which contradict each other. Such is the case of the Tenango Dam, in Puebla, México, which is used for fishing, irrigation, recreation and electric power generation, among others. The purpose of our study was to evaluate the state of health of the water, and the tilapia quality. Field visits were made in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, phosphates, nitrites and phosphorus; also metals: cadmium, chromium, copper and lead were determined in both water and tilapia. Results indicated that the physicochemical parameters are within Mexican admissible ranges. Nitrates and phosphorus exceed 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 Mexican law, while in tilapia, cadmium only exceeded the acceptable limit for consumption in two seasons. Based on the concentrations of nutrients and metals, it is concluded that water quality of the Tenango dam is not suitable for urban use, nor for the protection of aquatic life and tilapia should not be consumed. These levels of contaminants could represent a risk to the life associated with this artificial water body. The diverse uses and the absence of a management strategy have deteriorated the dam's water quality and also the tilapia as a resource associated with it; finally, this situation compromises the integrity of an aquatic body included in a site declared as a protected natural area.

TU074 Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks in Nigeria. A. Udei, Federal University of Technology / Department of Biotechnology; T. Orji, University of Nigeria Nsukka / human nutrition and diets. 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 and older ladies as means of appearance enhancement. The presence of heavy metals in most lipsticks may help to predict the possible risk associated with the use of these products. The main objective of this paper is to evaluate the hazard quotients of heavy metals due to daily ingestion or use of lipsticks among users and also to evaluate target cancer risks due to its use. This study was carried out in Wukari, Nigeria, samples of different lipsticks and lip glosses of many colours and texture were collected and analyzed for heavy metal contents (lead, Arsenic, Chromium, Cadmium and Mercury) using Atomic Absorption Spectrophotometer (AAS). The result of the mean concentration of the heavy metals are as follows; Lead, ranges between(2.65-7.40 ± 0.17) mg/kg;
The metal concentration in soil increases in the order; Cd < Co < Ni < Cr < Pb. This shows that some lipsticks 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 wide, random use of these chemics, attended coupled the pressure over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper may affect biochemical processes, such lipid metabolism of some organisms, but the exact changes in FA profile are still unknown. Nowadays, bivalve species are used in ecotoxicological bioassays due some particular characteristics, such as the wide distribution, ecological relevance, the capacity to filter and ingest large volumes of sediment particles and water and ease handling in the field and in the laboratory. Therefore, this work aims to determine toxic effects and changes in fatty acids profile composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes.

In a first phase organisms were exposed under laboratorial conditions to copper sulphate to determine lethal concentration; at a second phase, it was considered the effects of copper sulphate in the nutritive quality of both species and size classes at the field and in the lab. Our results state C. edule is more sensitive to copper sulphate (LC50 = 0.818 (0.595–0.987) mg/L; 1.129 (0.968–1.289) mg/L, to big and small organisms, respectively) than S. plana (LC50 = 2.563 (2.229–2.903) mg/L; 4.705 (3.540–12.292) mg/L, to big and small organisms, respectively). Furthermore the last one presents greater abundance and variety of FA and essential fatty acids (EFA), notably DHA and EPA, rates than C. edule. Still, big size class of both bivalve species is the most affected by the contaminant.

TU076  
Heavy metals in soil and vegetables of allotment gardens in the Cape Town, South Africa

M. Mathebula, E Wewers, T. Oosthuysen, T. Farrar, A. Giwa, Cape Peninsula University of Technology / Chemistry

Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are persistent environmental contaminants which ultimately accumulates in soil with possible translocation into the tissue of vegetables, thereby posing a potential risk to human health. While most research focus on major agricultural areas, less attention was paid to the accumulation of heavy metals in home gardens, schools and rural areas where subsistence farming is increasingly used in South Africa as a means of poverty alleviation and increasing food security. This study was conducted to investigate the concentration of selected heavy metals in soil, water and vegetables in some allotment gardens in the city of Cape Town, South Africa. Thereby assessing the health risk associated with the consumption of vegetables grown in the informal agricultural sector. Soil, water and vegetables were sampled during winter and summer seasons from the study areas and were analyzed for heavy metals (Pb, Cd, Mn, Zn, Cr, Cu, Ni, Fe and Co) using Inductively Coupled Plasma (ICP). Results showed that there are no significant seasonal or forest differences in the physiological properties of soil and water samples. The soil and water pH are slightly acidic, ranging from 6.30 to 6.90, and 5.60 to 7.00, respectively. Soil organic matter ranges from 1.7 to 13.5%. Results for water indicated that there was concentration fluctuation during winter and summer, with summer concentrations ranging from 0.062 to 0.947 mg/L, while in winter the range was 0.002 to 2.347 mg/L. Soil heavy metal concentrations ranged from 0.59 -1209.95 mg/kg in winter and 0.52 - 1127.41 mg/kg in summer. For both seasons the metal concentration in soil increases in the order; Cd < Co < Ni < Cr < Pb < Mn < Zn < Fe. The concentrations of all the elements in soil and water samples were within the permissible limits set by WHO and FAO. The concentration of heavy metals in vegetables were generally higher in summer (ranging from (nd - 116.26 mg/kg) than in winter (ranging from (nd - 144.28 mg/kg), with the general trend being in the order; Cd < Ni < Pb < Co < Cu < Cr < Zn < Mn < Fe. In general, the below ground-vegetables such as brinjals and greens presented higher accumulation concentrations than above-ground and leafy vegetables such as cabbage and spinach.

TU077  
High selenium lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh

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Background: Worldwide, the major chronic environmental threat to human health affecting over 100 million people, is daily exposure to naturally high levels of arsenic in drinking water and food, notably rice. Malnutrition increases the toxicity of arsenic. Low blood selenium specifically, increases the risk of arsenic-induced skin lesions and other manifestations of arsenic poisoning. Selenium, an essential element that interacts antagonistically with arsenic in the body, has been shown to decrease body burdens of arsenic and reduce arsenic-induced atherosclerosis in animals fed high selenium diets. Objectives: To reduce arsenic absorption, and therefore arsenic-associated toxicity in highly exposed people, through a dietary intervention with naturally high selenium lentils. This treatment is especially practical for populations already consuming lentils on a daily basis, as in the region notorious for chronic arsenic poisoning, the Indoagricultural plains of northeast India and Bangladesh. Methods: For six months in a double-blind study, 400 participants with tube well As levels from 10 to 1200 ppb based on atomic absorption spectroscopy (AAS) analysis (WHO limits: 10 ppb for the west and 50 ppb in other regions) ate the same variety of lentils with high (0.854ppm) or low (0.029ppm) selenium because of the soil where they were grown. Urine, stool and hair samples were collected before, during, and at the end of the study, to determine arsenic levels and other physiological responses. Major outcomes: Mixed model statistical analyses determined that people consuming the high selenium lentils excreted significantly more arsenic though their urine (p<0.05) than those on the low selenium lentils, but there were no differences in stool As concentrations. Considering females only, there was a trend towards a difference in hair As on the 2 diets, Hair As decreased by 0.20 ppm in the high selenium lentil group, whereas it increased by 0.49 ppm in the low selenium group (p=0.07). Summary: This study has shown evidence of the potential effectiveness of a simple, whole food solution of consuming lentils naturally high in selenium to reduce absorption of arsenic from water and food.

TU078  
Metals removal from water for hazard classification

G. Propson, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; R.F. Carbonaro, Mutch Associates, LLC / Civil and Environmental Engr; K.J. Rader, Mutch Associates, LLC; S. Baken, European Copper Institute; E.R. Garman, NiPERA / Ecotoxicologist

Metals usually enter aquatic ecosystems in anoxic environment and associated with particulate matter. It is important to examine the impact of this initial input in aquatic systems, considering processes such as partitioning, speciation and resulting biological effects. In addition, current European Union regulations and the global GHS system mandate a hazard evaluation, which includes the assessment of Rapid Degradation (greater than 70% within 28 days), which for metals equates to metal removal from the water column. The Transformation/Dissolution Protocol (OECD 29) is an established method that was modified to examine metal removal from the water column under anoxic conditions. The modifications include the addition of a small amount of sediment, and the inclusion of a resuspension event. We conducted a series of laboratory evaluations to address the following questions: Are copper (Cu) and nickel (Ni) removed from the water column of freshwater systems and if so, what is the rate of removal? How do various test conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case (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 typically found in environments that remove metals significantly faster as expected. Sediment type and loading rates affected pH, which started at 6.0 and 6.28 for the 28 d tests. Dry Buffalo River sediment, a sediment typically found in environments that remove metals significantly 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
Modelling the chronic toxicity of copper to fish at low pH
S. Baken, European Copper Institute; K. De Schampaelsrae, Ghent University (UGent) Applied Ecology and Environmental Biology
Bioavailability models account for the effects of water chemistry on metal toxicity to biota. They are a cornerstone of the environmental risk assessment of many trace metals, including copper. In this context, it has often been assumed that toxicity of dissolved copper to fish increases with decreasing pH. However, some studies show that this relationship may only be valid above pH 7. Below pH 7, the chronic toxicity of dissolved copper to fish seems to be independent of pH. Existing bioavailability models use the well-known mechanistic concept of the Biotic Ligand Model (BLM), but this modelling framework seems to have difficulties to reproduce the observed relationship of copper toxicity versus pH. This study was set up to refine the bioavailability models for chronic copper toxicity to fish, in order to better reflect the observed relationship between chronic copper toxicity and pH. The available chronic copper toxicity data to fish were reviewed. A new bioavailability model was developed using the concept of a generalized bioavailability model (gBAM). This semi-empirical model assumes a log-linear relationship between pH and effect concentrations (ECx) expressed as free copper ion activity (Cu2+) and links it to the geochemical specification model WHAM7 to predict toxicity on a dissolved copper basis. The existing bioavailability models were set up 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.

Novel In-situ Toxicity Assessment of Sediment Capping Effectiveness in Deep Water Systems
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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 selected capping materials for decreasing Zn dissolution from the pit lake. In situ testing was conducted using Daphnia magna, Hyallela 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.

REEChangE - Rare Earth Elements Ecotoxicology in a Changing Environment
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REEChangE focuses on the anthropogenic release of the rare earth elements (REE) lanthanum and gadolinium to the environment and their potential risk within ecosystems. REE are increasingly applied e.g. in green technology, and consequently also emitted to the environment. Considering their future use, release, and environmental fate, an evaluation of environmental risk from lanthanum and gadolinium will have to be based on information on exposure pathways, exposure and effect concentrations. The project REEChangE addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxicological responses obtained for Aliivibrio fisheri and Rhaphidocelis 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.

Sediment characteristics of natural and anthropogenic origin and their possible association with benthic macroinvertebrates in a minimally affected river in South Africa.
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Sediment characteristics generally entail metals, minerals, organic content, elements, particle size conductivity and pH. The origin of metals in sediment may originate from anthropogenic activities including mining, industries, agriculture as well as aerial deposition. Limited attention is however given to the contribution that natural occurring phenomena play in the concentration of metals in the sediment. Weathering of minerals originating from the primary lithology can on the one hand add to the metals in sediments and on the other hand to the particle size composition. Although it is well known that chemical pollutants, due to anthropogenic impacts, act as a major determinant for the macroinvertebrates composition in surface waters the influence of the above mentioned components in a pristine river is less known. The aim of this investigation was firstly to determine the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structure in the Mozambique River. A South African collection of macroinvertebrates was done in a subcatchment at various sites, dried and sieved using an Endocott dry-sieving system to collect fractions < 2000µm and < 50µm. The total sediment samples >2000µm and clay fraction samples, 50µm were subjected to metal, scanning electron microscopy and minerals by X-ray diffraction analyses. Element anlyses were done by means of an FEI Quanta 250 ESEM microscope equipped with an integrated Oxford Inca X-Max 20 EDS. Macroinvertebrates present in the benthos were collected for 15 minutes using a standard sweep net, preserved in 90% ethanol and identified up to family level. RDA redundancy analysis was constructed to investigate the distribution of macroinvertebrates Forty two families of which the vast majority associated with particles >2000µm, were found. Sediment particle sizes < 2000µm had a detrimental effect on the biodiversity. No significant correlation was demonstrated between variation in temperature, pH, and electrical conductivity and both diversity and abundance of macroinvertebrates. Although relatively high concentrations of selected metals were present in the sediment, it was largely from geological origin and most probably not bioavailable. Therefore, it can be concluded that, under these conditions, sediment particle size, played the decisive role on the distribution and abundance of macroinvertebrate taxa.

The effect of copper sulphate on the antioxidant enzymes activity of two size classes of Cerastoderma edule
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Anthropogenic activities, such as agriculture or industrial activities are the main sources of pollution contributing to the degradation of marine ecosystems affecting the living organisms of the aquatic systems. Copper is often released into the aquatic systems, and may affect these ecosystems and its communities. Copper sulphate is a copper-based formulation, used in the agriculture practices to control pests. The main aim of this study is to determine the effects of copper in the antioxidant defence system of an important commercial bivalve species, Cerastoderma edule in two size classes. In this work was observed the behaviour activity of the organisms during the exposure time to copper sulphate and subsequently it was determined the antioxidant enzymatic activities of GST, GRed and GPx in the muscle tissue (foot). Moreover, lipid peroxidation was evaluated.
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 toxics.

**TU084 The impact of single metals and mixtures in nature: a microcosm experiment**

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Exposure to ecological risks of metal-contaminated systems remains an important challenge. While laboratory experiments with metal mixture exposure are receiving more attention in the literature, little research has examined the interaction of natural stressors with metal mixtures. In the lab, we already performed experiments on *Axelius aquaticus*, exposing this freshwater isopod to a combination of metal mixtures and temperature stress. This way we could study effects on the individual level and relate metal accumulation to relevant sublethal endpoints (e.g., growth rate, feeding rate). The present study, a microcosm experiment in a greenhouse, was designed to gain more insight into the effects of these metals on populations and communities. Small ecosystems with several species of macroinvertebrates were exposed to Cd, Cu, Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed *Axelius aquaticus*, *Daphnia magna*, *Cryptocerus riparius* with different *Physostomum*, *S. officinarum* with Elodea canadensis (macrophytes) and *Raphidocellus subcapitatus* (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 showed 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 mixture negatively affected shoot and root length of *E. nuttallii* compared to the control treatment. However, after 8 weeks, we did 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***

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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*. Soil cores with a wide range of properties were spiked with Pb(NO3)2 at 9 concentrations of Pb to determine the effects of soil properties on Pb bioavailability and toxicity to *E. crypticus*. Survival and reproduction after 21 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. pH (MCl2) and pH(porewater) decreased with increasing total Pb concentrations and Pb accumulation for the soil samples, but pH decrease was much stronger for the soils with lower CEC and OC contents. Sorption of Pb from the CaCl2 extracts could be well described by a Freundlich isotherm (*R*2 = 0.96-0.99) and Freundlich sorption constant *K* increased linearly with increasing cation exchange capacity (CEC) (*R*2 = 0.86) or organic carbon content (OC) (*R*2 = 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 soils. 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 (*R*2 = 0.70-0.90) or pH(porewater) (*R*2 = 0.87-0.94). The differences in Pb toxicity among soils correlated with both CaCl2 extractable and internal Pb concentrations in soil (*R*2 = 0.97) and internal Pb concentrations (*R*2 = 0.97). Median effective concentrations (EC50) based on total Pb concentrations varied 12-fold among soils from 81 to 1008 mg Pb/kg dry soil. EC50 on the basis of total Pb concentrations increased linearly with increasing pH(porewater) (*R*2 = 0.70-0.94). The variation in EC50 was best explained by differences in the CaCl2 extractable Pb concentrations in the soils (*R*2 = 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.

**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, phsyico-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 undesirable 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 Centre for Pesticides and Health Risk Analysis and Applied Sciences (DiSTA) has developed the IT, together with the Wageningen University and Research Centre of Wageningen-NL, worked on a data collection project commissioned by the European Commission’s Safety Authority (EFSA). The aim of the project was to investigate the comparability of the EC, approach (Effect Concentration affecting a percentage *x* of test organisms) to the current NOEC approach (No Observed Effect
Concentration), both derived from chronic and long-term studies of a data sets of 70 active substances of plant protection products (PPP). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC(EC50 or EC90 as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC values are considered more appropriate for risk assessment than 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 EC50, EC90, and EC100 with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSAR) were used to validate the Effect Concentrations of the active substances of the selected pesticides, and to predict missing data. The whole approach is mainly oriented to the aquatic environment, and can provide useful information to screen the potential undesired toxic effects of new pesticides, and of alternatives to existing active substances, starting just from the chemical structure.

TU089 Influence of coatings in the bioaccumulation of TiO2 and CeO2 nanoparticles in rainbow trout

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In the framework of the Project GUIDEEnano 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 CeO2 NPs and TiO2 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 (±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hepatosomatic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO2 NPs. A difference was observed for the uncoated NP for which Ti levels in the fish were higher than for the other coated NPs. Ti levels reached basal values already in the first day of depuration indicating a very fast elimination of these NPs from the organism. Higher levels of Ce with respect to the control group could be measured at the end of the uptake phase in stomach, intestine and gills but not in liver. Ce levels were found in fish treated with the coated NPs but not in the group treated with the uncoated NPs. Levels of Ce could be measured the first day of depuration in stomach and intestine of fish treated with CeO2 NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO2 NPs uncoated or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO2 NPs. These results indicate a different behavior for the CeO2 NPs and TiO2 NPs. No relationship could be observed between the coating and the observed effects.

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TU090 Colloidal characterization of nano-enabled products for the 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, makes them within a few micrometers their unique transport to reach sub-cellular locations leading to potentially higher localized concentrations and toxicity. A lot of factors such as size, shape, surface coating and the fact that these particles are subject to fast alteration, make complicated the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In this context, in the frame of the EU H2020 NANO2020 Nano-Environment and Health project, innovative nano-enable 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 on the one hand, the colloidal characterization of the new formulations was performed by means of Dynamic Light Scattering (DLS) and Centrifugal Separation Analysis (CSA) techniques. Moreover, possible releases from outdoor conserved works of art were also investigated by immersion tests, simulating the exposure of the treated materials to the worst applicable environmental conditions (e.g. rain, humidity, temperature).

TU091 Considerations for Safe Innovation: The Case of Graphene

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Safe-by-design in chemistry may 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 becoming 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 identify potential hazards. After this the standardization of the production process becomes important in order to reach a more reliable exposure assessment and enable use of exposure reduction measures where needed. Furthermore we outline what information on graphene is already available for assessing potential human and environmental hazard, exposure, and risks. For example a first indication of the hazard of an (intended) product can be obtained by collecting information on a limited number of physicochemical properties of the intended graphene product: dimensions, shape and surface properties. In addition, we recommend further steps to be taken by various stakeholders to promote the safe production and safe use of graphene. We emphasize that a safe and time-efficient innovation process is only possible under the conditions of clear and timely communication between innovators, scientists, risk assessors and regulators.

TU092 Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine

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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: nanomedicine is not a complete, and combines knowledge from different fields. It is at the junction among pharma, medtech, biotech, nanotech and chemical companies which are important economic and social player in Europe. In this context, the GoNanoBioMat project aims to facilitate SMEs in Europe in the decision making for developing and producing safer and sustainable polymeric nanobiomaterials for drug delivery. To do so, the consortium designed a project framework that aims at supporting the entry of SMEs in an early stage of innovation. 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 and it is challenging to get a full understanding of the interactions of nanomaterials in the bio-interface and to find out what 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 nano-specific guidelines and checklists. The guidelines aim to facilitate the communication among the different stakeholders in the value chain and with regulators for safe and sustainable innovation.

TU093 Review of the applicability of early-stage sustainability methods integrating toxic and environmental assessment
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The chemical industry strives for the development of bio-based alternatives for present fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. Many sustainability assessment methods are developed for this purpose. The aim of this study is to evaluate a selection of 12 early-stage methods (ESMs), their applicability, the relevance for bio-based chemicals and the coherence of their outcomes, using bio-based lactic acid as a retrospective case study. The selected methods contain at least one of the following themes: energy, climate change, eutrophication, land use, human toxicity and ecotoxicity. These six themes were considered as most relevant for the case of bio-based lactic acid. The selected early-stage methods address 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 and toxicology. In general, within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

TU094 Liquid organic hydrogen carriers (LOHC) - comparative hazard assessment
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Renewable energy stored in LOHC systems could replace fossil fuels yet their environmental impacts are largely unknown. This technology is still relatively new, and requires R&D efforts to optimise its performance to commercially attractive levels. This opens the possibility to proactively design the carriers for increased operational and environmental safety. A preliminary, comparative hazard assessment was performed using automotive diesel oil as a reference. The biodegradability and acute/subchronic (eco)toxicity using: enzymes (acylcholine esterase), cell lines (ICP-81), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants ( Lemma minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinidine, ethyl-, propyl- and butyl-cyclohexyl LOHC. 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.

TU095 1-Octanol and 2-Butanone as biofuel candidates - Using “Green Toxicology” for biofuel development
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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. (Ecotox)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two bio-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 “Tailor made fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TU096 Investigation of the toxic effects of new mixtures of deep eutectic solvents (DESs) 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 environment, has brought to the necessity to find greener, readily biodegradable and low cost solvents. This new concept of green chemistry has recently led to the synthesis of Ionic Liquids (ILs), from which have evolved in few years the deep eutectic solvents (DESs).[1] These compounds are obtained mixing two components: a quaternary ammonium salt (e.g. ChCl) with different hydrogen bond donors, in such a ratio that the resulting substance has a significantly lower melting point than that of each individual component. DESs have proved to be environmentally sustainable and alternative to the conventional organic solvents in synthetic chemistry, able to increase efficiency of organic transformations. These solvents have attracted widespread academic and industrial interests, and have found almost unanimously worldwide approval. Cosmetics has ‘conquered’ in the last years one of the most profitable industries. The majority of cosmetics are composed of chemicals generally as emulsions. Given the ease of synthesizing DESs, along with their low cost, it is thought to be possible use them in the formulation of cosmetic and beauty products. Some of these DESs contain nitrogen (N), which can be used as fertilizer in the growth of the crops. Another field of interest could be the agriculture as well: some of these solvents can be produced as gels, meaning that they can be developed as a plant-based fertilizer. Toxicological studies on ChCl+Glycerol and ChCl+Levulinic acid (never before studied) on algal species of the genus Symbiodinium and on skin in vitro cells have been carried out in order to extend the limited knowledge about toxicity at environmental and human level, as well as the biodegradation pathway of this family of solvents. Preliminary results show extremely low toxicity on Symbiodinium clade B, known to be highly sensitive to environmental stress, for all the tested mixtures. Algae growth and Reactive Oxygen Species (ROS) production, a general indicator of stress, is indeed not affected by all the tested compounds in the order of g/L. Results from the present study indicate an expected safer development of biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development.

New frontiers in Life Cycle Inventory data collection and modelling (P)

TI/097 Predicting environmentally beneficial production pathways for chemicals with neural networks
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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 0.66 for CED and CC, respectively. The route-specific prediction is illustrated for methanol production from CO2 versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TI/098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
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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 LCI database for the estimation of the environmental footprint (PEF) of major domestic food exports to Europe and to use the common protocol and food – specific guidelines (PCR) to estimate environmental footprint, And aims to obtain EPD certification. 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.

TI/099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; O. 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 communication link the life cycle environmental performances for EF have been defined in a specific EU recommendation (2013/179/EU). Within this framework, the International reference Life Cycle Data system (ILCD) format, developed since 2007, along with a simplified set of compliance rules called “ILCD Entry Level Requirements” has been recommended as a baseline for data development in the EF scheme. However, in the development of a global database for the estimation of the environmental footprint (PEF) of major domestic food exports to Europe and to use the common protocol and food – specific guidelines (PCR) to estimate environmental footprint, And aims to obtain EPD certification. 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.

contain some format, syntax and conceptual errors which were inherited from several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factor well as well as implementation issues and their impact on the database implementation. Furthermore, a list of changes made from the ILCD to the EF package, beyond the LCIA methods recommended (i.e. Elementary Flows, Flow Properties, Unit Groups) and complementary objects defining the compliance (i.e. stylesheets, schemas) are described, in a change log file available through the EFCA website. Among the above mentioned at once the overall changes occurred in the ILCD-EF transition phase can be resumed as follows: - 1242 obsolete or wrong environmental flows have been deleted /mapped - 560 new environmental 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 wrongly classified or useless flow properties have been deleted and mapped to the remaining ones - 35 unit groups have been deleted, one new has been created.

TI/101 New tools for Environmental Footprint data checking and sharing:
Soda4LCA, ILCD validator and Registry for the node management
R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
Several tools for Life Cycle Inventory data development, validation, sharing and registration to the Life Cycle Data Network (LCDN) have been released by the EC since 2007, and improved after the official launch of the LCDN (2014). All those tools were originally meant for the International Life Cycle Data (ILCD) scheme. Since 2013 after a specific EC Communication (COM/2013/0196) the Environmental Footprint (EF) scheme has been developed and led to significant changes in the structure of the ILCD/LCDN. During the development of EF compliant data, the tools had to be adapted and improved to fulfill new requirements. Particularly the following tools and software have been changed: - ILCD validation tool: software for the compliance assessment of datasets (format syntax, archive structure, nomenclature, links and orphaned items, categorization, etc.) - soda4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - ILCD profile: online registration facility that can download data from different nodes running on soda4LCA, and meant to make available only fully compliant data (while the nodes can host also intermediate data) The changes that have been applied can be summarized as follows: - ILCD validation tool: additional validation profiles added for EF scheme. Checks against different parameters for Elementary Flows, location IDs, new LCIA methods, Flow Properties, Unit Groups and schemas, according to the changes made in the DB structure - soda4LCA: new access profiles are available for data stocks. The developer can now select entire data stocks and restrict the access only to authorized users. The entire data stock can be now downloaded directly, while before it was possible only at the single dataset level. The registration form includes a statement for the use of data within the EF framework. Declaration of compliance in the registration phase and possibility of multiple registration in more than one registry at once (a dataset can be both ILCD and EF compliant and therefore registered in two registries with different compliances declared). - LCDN registry: a dedicated registry has been developed for EF, with new functions. The compliance scheme is now possible (before was implicit since only ILCD was possible), possibility to register entire batches of data at once (before each single dataset had to be registered manually). Search interface improved.

TI/102 Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCIs in the perspective of the applicability of the implementation methods of the new ILCD/LCDN standards
M. Baiz, thinkstep / LCA; G. Castelan, PlasticsEurope / LCA
The ISO 14046 standard has clarified the definitions of water use and of water consumption which is the part of water withdrawn from a drainage basin not returned back to the same drainage basin. These only definitio

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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 operations on water in a chemical plant and the link to the life cycle inventory phase and ILCD flow names. This is the first step in using the PlasticsEurope methodology for calculating eco-profiles. It is expandable or adaptable to all kind of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to go to LCA. The presentation aims to attack LCI/IA water experts and scientists as well as people applying the water methods in practice to exchange on challenges, relevancy of aspects and to align on a continuous improvement of water data, regionalization efforts and method improvement in the future, to inspire broad application.

TU102: Methodological improvements by dynamic approaches for the life cycle assessments of buildings
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Nowadays in France, environmental and energy rules for the construction sector are based on environmental performances of products assessed through LCA methodology. However, the actual practice of LCA is lacking of temporal dimension whereas the temporal evolution during the long lifetime span of buildings has not negligible impact on overall LCA results. A new framework of LCA method was recently proposed by L.Barna et al (2016) and A.Shimako et al (2017) with a particular attention to the process and supply chains dynamics (web tool DyPLCA, http://dycla.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 8.0 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, 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 LCA makes it possible to see the impacts of temporal aspects of the LCA data and to make a more detailed 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 commodity supply chains is a finding that has been presented in 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 community in assessing these impacts, this is 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-eq. emissions associated, on the one hand, to annual production of soybean supplied from Brazil for the period 2010-2015; on the other hand, to every individual supply chain embodied in the whole supply of seed, oil, and cake to the international market. These include the following life cycle stages: land use change (LUC), soybean farming, domestic transport, export, and crushing, dealing with allocation challenges. In this way, our approach represents the convergence between top-down Multi-Regional IO analysis and bottom-up Attributional LCA. Preliminary results highlight the relevance in addition that applies to further up the entire supply chain, mainly LUC, for which considering 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 for deforestation and associated carbon emissions, provided that spatial explicit data is available. This framework tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

TU104: Carbon Footprint Projections for Japan Using Computable General Equilibrium
Y. Ichisugi, Tokyo City University; T. Masui, National Institute for Environmental Studies; N. Isubo, Tokyo City University
In 2015, Science Based Targets (SBT) has been paid attention to the world. The targets adopted by companies reducing greenhouse gas (GHG) emissions to keep global temperature below 2 degrees increase from that of preindustrial revolution. 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 cycle for the impact calculation. A new approach is needed to consider the whole 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 8.0 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, 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 LCA makes it possible to see the impacts of temporal aspects of the LCA data and to make a more detailed 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.
In general, a flow in life cycle inventory data refers to an input or output to a process. Flows may be of two broad types: elementary flows or intermediate (known as “technosphere”) flows according to ISO 14044 (ISO 14044 2006).

Elementary flows may be defined as flows of energy, or space that are used directly from the environment or released directly back into the environment. Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An early activity within the UNEP-SETAC Life Cycle Initiative was the creation of a recommended list of flow exchanges by the Data Availability and Data Quality Workgroup (de Beaufort-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 in the building up of the KOS data. In this framework, we provide an example application of the KOS to current elementary flow nomenclature. References [1] de Beaufort-Langeveld A, Bretz R, Hischier R, Huijbregts M, Jean P, Tannier T, van Hoof G (2003) Code of life-cycle inventory practice. SETAC Press, Pensacola, FL [2] Edelen A, Ingersen W, Rodegui C, Alvarenga R, de Almeida AR, Wernet G (2017) Critical review of elementary flows in LCA data. INT J LIFE CYCLE ASS. https://doi.org/10.1007/s11671-017-1354-3 [3] ISO 14044 (2006) ISO 14044: Environmental management–Life cycle assessment—Requirements and guidelines. International Organization for Standardization, Switzerland.
Integrating natural processes in environmental hazard assessments of the oil sands
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The Athabasca oil sands deposits in northern Alberta, Canada are a naturally occurring mixture of bitumen, sand, clay and other minerals. Bitumen, which is a heavy and extremely viscous oil, is mined and then subsequently refined to produce gasoline, diesel and other hydrocarbon-based products. Moreover, the naturally occurring Athabasca Oil sands deposits are a source of both physical and chemical stressors to regional rivers that flow through the deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted using Parhyale hawaiensis, an amphipod species associated with the study sites for the assessment of stressors 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; whether toxicology tests with 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 for 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 for amphipods Gammarus pulex (Crustacea, amphipoda), which can be found throughout a pollution gradient of a stream. In our research, we investigated whether G. pulex individuals have an ability to adapt to the pollution gradient and to survive likewise in pristine and in polluted sites or whether different conditions select for different phenotypes within the population. G. pulex individuals were sampled at different sites along a pollution gradient in the river Holtemme. The species Gammarus pulex is a crustacean, an amphipod that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolome in 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 acclimation to laboratory conditions. The results indicated that sex, mating 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 prudent to pre-select animals for understanding delayed effects on the offspring and the population dynamics. 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 organism was taken under an stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were fed three times a week, the necessary conditions of salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertook full regeneration. At the end of each experiment, another picture was taken to determine the difference between the length (mm) before and after full regeneration. Autonomous regeneration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently. Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxicants to determine their ability to regenerate 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 Rampizzo 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. With these kinds of studies direct as well as indirect effects on invertebrate communities in the Olifants River in the Western Cape, is not only recognized as a pristine river along the South African coastline. It is also one of the three hotspot for freshwater biodiversity, but seen by many, until the previous decade, to be affected by freshwater macro-invertebrates. In South Africa, SASS5 (South African Scoring System for Invertebrates) is a screening tool addressed to lower tier testing to get a broader idea about the relevant effects on ecosystem structure and function; 2) as monitoring tool for products which passed risk assessment to check up on community level effects; 3) as monitoring tool for typical sequence scenarios of different products which will be used together in one crop. Here exemplary results of community studies and a screening study will be presented.

TU116
Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa
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Freshwater ecosystems are considered among the most threatened, as a result of current trends in water utilization globally. Within the Western Cape, 76% of rivers are polluted and run the risk of irreversibly losing their ability to support ecosystems. The extent of riverine pollution is a function of water quality and quantity. Numerous pollutants result from these activities, with metals being particularly prevalent in most urban rivers. These pollutants are known to affect freshwater macro-invertebrate communities. In South Africa, SASS5 (South African Scoring System for Invertebrates) is a river health index that studies the invertebrate assemblages within specific riverine microhabitats, and can assist in shaping the relationship between water quality and biodiversity of freshwater communities. The Olifants River in the Western Cape, is not only recognized as a hotspot for freshwater biodiversity, but seen by many, until the previous decade, to be the last pristine river along the South African coastline. It is also one of the three main feeding rivers to the City of Cape Town for fresh water. Despite increasing urbanisation, the last State-of-Rivers Report for this river was published in 2006. It has therefore become crucial to investigate the current degree of pollution within this river, as well as the general integrity of the system. This study aimed to determine the degree of metal pollution along the length of the Olifants River, as well as to investigate the effects of pollution and land use on the invertebrate communities, using SASS5. Water and sediment samples were collected seasonally at 5 sites from upper to lower reaches, acid digested and analysed with an ICP-AES for metal concentrations. Invertebrates were also sampled seasonally, identified and scored according to SASS5 sensitivity scores. An Average Score Per Taxon (ASPT) was calculated for each site. The results showed a general trend of increasing sediment metal concentrations, land use practices and habitat alterations, with concomitant decreasing ASPT’s, from site 1 to site 5, indicating a loss of certain sensitive species at the most impacted downstream sites. Although metal pollution was found to be relatively low, a cocktail of pollutants, coupled with structural alterations, are clearly impacting the health and integrity of this river system. A future study should focus on organic pollutants, as agriculture is one of the main land use practices in the area.

TU117
QWATER - Bioassay integration under the European Water Framework Directive?: A step towards an ecological approach
M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; P. Acvedo, IREC-Instituto de Investigación en Recursos Cinegéticos; A.I. País-Costa, MARE-EBD; L.R. Vieira, ICBAS & CIMAR, University of Porto / Department of Populations Study Lab of Ecotoxicology; J.M. Neto, MARE; M. Taggart, University of the Highlands and Islands / Environmental Research Institute; N. Álvarez-Ospina, Universitat Potsdam; L. Guillerminho, ICBAS & CIMAR University of Porto / Department of Biology; R. Ribeiro, Universidade de Coimbra / Life Sciences; J.C. Marques, TO118 - Mindable to Perform a complete assessment of water quality status. The Water Framework Directive (WFD) is the most important piece of water legislation in Europe. It aims at ensuring the ‘good water status’ of EU water bodies and includes both chemical and ecological status. To achieve and assess a ‘good ecological status’ the WFD advocates the integration of various lines of evidence, and demands a set of low-cost tools and techniques to deliver appropriate data. The WFD accounts for chemical and ecological status, and requires the evaluation of 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 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, bioassays and biomarkers, and to use the findings in the future to ensure an ecological status of water bodies. Overall, this project allowed us to efficiently contribute to national and international efforts focused in evaluating the water quality in European water bodies.

TU118
Chronic testing of mayfly and stonefly species - Development of a new approach
Aquatic organisms, especially lotic invertebrate species originating from running waters, are exposed to releases of plant protection products which are mainly used in agriculture. Since lotic invertebrate species are regarded to be very sensitive but are hardly considered in chronic ecotoxicity testing, we developed a test system in order to investigate chronic effects on mayfly and stonefly species. After successful development of a test system for stonefly larvae Paurometra 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 surroundings are adapted to the natural habitat of the test organisms. As endpoints growth, emergence and mortality are observed during a 21 day exposure period. For the studies we use field collected larvae which are adapted to laboratory conditions.
before test start. In a first step the test conditions were adapted to the requirements of mayfly larvae. Therefore testing of different media was performed. It turned out that, contrary to testing of 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 Tetratin®, which was used in snail testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. Acclimation of mayfly larvae were acclimated for 48 hours, the acclimation period was extended to seven days before test start. Under these conditions mayfly larvae showed an acceptable mortality of test organisms. The next step is to perform a test with the test substance Imidacloprid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and snail larvae to Imidacloprid will be compared. The new testing method can provide toxicity data of different testing media with different aquatic organisms, 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 Biomphalaria straminea, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 126.8 μg L⁻¹, and the equivalent to 126.8 μg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were chosen so as to have the same molarity as their toxicant levels. In the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crinidians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment elutriate. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed as an ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken into account in ecotoxicological risk assessment.

TU120

Toxicity of lanthanides to freshwater microcrustaceans


The application of lanthanides (Ln) in different sectors of the world economy has significantly increased during the last two decades. This process has been accompanied by the introduction of different environmental matrices such as soil, surface water, groundwater and even in tap water have already been registered. The disruption of the natural biogeochemical cycle of Ln increases the risk of biota being exposed to elevated concentrations of Ln. However, the ecotoxicological effects of these elements and their fate in the environment are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, noticeably vary presumably due to different test conditions. For this study, acute ecotoxicity testing of Ln, Cu, Pr, Nd and Gd nitrates to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water.

Also, long-term (21 days) exposure of D. magna (OECD 211) in lake water was included. It was shown that the Ln fractionation between two main phases (precipitated or settled or remained in the water column) changed during the tests depending on (i) water composition, (ii) nominal concentration, (iii) exposure time, and (iii) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigated Ln to both crustaceans was similar. For example, E(L)C₅₀ values for Gd and other Ln was statistically significant (p<0.05) only in T. platyurus. In the lake water, bioavailability of Ln was much lower: mortality of exposed organisms did not exceed 25% at the largest tested concentration (50 mg Ln/L). In contrast to acute assays, the 21 day chronic test performed in the lake water showed high Ln toxicity to D. magna (0.2 to 0.5 mg L⁻¹). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between E(L)C₅₀ values for Gd and other Ln were not statistically significant. Thus, our results support the hypothesis that different lanthanides have a similar mechanism of toxicity in crustaceans. This work was supported by Estonian Research Council grant IUT23-5.

TU121

Relevance and suitability of invertebrates swimming behavior as sub- lethal endpoint to be considered for ecotoxicological investigation

s. morgana, V. Piazza, C. Gambardella, E. Costa, F. Garaventa, M. Faimali, CNR ISMAR

Ecotoxicology is aimed to assess, monitor and predict the effect of contaminants in the environment. Looking for new and alternative approaches in this discipline has become of increasing importance. Furthermore, within the 3Rs approach (reduction, refinement and replacement) the basic idea is to reduce the use of vertebrate organisms and to refine the procedures to minimize pain, suffering, and distress. To achieve this goal, ecotoxicology needs analytical tools to detect early signs of toxicity at very low toxicant levels. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crinidians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment elutriates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed as an 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.

Chemical and phototoxic impacts at concentrations as low as 0.1 mg/L and >90% mortality at 0.75 mg/L were observed in fathead minnows, Pimephales promelas, and red swamp crayfish, Procambarus clarkii. Fathead minnows showed negative impacts at concentrations as low as 0.1 mg/L and >90% mortality at 0.75 mg/L and red swamp crayfish showed negative impacts at concentrations ranging from 0.50-1.0 mg/L. The effects at similar concentrations show that dicloran is toxic even at very low toxicant levels. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crinidians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment elutriates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed as an 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.

TU123

Impacts of anti-cancer drugs on freshwater rotifers at environmentally realistic concentrations

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The toxic effects of anti-cancer drugs on freshwater rotifers at environmentally realistic concentrations was evaluated. The tests were performed using phototactic responses and mortality of individuals. The phototoxic effects of nine drugs were evaluated: doxorubicin, mitomycin, etoposide, daunomycin, cyclophosphamide, methotrexate, vincristine, cisplatin and carboplatin. The phototoxic impacts were assessed using a vertebrate and invertebrate species (fathead minnows, Pimephales promelas, and red swamp crayfish, Procambarus clarkii). Fathead minnows showed negative impacts at concentrations as low as 0.1 mg/L and >90% mortality at 0.75 mg/L and red swamp crayfish showed negative impacts at concentrations ranging from 0.50-1.0 mg/L. The effects at similar concentrations show that P. clarkii is a useful, nontraditional organism to be used for ecotoxicological analyses in areas such as Louisiana where they are of such high importance. The use of crayfish, or other valued invertebrates, in ecotoxicology testing are additionally beneficial as they do not require IACUC approval and can likely be spawned in labs.
C. Pascoal, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology

As human population increases, the presence of emergent chemical contaminants (ECCs) in freshwaters increases. ECCs have shown to be persistent and bioactive, reaching the freshwater aquatic systems mostly unattended, where their fate and behavior is little understood. Anti-cancer drugs are among the ECCs of concern due to their high cytotoxicity and increasing usage. The administration of drugs in corals, instead of single drug treatment, may make the assessment of the environmental risk of these compounds a difficult task with much information lacking on sub-lethal effects on aquatic species. We used two cytotoxic drugs aiming at linking their effects on the reproduction inhibition of the rotifer Brachionus calyciflorus with processes of oxidative stress. The rotifer was exposed to two binary mixtures of a non-antimicrobial (5-Fluorouracil, 5FU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Fluorouracil had a stronger effect (EC₅₀=0.074 mg L⁻¹) on the population growth rate than Doxorubicin (EC₅₀=13 mg L⁻¹) and toxicity effects were detected at environmentally relevant concentrations. Two concentrations of each drug were chosen for binary mixtures and two concentrations per drug were used to assess reactive oxygen species (ROS) accumulation and plasma membrane damage with epifluorescence microscopy. In the presence of low concentrations of 5FU, there was a reduction of the toxicity induced by DOX indicating possible antagonistic effects between both drugs. At concentrations, as low as EC₅₀ we found accumulation of ROS in a dose dependent manner showing a clear connection between ROS accumulation and the toxicity of these compounds. Furthermore, this investigation showed that the ROS production, homeostatic mechanisms and effect on reproduction, cellular effects were found with possible consequences for the community at the long term.

TU124 Development in vitro and in vivo methods of measuring acetylcholinesterase and general esterases in aquatic invertebrates

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Quantification of acetylcholinesterase (AChE) and other esterase activities are important in terms of assessing the toxic mechanism of organophosphate and carbamate insecticides. There are several techniques for measuring AChE and general esterases (GE) activity involving spectrophotometric or fluorescence detection of transformation products. In this study, we tested four methods to detect AChE and GE activity in vitro and in vivo in the two aquatic invertebrate species: Daphnia magna and Brachionus calyciflorus. The species have shown that TCE causes oxidative stress in both algal cells and coral tissue will make it difficult to apportion 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 algae and microbial communities. The aim of this study was: 1) to compare the inherent esterase activities of D.magna and C. riparius with the species with the highest activity. 2) to compare in vitro with in vivo measurements and 3) to compare the inherent esterase activities of D.magna and C. riparius. The four assays were: 1) AChE-assay using acetylthiocholine iodide (ATCI) as substrate, 5,5'-dithio-bis(2-nitrobenzoic acid) (DTNB) as chromogen, measuring the production of 5-thio-2-nitrobenzolic acid; 2) AChE-assay using acetylthiocholine iodide (ATCI) as substrate, measuring resorufin production; 3) GE-assay using 1-naphthyl acetate (1-NA) as the substrate, measuring 1-naphthol production and 4) GE-assay using 4-methylumbelliferyl butyrate (4-MUB) as the substrate, measuring 4-methylumbelliferone production. Michaelis-Menten curves were created for all substrates, where it was possible. The results showed that the GE-assay using 4-MUB measured general esterase activities well both in vitro and in vivo in the two aquatic invertebrate species. The AChE activity in vivo and in vitro was performed by counting the number of alive individuals per 5 mL vials each containing 20 individuals. 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. 5) To investigate the effect of 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 (Moraria sp.) under different time exposures. The species have shown that TCE causes oxidative stress in algae and microbial communities. The aim of this study was: 1) to compare the inherent esterase activities of D.magna and C. riparius with the species with the highest activity. 2) to compare in vitro with in vivo measurements and 3) to compare the inherent esterase activities of D.magna and C. riparius, respectively, making C. riparius the species with the highest activity. Turning to in vivo measurements, the GE-activities were 49.1 and 17.4 nmol min⁻¹ mg⁻¹ protein for D.magna and C. riparius. The results of GE-assays using 1-NA and 4-MUB are similar. The AChE-assay could not be conducted in vivo. The GE-assay using 4-MUB, however, could be conducted in vitro as well as in vivo. The AChE-activity in vivo was higher than the AChE-activity in D.magna was lower compared to C. riparius.
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster *Crassostrea* *brasiliana* exposed to pyrene (50 mg L\(^{-1}\) and 100 mg L\(^{-1}\)) and fluorene (100 mg L\(^{-1}\) and 200 mg L\(^{-1}\)), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcription levels of phase I (CYP1-like, CYP2-like, CYP2A14 and CYP156A1-like) and phase II (GST-like, GSTm-like and SULT-like) biotransformation genes, EROD, GST and GSTm activity, were evaluated in gills. The half-life time of pyrene (100 mg L\(^{-1}\)) = 2 h and 12 min) in water was lower than fluorene (100 mg L\(^{-1}\)) = 5 h and 54 min). These results might be related to the higher lipophilicity of pyrene, facilitating its influx through the plasma membrane into the intracellular compartment and enzymes involved in phase I biotransformation. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Additionally, these results provide evidence that these genes and enzymes in pyrene biotransformation metabolism. In addition, it suggests the participation of CYP2A14 gene in the biotransformation process of PAHs in gills of *C. brasiliana*.

**TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB *PACHYGRAPUS MARMORATUS* TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOUR (ITALY) AND OF AN ADJACENT MPA**

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 Uniniversitario 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-border management plans to actually protect the Marine Protected Areas. Male and female crabs were collected in the different areas: Livorno harbour, considered a polluted area, and the MPA, considered a non-polluted area. In addition, this study was conducted in 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), oxidative stress (lipid peroxidation, LPO; glutathione S- transferase, GST; glutathione peroxidase, GPX; glutathione reductase, GR; catalase, CAT; glutathione, GSH) and DNA damage (erythrocytic nuclear abnormalities, ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sampled specimens. Results showed that the crabs sampled at Livorno harbour are exposed to contaminants able to cause oxidative stress and genotoxic effects. LPO and ENA assay showed a statistically significant difference between specimens collected at Livorno harbour and the sampled 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.

**TU131 Promising invertebrate species as model organisms in ecotoxicology: ephyrae of the jellyfish Aurelia sp. and Sanderia malayensis**

E. Costa, C. Gambardella, V. Piazza, CNR ISMAR; S. Lavorato, Costa Edithуanin spa Aquario di Genova; M. Faimali, F. Garaventa, CNR 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, invertebrate species are being used extensively in laboratory tests for their usefulness for seeking mechanistic links between effects occurring at the individual level and consequences for higher levels of biological organization. In addition, compared to vertebrates they are easy to maintain under laboratory conditions, widely distributed and ecologically relevant. Although Cnidarian jellyfish (Scyphozoa) are known to play an important role in marine ecosystems, due to their sessile and generally colonial life style, 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 sub-lethal effects. The unequivocal demonstration of the existence of a sub-lethal response to this innovative invertebrate model for ecotoxicological testing. After these preliminary tests, ephyrae were exposed to a wide range of potentially toxic compounds (metals, surfactants, pesticides, nano-materials and harmful algae, emerging compounds), in order to evaluate the potential of ephyrae jellyfish in ecotoxicology. The experiments allowed to identify two end-points (sub-lethal, frequency of pulse 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 EC\(50\) 

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For the complete document, please refer to the reference source.
values obtained exposing ephyrae jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that ephyrae are an interesting and promising invertebrate model with a very high ecological relevance to be used in ecotoxicological investigations.

TU132 Paracentrotus lividus and Artemia sp.: never too old model organisms to give new end-points

S. Morgana, C. Gambardella, M. Faimali, F. Garaventa, CNR ISMAR

In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental instrument of chemical analysis. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount. 

Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in ecotoxicological studies with aquatic organisms. Behavioral responses have proven their usefulness in evidencing impacts of chemicals at environmental concentration that do not necessarily cause mortality; therefore, behavioral endpoints are less invasive than traditional acute tests, but still sensitive and more ecological relevant. In this work, we reported a novel research on the use of swimming behavior of two “old” marine model invertebrates in ecotoxicology, the crustacean Artemia sp. and the sea urchin Paracentrotus lividus. We selected two end-point endpoints. 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 used for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (±1) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU133 Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media

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Since 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. This WWTP has extraneous and sequential LC-UV fractionation methodology based on two different columns: a Nucleodur C8 column (21 fractions were collected) and an amionopropil column (15 fractions). Two endpoints were used to define the toxic effects after 48 h: the growth rate of the larvae and the rate of skeletal malformation. 6 levels (n=3) of dose-curve were prepared in units of relative enrichment factor (REF, final volume = 10 REF and EC50 =14 REF and EC50=39 REF). Regarding the chemical analysis, the final candidate list (206 compounds), mebendazole (an antihelminthic agent) was confirmed chromatographically with standards. Nevertheless, a sequential fractionation of 18 fractions was carried out with an amionopropil column, which showed a different orthogonality compared to C8 column, and the resulting 15 fractions were also submitted for further bioassays and data-dependent analysis. Overall, the results of this work suggest the possibility of addressing a kind of specific toxicity in sea-urchin embryos owing to the determination of only one toxic fraction and the contaminants identified in that fraction. Acknowledgement. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. L. Mijangos is grateful to the Basque Government and H. Ziarrusta to the Spanish Ministry for their predoctoral fellowships.

TU134 Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity

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Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxygenase pathway. As signaling molecules, they are important for diverse physiological systems such as inflammation, allergy, pregnancy, pain perception and blood pressure control. Therefore, they could be the important target for toxicant or drugs such as ibuprofen and aspirin. However, invertebrate model to evaluate eicosanoid pathway related toxicity has not yet been developed well though similar eicosanoid pathway was expected in invertebrate species. Therefore, the purpose of this study was to identify genetic information of key genes of eicosanoid pathway in Daphnia magna, a widely used invertebrate model, and to evaluate the transcription levels of the genes after the exposure to eicosanoid targeted drugs. To this end, we collected amino acid sequences of eicosanoids from other species and then compared the sequences in water flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as pla2, cox, pgd2a and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 μM. Then, we analyzed transcript levels. To ensure reliability, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under two 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 evaluate the effects of chemicals on eicosanoid synthesis pathway. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

TU135 Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach

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Placozoa human activities are negatively impacted by environmental contamination (e.g., industries, agriculture). Those contaminants may have continuous or pulse sources and can affect organisms from natural habitats. In different latitudes even phylogenetically close related species may present divergent chemical tolerances. 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 ensure reliability, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under two 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 evaluate the effects of chemicals on eicosanoid pathway. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

D. magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 μM. Then, we analyzed transcript levels. To ensure reliability, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under two 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 evaluate the effects of chemicals on eicosanoid pathway. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

LMU136 Chronic effects of BPA, BPS, and BPSIP in Daphnia magna

Y. Yang, B. Jeon, I. Ryoo, J. Lee, K. Ji, Yongin University / Biochemistry

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-isopropoxyphenylsulfonyl (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appears to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU137 Oxidative effects of mono(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level Y. Kwon, KIST Environmental Safety Group; Y. Seol, KIST-Europe / Environment Safety group
Mono(2-ethylhexyl)-phthalate (MEHP) is the metabolite of di-(2-ethylhexyl)-phthalate (DEHP), which is widely used in the industry as plasticizers. According to previous studies, DEHP inhibits molting hormone. In addition, MEHP is highly persistent and bioaccumulative in environment and living organisms. In EU regulation 2008/105/EC, on authorization of MEHP as well as some other disrupting chemical in aquatic organism such as Daphnia Magna. The aim of this study was to elucidate the linkages between toxicity test result and oxidative stress of MEHP. We studied the effects of oxidative stress as molecular initiating events on Daphnia magna. We observed the changes in different levels of the lipid peroxidation, glutathione S-transferases (GSTs), catalase (CAT) and superoxide dismutase (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU138 Are Daphnia magna and Chironomus riparius acute responses comparable? B. Ponti, ChemService Srl; R. Bettinetti, University of Insubria / DISTA; D. Garagna, ChemService s.r.l.; F. Casarotto, University of Insubria; M. Neri, ChemService srl - Controllo e Ricerche Laboratory ecotoxicity test results predict the responses of organisms with varying degrees of accuracy. Traditionally, the acute toxicity on aquatic invertebrates is estimated by exposing for 48 hours young cladocerans of Daphnia magna (OECD test guideline n. 202, 2004), taking advantage of its well-experienced sensitivity and reliability for a huge number of known and unknown toxicants. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data requirement in EU Regulation 2003/41/EC on plant protection of MEHP as well as other compound with 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 cladocerans. An alternative methodology has been applied for sexually reproducing organisms, as for example crayfish (Astacus fluviatilis), where the efficiency of the array can be used with other species improving also our knowledge about the mode of action of these compounds. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (Spain), CTM2015-64913-R/Au.A.B.M.G is the receiver of a pre-doctoral contract from the National University of Distance Education (UNED).

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius M.d. Bordalou, University of Aveiro; A. Rodrigues, University of Aveiro / Biology Department and CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Pestana, CESAM & University of Aveiro / Biology Natural populations are constantly facing a large array of environmental stressors, from both natural and anthropogenic origin, which represent a strong selective force shaping the behaviour, physiology and morphology of organisms. Genetic diversity acts as a key component of population adaptation and could be useful for disease resistance on aquatic species. The study aimed to understand the genetic and population response to perturbation and on their population response to perturbation and on their molecular and population level. Chironomus riparius was generally used to test the sensitivity (family genotypes) and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A. C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (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, final body weight and survival 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, University of Aveiro / Department of Biology and CESAM; M. Doiron, Indian Politechnic Institute of Leiria / MARE ILeiria; A. M. Soares, University of Aveiro / department of Biology & CESAM; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; M. Lemos, Instituto Politécnico de Leiria / MARE ILeiria Amitraz is a very effective formamidine insecticide used in agriculture to control fruit trees and cotton pests. Due to its widespread use and high persistence in the environment because their use in recreational and industrial activities. Described as endocrine disruptors in vertebrates, their effects on invertebrates have been poorly studied, especially in mixtures. On the other hand, Bisphenol A (BPA) is as plasticizer used in packaging and other industrial products with confirmed endocrine disruption activity. In this study we have used two common UV filters, octocrylene (OC) and 2-ethylhexyl-4-dimethylaminobenzoate (OD-PABA), and BPA to mimic the reactive mixture resulting from PPCP and interacted with plastic of PCP containers. These mixtures were then used to assess the biota of freshwater ecosystem so the main objective was studying of the effects that the mixtures can have on an invertebrate with a relevant role in the food chain of these ecosystems, Chironomus riparius. C. riparius is a dipteran with aquatic larvae frequently used in toxicity tests. Fourth instar larvae were exposed for 24 hours to single compounds and to binary and ternary mixture of DEHP and BPA. To mimic the reactive mixture leading to retrotranscription and Real-Time PCR using a specific array covering a relevant number of metabolic pathways like endocrine system, immune response, stress response, detoxification mechanisms and apoptosis among others. Using an array could improve the toxicological evaluation of the cellular effects of the compounds favoring the identification of new molecular biomarkers useful for ecological risk assessment and toxicity tests. The methodology used is to design the array can be used with other species improving also our knowledge about the mode of action of these compounds. This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).
the most sensible endpoint (LOEC of 40 µL L−1). Short-term exposures (48 h; 0, 10, 40, and 160 µL L−1) to aminarad induced glutathione peroxidase activity and a decrease in catalase activity. Additionally, aminarad 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 300 µg L−1 1,3-dichloropropene (1,3-D), while there was a significant decrease in DNA damage levels at 10 and 40 µL L−1 treatments. These results reveal possible biochemical targets of aminarad toxicity and suborganismal responses associated with aminarad 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 aminarad 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-16673).

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, University of Aveiro / Department of Biology & CESAM; T. Trémolet, T. Neves da Costa (Univ. Aveiro / Department of Biology & CESAM; P. Silva, Universidade de Aveiro; J. Ulcar, University of Ljubljana / Department of Biology; F.J. Wrana, University of Calgary / Department of Biological Sciences; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology

Agricultural practices include the use of agrochemicals for crop maintenance and enhanced production. Although soil contamination may result in, organism-specific damage, the effects of agrochemicals on soil microorganisms are largely unknown. 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 (19°C vs. 26°C) among other conditions (Cd: 5.25 mg kg−1 dw., Ag NPs: 0-100 mg kg/dw) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometric analysis was used to determine mortality of coelomocytes and changes in the relative proportion of amoeboocytes/eleocytes. Coelomocytes extruded from earthworms maintained at low and high temperature showed cell viability, but no changes were recorded in the relative proportion of amoeboocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoeboocytes. Thus, we can conclude that the response of the different subpopulations was dependent on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential use of amphidelphic earthworms for an accurate soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT810-13), Univ. Basque Country (UFI 11/37) and MINECO (Nanosilveromics Proj).

TU143 Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behaviour of amoeboocytes and eleocytes

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, acification, 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, amoeboocytes and eleocytes. However, the behaviour of those subpopulations against different stressors is still unclear. Hence, the aim of the present work was to address the effects of different stressors (increase in temperature, low OM, model and emerging –nanoparticles- contaminants) on E. fetida coelomocytes by assessing mortality and changes in the relative proportion of subpopulations (amoeboocytes, eleocytes). For that, earthworms were maintained under low OM content 6% vs. 10%, thermal stress (19°C vs. 26°C) among other conditions (Cd: 5.25 mg kg−1 dw., Ag NPs: 0-100 mg kg/dw) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometric analysis was used to determine mortality of coelomocytes and changes in the relative proportion amoeboocytes/eleocytes. Coelomocytes extruded from earthworms maintained at low and high temperature showed cell viability, but no changes were recorded in the relative proportion of amoeboocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoeboocytes. Thus, we can conclude that the response of the different subpopulations was dependent on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential use of amphidelphic earthworms for an accurate soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT810-13), Univ. Basque Country (UFI 11/37) and MINECO (Nanosilveromics Proj).

TU144 Terrestrial arthropods as indicators of environmental pollution
V. Lesch, North-West University; H. Bouwman, North-West University / Unit for Environmental Science and Management

In recent years, the use of and interest in terrestrial arthropods as indicators of environmental pollution is increasing. Arthropods are diverse, with over 31 000 described. Terrestrial arthropods are relatively easy to sample, and collection normally has less ethical restrictions than for higher animals. We investigated, in the species suitable for assessing side-effects on detritivorous soil arthropods. In Brazil, the acaricide abamectine and the insecticide difenoconazole are widely used in agriculture, but little data is available about their possible side effects on the soil community. The objective of this work therefore was to evaluate the effect of abamectine, pure and in the formulation Kraft®, and of difenoconazole, pure and in the formulation Score®, on the reproduction of F. candida using a standard OECD Lufa 2.2 soil. Juvenile F. candida, with age 10-12 days, were exposed following the standardized ISO and OECD test guidelines. The results were analyzed by analysis of variance (ANOVA) followed by Dunnett’s test at 5% significance level. Median lethal concentration (LC50) was calculated using Trimmed Spearman Karber (TSK) and EC10 and EC50 values for effects on reproduction were estimated using a logistic model. The results showed that both pesticides were more toxic in the formulation than when applied as pure active ingredient. For abamectine dosed as the formulation Kraft® EC10 was 1.0 (0.17-1.8) mg/kg dry soil, while it was 6.3 (1.8-11) mg/kg dry soil for the pure active ingredient. For difenoconazole applied as the formulation Score®, EC50 was 53.5 (40.0-67.0) mg/kg dry soil while no effects on springtail reproduction were seen at concentrations of the pure active ingredient up to 333 mg/kg dry soil. The data indicates that it is essential to perform official formulation toxicity tests with pure active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically underpin increased toxicity levels caused by the tested formulations.

TU145 Terrestrial arthropods as indicators of environmental pollution
V. Lesch, North-West University; H. Bouwman, North-West University / Unit for Environmental Science and Management
TU146
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms
Spray drift of pesticides has a negative impact on aquatic ecosystems and the environment, including damage to non-target organisms. Particularly, the drift of some insecticides can have detrimental effects on beneficial arthropods such as predatory mites. According to the recent EU Directive, the reduction of spray drift is required for a sustainable use of pesticides, yet without reduction of efficacy against pests. In this framework, eight field trials were conducted from 2012 to 2014 in two typical growing areas of Verona district (Northern Italy), four on apple orchards and four on vineyards. The aim of these trials was to evaluate, for two spray drift reduction techniques: 1) the spatial patterns of in-field droplets, 2) the efficacy against 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 (Albus, ATR 80 yellow), low-drift nozzles (Albus, 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 microasplastics 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 the present study, we observed the behaviour of freshwater organisms and evaluated whether they recognize and respond to microplastics. Adult zebrafish was exposed to the different concentration of microplastic (MP, 250-300 μm) and food materials (F) 20 mg MP, 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, 2.8±1.3, and 0±0±4. respectively. Ingestion rate of diving beetle on control group was calculated as 0.63±0.10 zebrafish wet/msec. The exposure group, which fed the MP10F10 exposed zebrafish, showed the significant decreasing (p < 0.05) of ingestion rate (0.5±0.08 zebrafish wet/sec) during 591±85 seconds. On diving beetle, the MP were only found at crop organ until 720 min after ingestion, and did not transfer to another 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 Korean Government Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

TU150
Microplastic shedding from functional textiles C. Bonsignore, Swerea IVF AB / Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); P. Mellin, Swerea KIMAB AB; O. Levensten, University of Borås; A. Hanning, Swerea IVF AB; S. Roos, Swerea IVF AB / Energy and Environment
Microplastic pollution of marine environment is an environmental issue which is intensely discussed on a global level. Synthetic based textiles contribute to microplastic pollution of the marine environment. Besides littering and the size-shape effects that microplastics have when being exposed to humans and animals they provide an additional vector for chemical pollutants, i.e. possibly providing a new entering mode into organisms of pollutants already existing in the sea. But fibers generated from consumer articles such as textile garments might carry chemical pollutants due to different chemical treatments. This study investigated the changes in female fertility of laboratory Caenorhabditis elegans and the size-shape effects that microplastics have when being exposed to humans and animals. Fibers from many kinds of functional materials were used in the experiment and the size-shape effects that microplastics have when being exposed to humans and animals. Fibers from many kinds of functional materials were used in the experiment and the size-shape effects that microplastics have when being exposed to humans and animals.
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 fluoride contaminated fibers to the environment, from washing via waste water treatment to the recipient. This study proved that functional textiles can contribute to the release of microplastic pollution due to the formation of synthetic fiber fragments during washing. Therefore, the fiber samples' chemical 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 organic compounds. In addition the results of this study suggest that similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

TU153 A cost-effective methodology for separation of microplastics from freshwater ecosystems

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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 temporal and spatial comparisons).

This work aims to assess the effectiveness of different separation methods as an attempt to identify and establish the most cost-effective approach. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (e.g. low/high-density polyethylene, polypropylene, polyethylene, polyvinyl chloride, polystyrene) 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 (peroxone oxidation) and multienzymatic detergent (enzymatic digestion). The samples were then undergone the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of density separation and organic matter degradation, the total mass of recovered MP, yield of separated MPs, cost of each method and, the simplicity and the quality of recovered polymers. Based on this multi-criteria approach, this study concludes that the wet peroxide oxidation with addition of zinc chloride was the most cost-effective method. This method should be used in future studies of microplastics monitoring. The results will be further verified using combustion ion detection in sludge matrix as well as the determination of hydrogen peroxide (peroxone oxidation) and multienzymatic detergent (enzymatic digestion). The samples were then undergone the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of density separation and organic matter degradation, the total mass of recovered MP, yield of separated MPs, cost of each method and, the simplicity and the quality of recovered polymers. Based on this multi-criteria approach, this study concludes that the wet peroxide oxidation with addition of zinc chloride was the most cost-effective method. This method should be used in future studies of microplastics monitoring. The results will be further verified using combustion ion detection in sludge matrix as well as the determination of hydrogen peroxide (peroxone oxidation) and multienzymatic detergent (enzymatic digestion).

Recent research has revealed that microplastics can be detected in sediment, water, and even in the human body. The presence of microplastics in the environment can have adverse effects on human health and the environment. The development of effective and cost-effective methods for the separation and analysis of microplastics is crucial for understanding their impact on the environment and human health. This study presents a cost-effective and efficient method for the separation of microplastics from freshwater ecosystems, providing a tool that can be used in future studies to monitor microplastic abundance and assess their environmental impact.
Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current modelling

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Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, coral reefs, the fishing industry and shipping transport safety. Microplastics, defined as particles < 5 mm, form a considerable portion of this pollution and have recently received increased attention following recent discoveries that not only can these particles be ingested by planktonic animals, but also outnumber natural food items in some ocean areas. Ingested particles can induce negative survival effects as well as serve as introduction vectors for accumulated persistent organic pollutants (POPs) or carcinogenic plastic additives into the base of the food chain, potentially leading to many seafood products consumed by humans. Research has mainly concentrated on marine systems, and while a growing number of studies focus on freshwater lakes, river systems have to date received little attention. In particular, riverine plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas remain largely unexplored. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from Landsat and Sentinel-2A. Model accumulation maps were validated against in situ sampling data from 9 beaches in the Po River mouth and particle size range (1.5 mm). Hydrodynamic modelling suggests that the amount of discharged particles is only semi-coupled to beaching rates. Object tracking revealed that beached of emitted particles was strongly mouth dependent and relatively low (less than 25% of all released particles from a given river mouth), primarily occurring within the first five days. The southernmost Po River mouth posed an exception, where more released particles (94%) were found to beach over an extended period of time and along a longer stretch of coastline. Comparison with remote sensing based accumulation maps and validation against in situ beach sampling are discussed. The presented methodology lays the groundwork for developing an operational monitoring system to assess microplastic pollution being emitted by a major river and its distribution along adjacent coastlines as well as into the open ocean.

Cause and effect of the plastic industry in South Africa as a developing country

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In 2017, the South African plastic industry has grown with 1.9%, compared with 2016 (Plastics SA). Although legislation is in place to promote recycling and sustainable use of natural resources, the recycling of plastic based materials is done predominantly by corporate initiative. Many South Africans believe that the country is lagging in terms of recycling. South Africa has however achieved a recycling rate of 41.8% in 2016, of which more than 75% occurs post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to achieve this goal. Inadequate waste disposal infrastructure and protocols, especially in informal settlements causes large quantities of unrecycled plastic to end up in aquatic systems and subsequently in the marine environment. Beaches surrounding estuaries are heavily polluted with macroplastics which calls for greater prevention and clean-up efforts. Much effort is spent corporately to reduce South Africa’s ‘plastic footprint’, but efforts in terms of microplastics are trailing. We collected and filtered 46 fresh water samples from various localities in and around Gauteng, the most densely populated province in South Africa. High levels of plastic pollution were found in almost all samples. Up to 40 plastic particles (> 20 µm) per litre of surface water of the Vaal River, the major river in the country’s largest drainage basin flowing through industrialised areas. These levels are comparable to high levels of microplastic pollution found in European rivers. The growing plastics industry in South Africa requires excellence in clean-up and recycling to reduce the negative impacts on the environment and create a viable plastic sector.

Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK

R.M. Blair, S. Waldron, University of Glasgow; C. Gauchotte-Lindsay, University of Glasgow / Infrastructure and Environment; V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

Microplastics (MPs; < 0.5 mm) are classified as contaminants of emerging concern but currently are not regulated by water quality standards. Microplastics are highly diverse and their distribution in the environment is highly variable in space and time, making their quantification and risk assessment difficult. Further, their monitoring and regulation are hindered by limited empirical data, particularly of fresh- and wastewater systems as important pathways of land-based contaminants to oceans. Here, a study was conducted in a tertiary sewage treatment plant in the UK (Glasgow, Scotland) to assess the presence of MPs in the system and the effect of treatment stage in removing these contaminants before discharge into recipient water bodies. The MPs were extracted from 5-L samples at each treatment stage, using H2O2 digestion and vacuum filtration through 1.2 µm GF filter. Characterisation and quantification of MPs was carried out by light microscopy followed by detailed chemical analysis of representative subsamples via SEM-EDS and FTIR-ATR. Microplastics were present in wastewater samples collected at all treatment stages, and abundances generally decreased from inflow to outflow. Further, high variability in MP abundances was evident across sampling dates. Chemical characterisation by SEM-EDS revealed that 94% of analysed pieces were C-based materials, but only 25% were confirmed plastics based on FTIR-ATR results. In conclusion, the tertiary treatment process evaluated here efficiently removes MPs entering the system but small quantities may still be discharged into the environment. Further, visual characterisation with light microscopy may result in overestimation of MPs due to misidentification of cellulose and other 1P1 microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

Weathering-induced changes in the effect of microplastic particles and their leachates

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Studies on the potential effects of microplastic (MP) particles in the aquatic environment are numerous. However, many laboratory studies apply spherical, pristine particles, which may be of limited relevance given UV light irradiation, mechanical stress, salinity, biofilm growth and other factors that can influence the weathering of the particles. The MSMPR (microplastics marine model for risk) project, funded under the OPS-Plastic division of the European project Oceans-funded project WEATHER-MIC is to assess the impacts that weathering has on the transport, fate and effects of MP particles and their leachates. We summarize recent results on potential effects. (1.) Impact of MP particles on organisms: We have exposed copepods, daphnia and algae to different fractions of virgin and weathered MP as well as particle-free leachates under controlled conditions. From the observation of apical endpoints in the acute toxicity assays, concentration-response relationships for the different fractions can be deduced. A critical evaluation of the suitability of the applied test protocols for the assessment of adverse effects of MP will be presented. (2.) Influence of ageing plastic and leachates on biofilm structure and function: Natural biofilms (containing bacteria, algae and fungi, embedded in extracellular polymeric substances) grown on different types of aged and pristine polymeric substrates have been studied to observe the influence of weathering on the attachment and succession of biofilms. Sum parameters (biomass, pigment profiles, photosynthesis) and sequencing data were studied. (3.) Mixture effects of leachates from the most common polymers: Cell-based bioassays have been applied to study mixture effects of additives and degradation products of the polymers liberated during weathering of plastic material in artificial seawater in agitated UV chambers. The chemicals in the seawater leachates were enriched by solid-phase extraction or chemicals were directly extracted from pristine particles by ultrasonic-assisted solvent extraction. The concentrated leachates and solvent extracts were then dosed into cell-based bioassays, covering i) cytotoxicity; ii) activation of metabolic pathways, e.g. via binding to essential carbon receptor; iii) specific, receptor-mediated effects such as estrogenicity; and iv) adipocyte stress responses such as oxidative stress. The results may help to understand effects caused by additives and parent compounds opposed to the degradation products liberated from the UV-weathered plastic.

Occurrence and characteristics of fine microplastics in sewage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscopy method

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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 existing in sewage water, 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 method of microplastics by FTIR and microscopy. MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.

TU160 Detection of micro-paint particles and microplastic in harbour soil samples using FPA-μFTIR-Imaging-FTIR
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, N. van Alst, F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering (26%); I. Albacete, University of Castilla-La Mancha; T. C. Schell, IMDEA Water Institute; T. van Bavel, Aarhus University / Department of Civil Engineering / Centre for Environmental Strategy; J. Lomholt, Aalborg University / Department of Civil Engineering / Centre for Environmental Strategy; V. C. D. van der Meulen, Aalborg University / Department of Civil Engineering / Centre for Environmental Strategy; K. Bjerregaard, Aalborg University / Department of Civil Engineering / Centre for Environmental Strategy. Detection of micro-paint particles and microplastics in harbour soil samples using FPA-μFTIR-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 (5000-50 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-μFTIR-Imaging spectroscopy and the data were processed with a dedicated software (MPHunter) developed at Aalborg University. The first results highlighted a high micro-paint and microplastic particles contamination. The total MP and MPP concentration were 222,500 particles Kg⁻¹, while the estimated mass was 17.1 mg Kg⁻¹. The most abundant polymers/paints detected were polyester (30%), acrylic coating (20%) and polyurethane (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 using the art analytical approach including multiple-step sample preparation and FPA-μFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

TU161 Runoff of microplastics from agricultural soil: a study in a semi-arid area R. Herling, NIVIA - 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 reach more than 95% of the sludge phase. Therefore, the use of sludge as a fertilizer for agricultural soils may be a relevant source of MPs in the terrestrial ecosystem and, through runoff, in surface waters. The fate of MP applied with sludge is strongly dependent on weather conditions (rain, temperature, etc.). The objective of this study was to determine the fate and distribution of MPs in the agricultural soil-water system. The study was performed in a field experiment (SETAC Europe Section of Water, Soil and Environment) 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 assess potential accumulation and MP impacts on the soil fauna. The content of MPs in runoff water, soil and biological samples were extracted using organic matter digestion (soil and organism samples), density separation (soil samples), and filtering (all samples). MPs were identified visually and characterised chemically using 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)
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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 concentration seems to vary. Finally, the more efficient stream, 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 work were (i) to evaluate the composition of MPs in surface waters, and (ii) to ascertain the MP contribution of WWTP effluents. The study was carried out in the Henares River watershed (Central Spain). Five WWTPs with differing dimensions (population equivalents between 10,000 and approx. 400,000), differing influent types (domestic, industrial, or both mixed), and differing treatment processes were selected. Wastewater inflow, outflow, and sludge (humid and dried) were sampled during two different seasons (spring and autumn). In addition, river water and sediment samples were taken in three different seasons (spring, summer, and autumn) at three differentially impacted sites: i) low human impact; ii) high agricultural impact; and iii) high mixed impact (urban, agricultural, industrial). MPs in river water and wastewater were divided into four fractions by filtering a suitable amount of water through plankton nets of different mesh sizes (from 300 to 20 mm). In order to assess the MP concentration and composition in the samples, solid substrates (sludge and river sediment) were subjected to an organic matter removal treatment, followed by density extraction. Subsequently, those samples, as well as the liquid samples (river and wastewater), were filtered onto filter papers to visually identify the MP content and then chemically characterize their polymer types (domestic, industrial, or both mixed), and differing treatment processes were selected. The collected particles were separated by a density separation method including multipletype sample preparation and FPA-μFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

TU163 Microplastics occurrence and composition in drinking water from a Norwegian urban area a. gomiero, International Research Institute of Stavanger / Environment; G. Skogerbø, IVAR; K. Øysæd, A. Vatland Krøvel, International Research Institute of Stavanger
Microplastics as a potential health and environmental problem has gained increasing attention recently. Microplastics is defined as plastic pieces smaller than 5 mm in diameter, and the sources of microplastic are many. State of the art literature reports that microplastics are ubiquitous worldwide. While several authors report frequent occurrence of different plastics in different compartments of marine, freshwater and terrestrial ecosystems; others point out the accumulation of micro- and nanometric sized plastic particles throughout the marine and terrestrial food webs posing the risk of marine and terrestrial life and ultimately the human health. Despite of these studies point out the occurrence of micro plastics in freshwater systems including surface and groundwater basins, very little in know about the occurrence of microplastics in the drinking water supply and their implications on human health. According to the WHO men should consume 3 L and women should consume 2.2 L of beverage per day. Most of these beverages consist of tap water, or drinks derived from tap water (such as coffee, tea, or reconstituted juice). The risk of plastic uptake from drinking water is currently unpredictable and water treatment plants (WWTPs) are not expected to remove all microplastic particles entirely. The aim of this project is to study potential accumulation of MP in drinking water and their implications on human health.
detect microplastic particles in drinking water supply systems with special focus on different polymeric composition and size fractions. Study area was the Rogaland area (Norway) populated by approx 110,000 inhabitants. Samples of drinking water were collected every two week for ten months contemporary from the supply water system collection point as well as in different sites of the urban area. A fast and sensitive method based on a GCMS-pyrolysis was developed. Polyethylene, Polypropylene and Polyvinyl chloride were the most recurrent polymers. Levels ranged from 0.02 to 16 ng/L. Time and space related trend are presented.

TU164 Macro and Micro (plastics) in the Environment of Some French rivers

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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 plastic pollution, the mobility and chemical composition over time of macroplastics present on the banks of an experimental site of the Allier River, and linking it to the density of the vegetal areas. 2. Set up on site a controlled pollution to follow its fate along the time. 3. Analyze the composition of 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 Plasticscages project supported by the CNRS[1, 2]. 4. Collect and analyze the composition of microplastics in the surface waters of different French rivers (Allier, Charente, Loire, Touvre, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babybag sampling net [3,4], which makes it possible to multiply samples and analyses. 1 Occurrence of plastic litter in the Allier river in France. Vincent Verney, Gaëlle Bissagou Koomba, Alexandre Garreau, Florence Delor-Jestin, Erwan Roussel, Olivier Voldoire, Jean-Luc Peiry; To be published 2- https://www.researchgate.net/project/PLASTICSCAGES 3- Promise compromise, the case of babybags, Max Liboiron, Engaging Science, Technology and Society 3(2017), 499-527 4- http://lapugiaisesauvage.org/laboratoirerecyclons

TU165 Spatial and temporal trends of microplastics in an urbanized Canadian river

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Microplastics are ubiquitous contaminants in the marine environment, but quantitative data on their presence in the freshwater environment is sparse. 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, and downstream of the river. Infrared Spectroscopy. Zebrafish exposed to microbeads individually would ingest different sizes of polyethylene microbeads (10-22µm, 45 to 54µm, 90-106µm, 212-250µm & 500-600µm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1(CYP1A1) and vitellogenin 1(VTG1) studies. Our objectives in microbeads exposure experiments using the INCA Models for Data Synthesis, Sampling Design and Scenario Analysis: Some models 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 the power of the Infrared Spectroscopy. Zebrafish exposed to microbeads individually would ingest different sizes of polyethylene microbeads (10-22µm, 45 to 54µm, 90-106µm, 212-250µm & 500-600µm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1(CYP1A1) and vitellogenin 1(VTG1) studies. Our objectives in microbeads exposure experiments using the INCA Models for Data Synthesis, Sampling Design and Scenario Analysis: Some models using the INCA-MP model of microplastic fate and transport in soils and surface waters

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TU166 A Historical Sediment Record of Microplastics in an Urban Lake, London, UK

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A historical record of microplastics extracted from a radionuclide (137Pb and 134Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particle abundance and calculated accumulation rates are indicative of plastic usage in the 20th century. Concentrations of microplastics extracted from the sediment, by sieving and floatation using dense liquid separation range from 30 to 880 particles per kg of dried sediment. Fibres dominate the assemblage of microplastic particles identified in the time-resolved sediment samples. 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 particles found in the sediments is linked to the density of the vegetal areas. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m3 in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW) and two stormwater outfalls (SWOs) (Kwun Tong Ferry Pier,New York Ma Tei Typhoon Shelter) which are potential microplastic pollution sources entering into the Victoria Harbour. Effluent samples from each of the five wastewater systems were collected in three weekdays per month and different seasons (December, March, June and September) to determine spatial, temporal (seasonal) variations of microbeads in treated sewage and stormwater discharges. The highest concentrations of microbeads present in effluents from STWs and SWOs respectively ranged from 137,239 to 1,081,597 particles per 100m3 (December 2016 to March 2017) that consider as moderate emission level. Biological samples (fishes and mussels) are also collected in two SWO for the assessment of microbeads abundance and composition in its digestive system. Microplastics of different shapes from sewage and biota (mainly fragments, lines, fibres, and pellets) were identified by means of Attenuated Total Reflectance-Fourier Transform-
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

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The term ‘microplastics’ was first used in 2004 to describe very small fragments of plastic (< 50 µm) in the water column and in sediments. In 1983, 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 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 pyrolysis-gas 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 and 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 (0.4%).

TU170 Removal of 10-500 µm microplastics from wastewater effluent by disc filter

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In this study the efficiency of a disc filter to remove microplastics 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 Grinsted, Denmark operated by Billund Spildvæske AS. The treated wastewater was sampled before and after the disc filter by sampling into 10 l stainless steel bottles and filtering with a large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical oxidation and 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 optimal 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 of the effluent samples after the filter (polystyrene and polystyrene).

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions

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Shortly after the introduction of many types of plastics (e.g. polystyrene, polyethylene teraphthalate, 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 (macroplastic) 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 pollutant burdens are transported. The long distance transport methods suggest that plastic waste will accompany, if not outlast, mankind for a long time to come. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps. Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on the environment, for example by: a) being taken up by organisms; b) being transferred to marine organisms by microplastics; c) affecting the water quality; d) being trapped in marine organisms; e) harming marine organisms; f) influencing the water quality. Microplastics have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of routes and conditions. Results from the six replicates for each campaign. After sample extraction and purification, validation of visually based microplastics identification was achieved using pyrolysis-gas 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 and 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 (0.4%).

TU172 How do we know that microplastics are different from natural particles in their effects on biota?

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Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of routes and conditions. Results from the six replicates for each campaign. After sample extraction and purification, validation of visually based microplastics identification was achieved using pyrolysis-gas 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 and 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 (0.4%).

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics

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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 microplulipants like pharmaceuticals, can be charged under certain pH conditions. While it is known for a wide variety of natural particles that charged compounds sorb only little or not at all, sorption interactions between microplastics and charged compounds have not been analysed so far. Thus, the aim of this study was to clarify the sorption behaviour of dissociating compounds to microplastic particles. We measured the equilibrium partitioning between 19 typical wastewater contaminants (pharmaceuticals, personal care products, pesticides) and microplastics at three different pH conditions (pH 4, 7, 10). The investigated compounds showed a wide variety in their physico-chemical properties, e.g. a log Kow range between 0.1 and 5.8 and pH-Kw-values from 1.6 to 13.9. We performed batch experiments with fourteen ionizable and five non-ionizable substances. In all experiments equilibrium was reached after two days. Measured log Kow for the neutral species ranged from 0.75 to 4.00. The uptake of contaminants varied according to their hydrophobicity. Sorption of ionizable substances is strongly influenced by the pH while non-ionizable substances showed a partitioning independent of pH. For sorption into polystyrene, the amount of accumulated pollutants is principally dominated by the neutral fraction, while the charged
species did not contribute. Thus, with increasing pH sorption of acids decreased while the sorption of bases increased. Whereas electrostatic interactions between charged species and polyethylene could not be detected, this might be different for other polymers, such as polystyrene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Hüffer, S. Slawek, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The worldwide production and usage of mainly disposable plastic has increased from 1.7 million tons in 1950 to 299 million tons in 2013 [1]. Consequently, plastic wastes are deposited in the environment and persist due to long durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composites and packaging material [3]. To date, microplastics have mainly been 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].


TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornearietis: behavioral and biochemical responses S. Kraus, University of Tübingen / Animal Physiological Ecology; H. Schmieg, Tübingen University / Animal Physiological Ecology; E.E. May, University of Tübingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tübingen / Animal Physiological Ecology; R. Triebskorn, University of Tuebingen / Animal Physiological Ecology. We explored these effects for pristine plastics and plastics combined with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornearietis). Snails were exposed to 10.000 polystyrene particles per liter (cyrogenically milled, < 100 μm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiacloprid. In order to quantify the behavioral and biochemical effects of microplastics we compared the behavior and biochemical responses of the giant rams-horn snail (Marisa cornearietis) before and after exposure, (2) quantifying uptake of plastic in the environment and (3) observing changes in behaviour (reproduction and survival). This study aims to build on current research on the effects of freshwater microplastics, focusing on the micro and nano plastics potential to transfer chemicals in the environment. The formation of a corona on plastic particles changes their surface characteristics which could lead to a change in how bioactive chemicals interact with the environment. 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 detersents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess how they can be influenced by microplastics in an already 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. Based on this data we can make recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU176 Effects of artificial weathering on polypropylene microplastics V. Fernández-González, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); M. J. Andrade-Garda, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); J.M. Andrade-Garda, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. López-Mahía, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muñategui, Universidade da Coruña / Analytical Chemistry

Microplastics are defined as plastic materials or fragments with diameter below 5 mm. These microplastics occur due to the release of manufactured (primary) microplastics in various products and the breakdown of larger plastic litter (secondary microplastics). The time required for plastic to degrade under natural conditions is estimated to be on the order of hundreds to thousands of years, seeing 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 to analyze the chemical and morphological changes. SEM images included reduced feeding and successful reproduction, change in organism’s behaviour and decreased survival. This study aims to build on current research on the effects of freshwater microplastics, focussing on the micro and nano plastics potential to transfer chemicals in the environment. The formation of a corona on plastic particles changes their surface characteristics which could lead to a change in how bioactive chemicals interact with the environment. 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 detersents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess how they can be influenced by microplastics in an already 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. Based on this data we can make recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

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 bioactive chemicals interact with the environment. 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 detersents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess how they can be influenced by microplastics in an already 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. Based on this data we can make recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.
Analytical Chemistry (ACES)
Conventional, oil-based polymers are considered as the major source of microplastic pollution, whereas biodegradable polymers (bioplastics) have not attracted much attention as sources of microplastics. However, given that production of bioplastics is increasing and that biodegradation is slow under ambient conditions, it is likely that they enter the aquatic environment in the same way as other plastics. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; biopolymer) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean *Daphnia magna*, a standard model species in ecotoxicology. To exclude particle effects caused by food dilution and thus identify microplastic-specific effects, kaolin clay was used as a reference treatment. In total, four treatments were included: PLA, PS, clay (reference), and control (food only). The exposure was conducted over 21 d using a plankton wheel to keep test particles and algae in suspension for comparable exposure concentrations. In the PS treatment, we observed high mortality, decreased feeding rate and reproductive output compared to all other treatments. These effects were not caused by toxic monomers of styrene or additives leaching out of the polymer, which was demonstrated in a follow-up test with the PS leachate. By contrast, no significant effects were found in the daphnids exposed to PLA compared to the reference treatment. Thus, a significantly higher toxicity of the conventional polymer was observed, whereas effects of the biodegradable microplastics were similar to those caused by the ubiquitously occurring clay particles. More studies are needed to identify the mechanisms of PS toxicity and to confirm the observed ecotoxicological differences between the polymer types using different test species.

To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

**TU179**
Effects of polystyrene microplastics in different life stages of brown trout (*Salmo trutta f. fario*)
H. Schmieg, Tübingen University / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology; F. Rezbach, University of Tubingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. Trübskorn, University of Tubingen / Animal Physiological Ecology. The widespread use of plastic products in our daily life has led to a constant increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for industrial 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 < 28 µm, up to 100,000 particles/L) in a 5 day exposure experiment with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (*Salmo trutta f. fario*). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the fluorescent dye DHE (dihydroethidium) associated to the MP exposure. We used an ORAC assay (oxygen radical absorbance capacity) and a TBARS assay (thiobarbituric acid reactive substances) to measure levels of lipid peroxidation and anti-oxidant substances, respectively. After hatching, we observed effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larva or juvenile brown trout. Further analyses are still in progress. The present study is part of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WR51378).

**TU180**
Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocerans
G. Jakumar, CML Leiden University / CML; N. Brum, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecology and Hydrology. Primary microplastics (PMP) 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 18oC, 22oC, and 26oC 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 18oC, followed by *D. pulex* and *D. magna*, which were of comparable sensitivity; however, the trend was reversed at 26oC. In addition, *C. dubia* was shown to be more toxic to *C. dubia*. Both PMP and SMP showed adverse effects on all three species during chronic exposure. Further, *C. dubia* was the most sensitive species followed by *D. pulex* and *D. magna*. All species were more affected by PMP than SMP during chronic exposure. The results of the current study indicate that exposure to microplastics has adverse effects on health and reproductive output of the species studied, although at relatively high levels of exposure, and that temperature as an environmentally relevant additional stressor has a major influence on species sensitivity to microplastics.

**TU181**
Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels
S. Magni, University of Milan / Department of Biosciences; F. Gagne, Environment and Climate Change Canada; C. Della Torre, State University of Milano / Biosciences; C. André, J. Auclair, H. Hanana, Environment and Climate Change Canada / Aquatic Contaminants Research Division; F. Bonasoro, University of Milano / Department of Environmental Science and Policy; A. Binelli, University of Milano / Department of Environmental Science and Policy. For that purpose, we conducted a fish early life stage experiment with mussels, expecially 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 MPs from WWTPs, we tested the following mixtures (MIXs) of polystyrene MPs: MIX1, which contained 2 millions/L of 10 µm MPs and 2 millions/L of 1 µm MPs, and MIX2, which contained 500,000/L of 10 µm MPs and 500,000/L of 1 µm MPs. Therefore, mussels were exposed for 7 days in static conditions to the MIXs and to related controls; every 3 days we collected from each tank the mussels to assess both chronic toxicity and uptake of polystyrene MPs. We evaluated the adverse effects by monitoring end-points of cellular stress, as the activity of antioxidant and detoxifying enzymes, oxidative damage, cyto-genotoxicity and neurotoxicity (analyses in progress). To evaluate the uptake of polystyrene MPs in the exposed mussels, exploiting the reflection of MPs, we collected hemolymph and then fixed them in the right soft tissue for cryostat sectioning. We then observed the samples using the confocal microscopy. Despite we found both sizes of polystyrene MPs in the hemolymph and soft tissues of mussels, we did not obtain significant increase of tested biomarkers compared to control, excepted for a significant increase of CAT activity at the end of exposure for mussels exposed to MIX 2. The lack of adverse effects induced by tested MPs could suggests that the toxicity of MPs could be unlikely associated to the MPs towards chemicals, or involved in metabolic pathways not detectable by our biomarkers. In addition, prolonging the exposure time the MP toxicity could be increased.

**TU182**
Polystyrene microplastic effects on the lipid peroxidation and antioxidant capacity in non- and temperature-stressed individuals of *Dreissena polymorpha*
A. Weber, N. Jeckel, C. Weil, S. Umbach, Goethe University Frankfurt am Main / Aquatic Ecotoxicology; N. Brennholt, German Federal Institute of Hydrology / Biochemistry and Ecotoxicology; G. Reiffscheid, German Federal Institute of Hydrology; M. Wagner, Norwegian University of Science and Technology / Department of Biology. Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and therefore MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species is missing. Therefore, we analyzed the effects of irregular polystyrene MP (< 63 µm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve *Dreissena polymorpha* both in a single and multiple stressor exposure regime. We exposed *D. polymorpha* to polystyrene MP at concentrations between 6.4 and 100,000 µL-1 over 6 weeks at 16 °C. After the exposure, the gizzard gland tissues were analyzed for malondialdehyde concentrations (TBARS assay, thiobarbituric acid reactive substances) as well as for the remaining abundance of hydrophilic, non-enzymatic antioxidant substances (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation...
and antioxidant capacity did not indicate any increased stress levels in response to chronic MP exposure in D. polymorpha. In addition, the same experiment performed in a sub-chronic exposure (1, 3 and 7 d) did not reveal stress-induced effects either. Therefore, this study indicates that poly styrene MP does not induce a stress response in D. polymorpha in the current exposure scenario. In a more environmentally realistic scenario, bivalves will experience other stressors (e.g. increased water temperature) besides particulate matter. Thus, we hypothesize that a subacute stress response can be moderated by MP exposure. To explore such a scenario further, we will present results from ongoing multiple-stressor experiments in which we expose D. polymorpha to MP at 16, 24 and 28 °C.

TU183 Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna
C. Schueg, Goethe University Frankfurt / Dpt. Aquatic Ecotoxicology; S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; M. Wagner, Norwegian University of Science and Technology / Department of Biology

The last decade has seen a surge in research investigating various aspects of micro- and nanoplastics originating from plastic pollution in aquatic ecosystems. Aspects include occurrence, uptake, and potential effects in biota. Working with particles in a laboratory setting bears its own kinds of challenges, some of which had already been described in the realm of nano- toxicology. One of our objectives was to study 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 significantly expand the known uptake pathways. To substantiate the limited available data, the aim of our study was to replicate these findings. We exposed neonate daphnids in a number of scenarios regarding particle concentration and exposure duration at two independent geographical locations using animals from two separate cultures. We expanded on the previous experiment by improving imaging through the addition of a confocal-based clearing followed by investigation through confocal laser scanning microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoparticles. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microparticles under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body fate and effects research 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 preponderance of MP to the terrestrial environment, data regarding the effects of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods Porcellio scaber and earthworms Eisenia andrei avoid soil contaminated with 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 ± 5.05 mm (with 62% of fragmented from plastic bag). The mean size of MP from facial cleanser was 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of fragmented from plastic bag). The mean size of MP from facial cleanser was 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of fragmented from plastic bag). The mean size of MP from facial cleanser was 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of fragmented from plastic bag).

TU185 Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study
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Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Beside their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported into biota by the so-called ‘Trojan horse effect’. In this study, a higher CPF could be leached out of the different concentrations of MP. This was confirmed with the aim to discover the Trojan horse effect by means of a laboratory aquatic microcosm study. The insecticide chlorpyrifos (CPF) was used sorbed to 5 µm polystyrene microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg 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 µg/L (H) in the water phase. After 48h of depuration, all 24 aquaria contained 16 L water and a 3 cm sediment layer, both taken from outdoor ponds. The natural plankton community got enriched by the amphipod Crangonyx pseudogracilis. After a pre-treatment period of five weeks, the experiment run for eight weeks. A chemical analysis of CPF in the water phase of the stock solutions and the treatment groups L and H (day 14) was performed. Since CPF could not be detected in neither of them, a strong sorption of CPF to MP is indicated. Abundances of Daphnia pulex revealed higher population increments in MPC than in C, L and H, indicating higher reproduction rates in the first two weeks after application. Furthermore, body lengths of juvenile D. pulex remained nearly constant during the test period in all MP treatments (MPC, L, H) while they increased in the controls (C). Interpreting these results, MP might have led to higher reproduction rates as a stress response which were lowered when CPF was present. In this case, CPF must have become bioavailable to D. pulex after ingestion of MP. For C. pseudogracilis, total abundances increased the most in MPC, whereas L and H developed similar as C. As for the cladoceran, MP might have led to higher reproduction rates that were lowered by CPF. The Trojan horse effect has probably been present in both cases. This could lead to an enhanced CMS, but the influence of CPF on the production and release into the environment. Beside their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported into biota by the so-called ‘Trojan horse effect’.

TU186 Microplastics exposures of fish: internalization and effects on behavior and growth
E. Cognet, Eawag / UTOX; X. Cousin, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; R. Behra, Eawag / Department of Environmental Toxicology; L. Joussard, IFREMER; L. Sigier, Eawag; M. Bégout, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; C. Cacho, University of Bordeaux / EPOC; K. Schirmer, Eawag / Environmental Toxicology

Awareness of the presence of microplastics, i.e. plastic particles ranging in size from 1 µm to 5 mm, in marine and freshwaters has recently risen but detection and quantification is challenging. Furthermore, whether they pose a risk to aquatic organisms is not yet clear. Aiming to understand the influence of microplastics and assess whether exposure impacts behavior and growth. For quantification of uptake, we hypothesized that it is possible to analyze the fish tissues (flow cytometry/viSNE) combination with viSNE, which allows the 2D clustering of particles with different features according to the fluorescence measured. Exposure experiments were carried out for up to three weeks, using different types of microplastic particles and a wide concentration range. In the flow, when particles were mixed with fish tissue, flow cytometry/viSNE was able to differentiate particle numbers, sizes and shapes. About 10% of added particles were internalized by the fish from all particles that floated or settled on the bottom. Particles ingestion resulted in a slight impact on behavior. Yet, floating particles were massively incorporated by the fish and significant numbers remained even after 24h of depuration. Based on this, we are currently exploring if continuous evaluation is necessary to elucidate the effects of microplastic deposition on 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 behavior 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. This was revealed for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub 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. This was shown for both types of exposures, individual and group.
feeding with microparticles contaminated food has consequences on juvenile fish growth. Taken together, our study demonstrates the power and limits of flow cytometry/visNE for microplastics quantification in a complex biological matrix like fish. The setup could be extended to other types and forms of microplastics in different environmental matrices. Moreover, our study sheds light on ecological consequences that microplastics exposure might have on fish.

TU187
Microplastic ingestion by fish: a comparison of Thames Estuary and Firth of Clyde populations
A.R. McGoran, Royal Holloway; P.R. Crow, 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 FTRIR 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 FTRIR 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, benthiic, flatfish ingested significantly more plastic than pelagic fish and other benthic fish. This may indicate that, in estuarine systems, plastics accumulate in the sediment.

TU188
Polystyrene microplastic uptake and effects on feeding behaviour and reproduction in the cladoceran Daphnia magna
B. De Felice, Università degli Studi di Milano; R. Bacchetta, University of Milan; P. Tremolada, University of Milano / Department of Biomolecular Sciences and Bionecology; M. Parolini, University of Milan / Department of Environmental Science and Policy
Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in diverse aquatic ecosystems worldwide. In recent years, the attention has been attracted toward microplastics (MPs), small plastic particles (dimensional range 0.1 mm-5 mm) which span a similar range of sizes as the natural food. Throughout the study, the ingestion of plastic by different species of Daphnia was assessed. Ingestion rate varied among the species examined. The feeding activity of the species was affected by the presence of microplastics in the gut. Moreover, the ingestion rate was influenced by the size of the plastic particles. The results suggest that microplastics can have an impact on the feeding behaviour of Daphnia and, consequently, on its reproduction.

TU189
Uptake of differently sized microplastics in gut passage by different species of Daphnia
S. SUIPLAN, University of Birmingham; I Lynch, University of Birmingham / Geography Earth Environmental Science; J. 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 (Yepem, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (rapators) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.2-3.2 mm) to D. galeata (1.3-2.0 mm) which span a similar range of sizes as micro and nano plastics, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10.0 mm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of the number of particle) (Nasser, 2016). The hypothesis tested was that the size of microplastic particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ800) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescently-labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU190
Determination of microplastics in mackerel stomachs by enzymatic digestion and µFTIR
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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 the microplastics (1-5 mm). The presence and accumulation in the ocean is cause for concern for several reasons, one of the most important is that they can be ingested by marine biota [1]. Different studies have shown the effects on the biota, such as intestinal blockage, decreased mobility or death [2]. Microplastics can absorb persistent bioaccumulative and toxic compounds from seawater. Once ingested, the absorbed pollutants may be transferred to the respective organisms. A variety of methods has been developed to measure microplastics in biota. One important aspect of these analytical methods is the extraction of microplastics from interfering biomass. Many studies have employed one or more chemicals (KOH, H2O2) to dissolve the biomass, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for µ-spectroscopy-based analyses. Enzymatic digestion methods have been used to minimize damage to plastics [3]. An enzymatic digestion has been developed and optimized for digesting biological material without destroying microplastics. Different times and enzymes were tested to optimize the enzymatic protocol. In addition, the enzymatic protocol was compared with chemical digestion (KOH) for the treatment of mackerel stomachs. The optimized enzymatic protocol has been adapted to quantify the microplastics debris present in the mackerel stomach. Identification and characterization of microplastics was done by µFTIR.

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TU191
Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach
S. Moses, University of Bayreuth / Animal Ecology I; M. Loeder, C. Larcher, University of Bayreuth / Animal Ecology I
For the first time worldwide, in the joint project PLAWES the pollution with microplastics of a large European river basin will be investigated on the example of the model system Weser-National Park Wadden Sea. PLAWES, as a pioneer study, is going to conduct an interdisciplinary and ecosystem overarching analysis concerning the contamination with microplastics from the headstreams to the North Sea, thereby considering exemplarily major point (e.g. wastewater treatment plants, combined sewer systems) and diffuse (drainage, atmosphere) sources and entry routes. The new insights are going to be included in a new modeling concept for the identification of primary transport mechanisms and accumulation zones of microplastics. Effects of microplastics on ecosystems of the Weser-Wadden Sea system will be investigated on both, aquatic invertebrates and the interaction of pathogens with microplastics in biofilms. The insights on ecologically relevant aspects are going to be used to assess the environmental effects of microplastics on the model system Weser-National Park Wadden Sea and to transfer these to other systems. Furthermore, the results will be used to develop novel teaching materials to provide an education platform for teachers, pupils and parents across Europe. Hence, PLAWES will generate unique data on the impacts of microplastics on a large European river basin and on environmental health. This will not only be instrumental for decision makers and stakeholders but also serve as focal point to develop science-based solutions.

TU192
Photochemical fragmentation of freshwater (micro)plastics under UV irradiations
V. Verney, CNRS - ICCF / Photochimic-CVP; G. BISSAGOU KOUMBA, UCA-ICCF; F. Delor Jestin, Sigma-ICCF
We begin to understand and describe more and more the fate of a plastic waste arriving (and remaining) in the aquatic environment. Nevertheless, we still do not know many things, for example, the time scaling of the process from the abandonment of a waste, its arrival, and its persistence in the aquatic environment.

During this period, the material will be exposed to various environmental aggressions that will initiate and spread the photocatalysis of the material. This scenario is accompanied by a physical fragmentation into microplastics of increasingly smaller sizes, an increasing chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastics fragments (Polystyrene, Polypropylene and Polylyactic 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.

Polyethylene 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 high functionality and the high liquid chromatography. The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acetic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients
I. Davies, Personal Care Products Council / Science

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPCPs) contain a wide array of polymeric ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physichem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and their high contribution to litter is considered to be significant. Potential litters are envisaged when exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physichem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physichem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU194 Toxicological effects of irregularly-shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)
J. Park, Korea Institute of Toxicology; J. Choi, Korea Institute of Korea KiT; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus typically irregular in shape. The objective of this study was to compare the effects of spherical or irregular shapes of microplastics on the changes in organ distribution, swimming behavior, gene expression, and enzyme activities in sheepshead minnow (Cyprinodon variegatus). Both types of microplastics were accumulated in the digestive system, causing intestinal distension. 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,n in

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast
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The ubiquitous presence of MPs has been demonstrated by scientists for recent years. They are detected in all environmental compartments: air, freshwater, aquatic organisms and particularly in marine ecosystems. Sediments are known as the most important exposed 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 pFTIR spectroscopy in reflection mode. Then, a test was performed in order to determine the replicate number required to obtain a sufficient representativeness of the whole sampled sediment. For the sediment collected in the field, MPs were found in each location and for each season. Average levels ranged from 38 (± 46.72) to 102 (± 105.37) MPS per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by pFTIR with a high proportion of PE and PP, 38 and 23% respectively. Five MP types (PE, PP, PVC, polyester and polystyrene) represented more than 90% of MPs. Interesting information of MP characteristics supported the explanation of the source and also the long-time passed in marine environment. None of significant differences were found among six sample groups. This work provides the first dataset on the level of contamination in sediments from the French Atlantic Coast.

TU196 Derivation, Validation and Implementation of Environmental Quality Benchmarks (P)

Challenges in implementing legal frameworks for assessing water quality: the cases of the EU and Swiss approaches
N. Chevè, M. Milano, E. Bernard, University of Lausanne / Faculty of Geosciences and Environment

Human activities have a great impact on river quality. Monitoring programs show that multiple chemicals are present in water and that physico-chemical properties and runoff/dilution capacity of rivers evolve due to climatic changes. These changes can affect the aquatic ecosystems as well as the amount of useable water. It is therefore crucial to evaluate the state of river systems using a holistic approach. The European Commission established a framework to highlight rivers' ecological deficits and to enhance regional or local water management plans. In Switzerland, such a framework is currently under development. In this study, we compared both procedures and implemented them in a Swiss catchment dominated by agricultural activities. The goal was to identify challenges linked to the application of these approaches. Both frameworks are based on the idea that no single approach meets a good environmental state and that the latter deteriorates as tributaries and wastewater discharging flow into the main riverbed. Chemical issues and water quality changes due to hydro-climatic variations and management strategies were also pinpointed. Both frameworks are thus able to highlight the main problems of the river and are consistent with each other. They are thus useful tools to survey the spatial and temporal evolution of rivers quality. However, several challenges remain, especially regarding the strategies to monitor and analyze chemicals, the definition of target values and conditions, the evaluation and integration of human-induced-pressures, and the overall evaluation of the rivers state. Development of integrated indicators is seen as a potential solution to explore river health and to provide efficient restoration measures by water managers.

TU197 Updating the Environmental Quality Standards for the EU priority substance chlorpyrifos
M. Wälti, Ecotox Centre CH / Ecotoxicology; M. Casado-Martinez, Centre Ecostox, E. Jung, L. Poirier, Centre Ecostox EAWAG/EPFL; T. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

Chlorpyrifos (CPY) is widely used as an active ingredient in insecticides. Since 2005 CPY 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 was to update 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 for A. baltica taken from the EESA authorisation dossier and set as an assessment factor (AF) of 10. The original MAC-EQS was derived from mesocosm NOECs using an AF of 1. The revised MAC-EQS of 0.0044 mg/L is based on an HC5, from a species sensitivity distribution (SSD) for crustaceans and insects using
The lowest eligible AF of 5. The SSD reveals branchiopoda and amphipoda being the most sensitive taxonomic groups for CPy. A re-evaluation of old and new mesocosm data showed that using the available mesocosm data for EQS derivation is likely to be underprotective for amphipoda. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the QS referring to the pelagic community”. The data sets show that the chronic (10 days) toxicology data for sediment is available for only 3% of sites and samples across Europe. The resulting sediment EQSsed,af of 0.32 µg/kg dw (acute) to 0.032 µg/kg dw (chronic). Acute data show that the amphipod H. azteca might be as sensitive to CPy as the insects C. riparius and C. tentans but chronic data are available only for insects. The sediment resulting EQSsed,af of 0.32 µg/kg dw was derived by applying an AF of 100 on the chronic NOEC for C. riparius. For comparison, also the equilibrium partitioning method was used to derive an EQSsed from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQSsed,ip of 0.016 µg/kg dw. Without this AF, the EQSsed,af would be in the same order of magnitude as the calculated EQSsed,af. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

TU198 Lead exposures in European Freshwaters: are they a risk? A regulatory assessment accounting for bioavailability
I. Wilson, A. Peters, G. Merrington, wca; J. Chowdhury, International Lead Association / Senior Scientist -Environment
Lead (Pb) is a chemical for which one EQS has been set and is applied all across Europe to ensure the protection of aquatic biota. Lead dissolved organic carbon (DOC): Pb concentrations that are greater than the EQS of 1.2 µg L⁻¹. The greatest frequencies of such sites are found in the Alps and Norway. The lowest PbEQS 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)
J. T. Trebi, DEBtox R Research / Dept of Theoretical Biology; R. Ashauer, University of York / Environment
The book contains a detailed description of the model framework, GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field as it is explicitly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatment on this model framework. In a CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.

TU202 Dose-response modelling in aquatic and terrestrial effect models
C. Wang, WSC Scientific GmbH / Dept Efate Modelling; K. Billau, WSC Scientific GmbH
In recent years mechanistic effect models including GUTS and DEBtox have been successfully used in the aquatic and terrestrial risk assessment of pesticides. These models offer the advantage that results from laboratory studies, usually conducted with constant exposure, can be extended to time variable exposure, which is more typical under field conditions. At present these models consider a threshold beyond regionally relevant water chemistry data (99.3%). Sites where elevated ambient background levels of copper are combined with very high bioavailability, principally when the waters have low DOC concentrations, are those most likely to be at risk due to copper exposures.
which effects start to appear. Once this threshold is surpassed the amount of effect can help to evaluate sublethal relationships and confirm that climate change effects on sea ice and food web dynamics have impacted grey seal condition (i.e. blubber thickness). We use our model to explore these relationships and confirm that the seal condition in the Baltic is vulnerable to change in food quality/quantity and can lead to down-stream consequences on reproductive success. The results offer new insights into physiology and ecology of Baltic grey seals with the potential to lead to novel approaches for the study of stress ecology and conservation of this species.

**TU204**
Investigating metabolic acceleration in dynamic energy budget models of copepods using the ecotoxicological model Nitocra spinipes

J. Koch, GhEnToxLab (Ghent University) / Applied Ecological and Environmental Biology; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology.

Copepods form an essential part of marine ecosystems and constitute a large portion of animal biomass on earth. Moreover, their small body size and short life cycle make them convenient test organisms in ecotoxicology studies. Beside acute toxicity, the evaluation and extrapolation of toxicity data in N. spinipes, 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. Desforges, Aarhus University (AU) / bioscience; G.M. Marques, University of Lisbon; K. Kauhala, Natural Resources Institute Finland Luke; K. Harding, University of Gothenburg Sweden.

Marine mammals are considered as sentinel species for marine ecosystem health. In the Baltic, grey seals (Halichoerus grypus) can serve this purpose as they are top predators and have shown to respond to anthropogenic and environmental stressors over the past decades. These stressors can influence the physiology and health of grey seals, ultimately leading to individual and population level consequences. Acknowledging the need for mechanistic understandings of stressor effects, we have developed a full lifecycle bioenergetics model for Baltic grey seals using Dynamic Energy Budget (DEB) theory. We use the comprehensive information available in the literature on grey seal physiology and metabolism and parameterize our model using experimental data. As CB153 is poorly biotransformable in fish, its bioaccumulation in juveniles mainly relies on the ingestion of contaminated food. Further, we considered this congener as an additional tracer of potential preys in the wild. Indeed, diet reconstruction from stomach contents and isotope data provided us with contrasted pictures. We provide new insights into fatty acid composition and biochemical pathways as well as enzyme kinetic parameters for PBDEs in juvenile grey seals. 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.

**TU206**
Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters
H. Ijm, J. J., Na, J. Jung, Korea University / Environmental Science and Ecological Engineering.

Present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history trait responses of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited continuous higher production of reactive oxygen species (ROS). In short term exposure, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. In contrast, daphnids showed significantly enhanced catalase (CAT) activity. The enzyme peroxidase (POD) activity was not influenced by temperature. Lower lipid peroxidation (LPO) level at elevated temperature under prolonged exposure suggests that antioxidant enzymes successfully prevented ROS-mediated damage. In addition, exposing D. magna to elevated temperature significantly shortened time to first brood, brood size, and body length, but induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature induced that D. magna is therefore more sensitive to environmental changes rather than growth and reproduction to cope with the thermal stress. Moreover, a multi-generation study was performed to evaluate multigenerational effects of temperature on D. magna.

**TU207**
Transport-protein metal binding links uptake biodynamics for predicting copper in tilapia
Y. Chen, Kaohsiung Medical University / Biomedical Science and Environmental Biology; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Biosciences and Environmental Engineering.

Metal could bind to transport protein, then accumulate in the cellular and tissue. It points out that the metal ion accumulating in target subcellular compartment could reflect the metal toxicity. Copper (Cu) plays an essential role in cellular metabolism of aquatic organisms, but it would cause toxicity with excessive accumulation. The purpose of this study was to conduct the short-term exposure experiment to examine the Cu accumulation in tilapia, then combined with bioavailability and subcellular partitioning to estimate the Cu binding situation and mechanism of toxicity on gill. We developed a mathematical framework that quantified the Cu affinity and the amount of transport protein in different subcellular compartment. Results indicated that Cu accumulation in metabolically active pool (MAP) preferred to organelles than heat denatured protein, and Cu accumulation in Cu metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters of maximum Cu influx rate, total number of transport protein and affinity constant didn’t have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 ml g⁻¹ was
significant higher than that of MAP 0.269±0.018 ml μg⁻¹ (p < 0.001), and the uptake
rate constant of MDP 0.128±0.001 ml g⁻¹ hr⁻¹ was also significantly greater than MAP
0.086±0.001 ml g⁻¹ hr⁻¹ (p < 0.001), it revealed that Cu was likely to bind on MDP in the
low exposure concentration than that of MAP. This study concluded that Cu
tend to accumulate in MDP, then may cause less toxicity to tilapia. Keywords:
Copper; bioavailability; transport protein; subcellular partitioning
TU208
Relationships between subcellular metal partitioning and biomarkers of
effects in white suckers (Catostomus commersonii) exposed to an
environmental metal gradient
D. A. Ersoy, Jordan State University / School of the Environment;
I. R. Schultz, NOAA AFWRC / National Estuarine Research
Natural Resources; A. Mikhail, Arizona State University / School of Mathematical and
Natural Sciences; K. Conrow, Arizona State University; N. Vinas, Mississippi State University / Engineer Research and Development Center
Acetylcholinesterase (AChE) is an enzyme
that hydrolyzes acetylcholine in order to eliminate it from the body, and when AChE is inhibited acetylcholine levels increase. Excess acetylcholine at cholinergic synapses overstimulates muscarinic- and nicotinic-type receptors. These receptors are found in most organs of the body, thus multiple adverse outcomes may result. Moreover, a wide variety of chemicals including organophosphates, carbamates and some high nitrogen compounds, can inhibit AChE. Thus, the impact of AChE inhibition is large, yet relatively little research has been focused on developing related adverse outcome pathways (AOPs) or a network for this molecular initiating event. This presentation focuses upon the construction of adverse outcome
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 on developing related adverse outcome pathways (AOPs) or a network for this molecular initiating event. This presentation focuses upon the construction of adverse outcome pathways that result from AChE inhibition in zebrafish (Danio rerio). We performed a comprehensive review of the literature to identify studies and datasets that could be used to construct an AChE AOP. Adverse outcomes include seizures, impairment of the retina architecture and behavioral changes. Preliminary AOPs for these outcomes will be presented with references to the studies that support the AOP, and identification of data needed for quantitative AOP development.
TU210 Development of a Novel Quantitative Adverse Outcome Pathway Predictive Model for Lung Cancer
T. Hill, US EPA NHEERL/JST/D/CB / ORD NHEERL Integrated System
Toxicology Division; R. Conolly, US EPA RTP
Traditional methods for carcinogenicity testing are resource-intensive, retrospective, and time-consuming. An increasing testing burden has generated interest in the adverse outcome pathway (AOP) concept as a tool to evaluate chemical safety in a more efficient, rapid and effective manner that better directs resource utilization. A central premise of the AOP concept is that pathway progression from the molecular initiating event (MIE) implies a definable “response-response” (R-R) relationship exists between each key event (KE) that drives the pathway towards the adverse outcome. Computational description of these R-R relationships in a quantitative AOP (qAOP) enables dose-response consideration of probabilities and uncertainty, as well as flagging of specific at-risk populations or sentinel species. The qAOP also provides a platform to utilize early genomics and in vitro data streams for rapid, long-range-intensity planning as well as the development of risk assessment tools that inform the level of risk. This poster describes a novel AOP/qAOP for lung cancer in the mouse from the MIE of CYP2F2-specific formation of reactive metabolites, advancing through KE for protein/nuclear acid adducts, diminished CC10 capacity and hyperplasia of CC10 deficient Club 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 characterization of R-R relationships, and identification of data gaps or additional research as required. This approach supports international efforts on use of quantitative effect thresholds for adversity predictions and incorporation of novel data streams into the cancer risk assessment process. This abstract does not necessarily represent the views or policies of the U.S. EPA.
TU211 A combined PBTK and qAOP-modeling approach to assess the impact of dioxin-like compound (DLC)-induced embryotoxicity on recruitment failure in European eels
M. Brinkmann, University of Saskatchewan / School of Environment and
Sustainability and Toxicology Centre; L. Ramilo, H. Sonnenberg, Québec INRS / Centre Eau Terre E
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 to many species of fish, and maternally transferred in artificially matured eels. However, to date researchers have not been able to locate a specific batch effect or the release of novel compounds in their 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 AhR signaling in gonadal tissue to mortality in juvenile European eels. We have developed a qAOP for DLCs in eels with embryo lethality across nine species of fishes exposed to DLCs. To this end, AHR2 was cloned from European eel and used to predict eel-specific relative potencies of five DLCs representing congeners measured at among the greatest concentrations in gonads of eels. Using this data, mortality of early life stages of eels was estimated based on the internal concentrations predicted by the PBTK model. Our integrated PBTK model and qAOP approach will ultimately shed light on the question whether early life stage mortality induced by exposure to DLCs has the potential to significantly contribute to the observed decline in recruitment of eels.
TU212 Salmonid pituitary cells as a test system for identifying endocrine disrupting compounds
L. Harding, University of Washington / Aquatic and Fishery Sciences; I.R. Schultz, NOAA AFWRC / Marine Science Laboratory; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; P. Swanson, NOAA-NWFS
The pituitary gland is a primary target organ for the endocrine system, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17β-ethynylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fshb) mRNA levels. These results motivated us to expand our studies by developing an in vitro test system of salmonid pituitary cells to expand our understanding of the impact of EDCs on the pituitary gland.
Integrating life cycle approaches towards a sustainable circular economy (P)

TU214 Metal and mineral resources in LCIA - What’s the problem?
R. Schulze, University of Leiden / CML; J. Guinee, University of Leiden / Institute of Environmental Sciences; R.A. Alvarez, Z. Weng, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, EUROMINE.

The current lack of a consensus on how to assess impacts from abiotic resource use in life cycle impact assessment (LCIA). Unlike other environmental impact categories, abiotic resource use does not have just one, explicitly agreed-upon, international management goal. The SUPRIM project focuses on impacts which occur directly from the use of abiotic resources such as minerals, metals, and natural materials. It concerns impacts associated with their availability or accessibility, but excludes impacts covered by other impact categories, such as toxic emissions or adverse working conditions. The current state-of-the-art LCIA for abiotic resources has been criticized by representatives of the metals & mining industry. The LCA community is developing new methods, which all focus on different issues associated with resource use. This lack of a broadly accepted method, likely attributable to the lack of a common perspective on resource use and a common understanding of the potential problem(s) related to the use of resources, was the starting point of SUPRIM. The aim of the project is to obtain an understanding of different stakeholders’ views and concerns regarding potential issues associated with the use of resources. The gained insights are provided in the form of a structured overview of those views, and used as a basis for further method development. They are achieved by taking a step back towards a structured discussion about potential problems with resource use, and different motivations behind resource management concepts. To guide the discussion towards a clear outcome, a framework was developed. It introduces distinctive criteria for the evaluation and/or formulation of perspectives and problems on resource use, which will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders from industry, policy and academia. The workshop outcome will be used to guide the further development of impact assessment from abiotic resource use in LCIA, such as a reduced future availability of the resources themselves, changes to their ability to provide functions, losses of certain desired properties in the environment or the technosphere, or an increased difficulty to access them. We aim to present both the framework developed for the formulation and evaluation of perspectives and the outcome of its first application during the workshop stakeholder workshop.

TU215 The relevance of the end-of-life stage for the environmental impact of batteries J.P. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HHI; M. Dornmann, Institute for Technology Assessment and Systems Analysis; C. Minke, Technische Universität Clausthal / Energy Research Center; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Numerous LCA studies exist in the field of energy storage, especially batteries. However, the majority of these studies focus on the production and use phase, while the battery disposal or recycling is usually evaluated in separate studies that focus explicitly on this part of the life cycle. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LFP-LTO battery (rack-mounted storage), a hybrid aqueous ion battery (AHIB) and a vanadium redox flow battery (VRFB), all with the same net energy storage capacity. The results show that considering the end-of-life stage actually does change the outcomes of the results significantly and that cradle-to-gate assessments are not appropriate for comparing very different battery technologies. Highly integrated batteries like the LIB have advantages under a cradle-to-gate perspective (higher energy density and thus lower material demand per provided capacity), while less integrated systems can have significant advantages when it comes to recyclability. The AHIB and VRFB are easy to dismantle and all major components can be recovered by mechanical dismantling on a macro-scale. The highly integrated LIB require complex processes and obtain a commingled fraction of micro-size particles that are difficult to separate and require significant process inputs while only recovering a fraction of the materials originally contained in the batteries. This can change the picture fundamentally towards an advantage of technologies easy to dismantle on macro-scale (AHIB and VRFB) in comparison with highly integrated cells (LIB). Thus, design for recyclability is highly important in terms of future circular economy and might easily outweigh the possibly reduced energy density of lower performance.
TU21
The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends
F. Reale, EC JRC; V. Castellani, European Commission - Joint Research Centre / Sustainable Resources, Bio-Economy; B. Hirsch, EMPA / Technology and Society Lab; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
Household appliances are an important contributor to the overall impact generated by European citizens’ consumption of products. In 2010 the energy-related products covered by the Ecodesign directive responsible for 53% of total EU-28 greenhouse gas emissions. The aim of this study was to evaluate what insights from the Life Cycle Assessment (LCA) of future scenarios of the European consumption of household appliances in the residential sector. The consumption is a Basket of Products (BoP) owned by an average European citizen. The BoP baseline consists of a process-based LCI model for a BoP that represents the most relevant household appliances in terms of energy consumption and market share: dishwasher, washing machine, drying machine, air conditioner, refrigerator, TV screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overall scenario covering the design options for products energy efficiency and expected trends in purchase and user behavior has been calculated and compared with the baseline. The baseline household energy consumption (with ILCD impact assessment method) confirms 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 the appliances and due to the 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 HTP, FETP, LUC and FRD – show a higher potential impact in the scenarios than it is in the baseline. Obtained results show clearly that just heading for more efficient devices is a necessary, but not yet a sufficient condition towards more sustainability; we as a society have also to re-evaluate the way we acquire (more and more) such devices and are spending more and more time behind them – here some limitations may 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-placement models to environmental research. This study

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 this study, we evaluate the effectiveness of the car inspection system in reducing carbon dioxide emissions from the viewpoint of policy makers. We developed a DHM model to estimate car replacement purchase rates based on consumer behavior aimed at maximizing utility levels over time. By combining replacement purchase rates estimated 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 DDM model are robust, showing that car owners behave with a forward-looking perspective. In addition, it is clear that offering subsidies for car inspection costs can be expected to have a substantial effect on cutting CO2 emissions associated with the transport sector because it would dampen car replacement purchase behavior and thereby increase the average economic lifetime of cars. The results of this study show that revising Japan’s car inspection system has the potential to change a major trend in automotive emissions reduction, the car replacement rate. A reduction in CO2 emissions can be achieved by promoting a process of “environmental benefit” contributing to reducing CO2 emissions. However, in practice, completely scrapping the current car inspection system would be very difficult. This is because, although abolishing inspections would relieve car owners of a painful cost burden, it might also put the safety of car operation at risk, due to the failure to detect problems that a car inspection would ordinarily detect.

TU222
Li-S batteries for electric vehicles, challenges for circular economy objectives
F. Reale, EC JRC; V. Castellani, European Commission
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 goal of 15% of vehicles alternatively powered in short term, it is necessary to search for new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries are the closest battery technology capable of meeting these expectations. Although Li-S can overcome the technical issues, this solution still needs to demonstrate how the socio-economic-environmental barriers associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at their end of life with the aim of recovering the maximum amount of valuable materials. This study focuses on the methodological design to analyze the environmental and social aspects related to Li-S batteries using LCA perspective in a circular economy context. This research has the following objectives: 1) To evaluate their environmental profile; 2) To identify their possible use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.
the building is reduced, preventing condensation problems on the insulating material. Currently, the implementation of an insulation system combined with a vapor barrier presents three major problems: an important time for placing, a random durability in time (stability of tapes of junction, adherence to the existing walls, punching resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + renewable energy source), 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 coverings by being compactable in a layer. 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 has already been made out: the Derbiskin®. The preliminary life cycle assessment results support the technical partners along the whole development and evolution of the membrane by pointing out the hotspots of the system, from the choice of the components of the vegetal binder or the spunbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters and subsidized by the Walloon Region (BE).

TU224
Life Cycle Assessment of Recycled Asphalt and Biomaterials for Road Pavements
A. Jimenez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC TransPortation is one of the main economic drivers in transport and roads are the most important mean of transport. To build and maintain roads is essential to ensure the efficiency and keep up the level of this service. However, these operations require a high consumption of non-renewable and raw materials (aggregates and petroleum-based materials) which is one of the major concerns nowadays in this field. To overcome this issue, the use of recycled materials in pavements engineering has become very popular in the last decades. In addition to the raw material saving, recycling reduces costs and save landfill space. In this regard, the increase of recycling rates of asphalt materials, aiming at 100%, is key to move towards the implementation of a sustainable circular economy in pavement engineering. However, the amount of recycled material that can be used in a pavement is limited due to some uncertainties. A first step is already carried out: the Deformance. To cope with this issue, if high recycled asphalt amounts are to be used in asphalt mixtures, the recycled material has to be treated and new components have to be added in the asphalt mixture. These processes and new components may hide the advantages of using recycled materials from the environmental and economical point of view. Within the ERA-NET Plus Infravation 2014 Call, the project BioRePavation analysed three alternative biomaterials to be included in high-recycled asphalt content mixtures to help increase recycling rates in an European case study. A comparative full Life Cycle Assessment of the asphalt pavements was carried out for each alternative to determine whether the use of recycled asphalt mixture in high amounts including biomaterials still entails environmental advantages. From a preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with high high recycled content would have a lower carbon footprint than the asphalt mixes currently used in Europe. This type of studies are needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.

TU225
Dynamic vs static LCA to explore the sustainability of industrial waste recycling
A. Di Maria, KU Leuven / MTM; A. Levasseur, École de technologie supérieure / Construction engineering; K. Van Acker, KU Leuven / Materials Engineering LCA methodology is often used to promote the circular economy in the construction sector. However, that case is not so simple. Due to the fact that the carbon footprint of recycled asphalt is often lower than that of asphalt mixes currently used in Europe, traditional LCA presents challenges when assessing the environmental impacts of building and construction materials. Construction materials can accumulate in buildings and infrastructures for several decades, with considerable stocks of materials along the life cycle. Due to the long life of construction materials, LCA should take into consideration also time related aspects. However, in the current LCA, any temporal information is lost, making static LCA solutions better suited for retrospective assessment rather than forecasting purposes. To fill this gap, this study proposes a time-dependent LCA 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 developing circular processes in their sector of living into healthier, more sustainable environments, and they thus promote a number of circular initiatives. However, do these initiatives help to achieve the goals included in local sustainability agendas? Or are they less environmentally favorable than conventional, linear systems? Systematic environmental accounting might give an answer to these questions once decision-makers have access to practice-oriented studies. In this contribution, we seek to determine whether research has effectively quantified the environmental performance of the initiatives promoted in cities. To do so, we gathered the features of circular economy initiatives reported by a pool of cities to understand what they refer to when addressing circular economy. At the same time, we reviewed scientific literature that applied quantitative environmental tools to analyze case studies of circular economy practices. These tools included life cycle assessment (LCA) and environmental footprint (EF) studies. Our 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 through 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. 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) and environmental footprint (EF) studies. Our 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.

TU228
Opportunities and threats in water treatment options as investigated by LCA
S. Kools, T. van den Brand, KWR Watercycle Research Institute; D. Lo Presti, The University of Nottingham; D. S. Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy
In this research two LCA studies are presented as starting points in studies on water treatment technologies that can promote a circular economy. The preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with high high recycled content would have a lower carbon footprint than the asphalt mixes currently used in Europe. This type of studies are needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.

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In this research two LCA studies are presented as starting points in studies on water treatment technologies that can promote a circular economy. The preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with high high recycled content would have a lower carbon footprint than the asphalt mixes currently used in Europe. This type of studies are needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.
tool to direct future research. We performed the work using Simapro 8.0 software, method Recipe Endpoint (E) and the Ecoinvent 3.0 database. First, in drinking water production, flocculants are used to remove particles, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new flocculants. Our LCA study showed that flocculants obtained from iron sludge after HCl dosage have a significant lower environmental impact than commercial alternative. Recommen
ding this practice would be promising for its design and socioeconomical benefits. The authors posit that a multi-objective approach, such as this, can prevent unforeseen burdens shifting between environmental impacts while providing implementable benefits 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-approach will be used to achieve a representative data set for the territories, which will consist of material flow data from national and regional sources scaled down to the territory and individual producer data (primary and processed) scaled up to the territory level. A feedback loop is placed between the modules of biotechnologies and the environmental system at the level of the territory, in order to observe the effects of waste optimization on the territory. Results: The performance of the biotechnologies will very likely depend largely on energy consumption and the intended use of the new products viz. how the residual resources from wine production are used. At the territorial level the authors posit that local managerial practices in terms of wine production will be greatly influential for global warming, eutrophication and resource depletion potentials. Fertilizer inputs, both mineral and organic, and pesticide use will very likely differ from territory to territory and will impact the above mentioned categories as well as toxicity related impact categories. Another important aspect will be the energy consumption of the territories and the influence of future energy grid greening on the future impacts of the technologies proposed today.

TU231 Environmental Benefits of a Circular Economy: Connecting Waste Type and Geographic Proximity

R. Iten, K. Kelly, M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resources and Environment Science

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 the availability 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 seasonal use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reuse of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232 Evaluation of nutrients and energy recovery technologies through Life Cycle approaches

M. Ruiz Mateo, CETaqua Water Technology Centre; M. Calvet, CETAQUA / MASE; S. Lopez, CETaqua Water Technology Centre / Santiation; M. Isasa, CETaqua Water Technology Centre / MASE; Y. Lorenzo-Toja, CETaqua, Water Technology Centre; D. Marin, CETaqua, Water Technology Centre / Environment and Socioeconomics

Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the fertilizer industry to produce new products that remain unused in the traditional linear industry. A holistic approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCA 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 capacities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burdens 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 biorefinery ecodesign that would incorporate

TU229 Closing the loop in a territory: LCA approaches to boost resource recovery

M. Calvet, CETAQUA / MASE; M. Amores Barrero, CETaqua, Water Technology Centre; D. Marin, CETaqua, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETaqua Water Technology Centre / MASE; M. Termes, CETAQUA; M. Ruiz Mateo, CETaqua 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 considered for further research. As second case study, we investigated water management in shale gas production, since hydraulic fracturing technologies require significant volumes of water for well development and produce high volumes of wastewater with highly variable composition. Different treatment options for waste water from shale gas production were compared in case 2. It is important to note that each process resulted in different effluent quality. Each process included a pre-treatment step consisting of air flocculation and biogradation, followed by either discharge directly to seawater, or treatment with vappour compression distillation (VCD) with water discharge to surface water and injection of the brine back to the deep underground formation. The LCA study on of shale gas waste water treatment indicated that more detailed information on the concentrations of compounds in the waste water is required. A technical research into the efficiency of the VCD, to optimize compound removal from 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.

TU230 Innovative method to optimize territorial organic waste resources

G.C. Vega, The Technical University of Denmark (DTU) / Management Engineering; J. Sohn, The Technical University of Denmark DTU / DTU Management Engineering; M. Birkved, Technical University of Denmark / QSA Dept of Management Engg

A truly environmentally sustainable bioeconomy requires integrative approaches for design and implementation. A holistic approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCA 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 capacities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burdens 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 biorefinery ecodesign that would incorporate

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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. The conventional processes are located: Vilanova WWTP and Murcia Este WWTP. Special focus has been put to impact on climate change, which is expected to be reduced thanks to the recovery of nutrients that could replace chemical fertilisers and due to the higher biogas production and its further valorisation. Life Cycle Costing (LCC) analysis has been undertaken in order to assess all relevant costs associated with the life cycle of both systems and the cost incurred with CAPEX (capital 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.

TU233 Life Cycle Assessment of a novel process of polyhydroxyalkanoates production with waste and by-products from wine industry value chain A. Novi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; L. Vogli, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Righi, University of Bologna / Physics; S. Macrelli, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Samori, C. Torri, Università di Bologna / Dipartimento di Chimica G Ciamician; A. Passerini, Università di Bologna / Dipartimento di Chimica G Ciamician Alma Mater Studiorum TU233 EU wine production accounts for some 60 percent of worldwide output, with France and Italy being the largest wine producer countries in the world (Gaeta and Corsinovi, 2014). The wine industry influences the environment with the use of soil, water, energy, fertilizers and pesticides. In addition it produces liquid and solid organic waste that has to be managed in the proper manner in order to minimize environmental impacts. In recent years, some innovative technologies have been proposed for the valorization of winery waste and by-products (i.e. grape marc, grape seeds, vinification lees, etc.) (Devesa-Rey et al., 2011). VALSOVIT is a research project funded by Emilia Romagna Region (Italy) which aims to valorize wine industry by-products. Its focus is the development of an integrated strategy for the transformation of waste from the whole oenological supply chain into high added-value products such as polymers, base chemicals, and molecules for the nutraceutical, cosmetic and agrochemical industries. In this framework, a novel experimental process for the valorization of wine lees and sewage sludge is carried out. These winery residues are subject to anaerobic acidogenic fermentation in order to produce volatile fatty acids (VFAs), which in turn are used to feed a mixed microbial community (MMC) able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The last step consists of PHAs extraction using dimethyl carbonate (DMC). Life cycle assessment is applied to calculate and compare the environmental impacts related to the production of one kg of PHA. The analysis is conducted without primary fossil fuels (primary materials) and is specific to the PHA production process. The methodological approach is focused on the different steps of production and concentrate on the LCA core steps of production and concentrate on the LCA core steps of production. To this end, a life cycle cost assessment is undertaken in order to identify potential risks. The study can be developed to develop knowledge on how to improve the quality and cost-effectiveness of the PHA production process. The study can be developed to develop knowledge on how to improve the quality and cost-effectiveness of the PHA production process. The study can be developed to develop knowledge on how to improve the quality and cost-effectiveness of the PHA production process. The study can be developed to develop knowledge on how to improve the quality and cost-effectiveness of the PHA production process.

TU234 Environmental, social and economic challenges towards a bio-economy based production: the STAR-ProBio project, Sustainability Transition Assessment and Research of Bio-based Products P. Deve, Unitelma Sapientia University of Rome; S. Righi, University of Bologna / Physics; E. Merloni, University of Bologna; L. Summerton, University of York; L. Ladu, Technische Universität Berlin; A. Koutinas, Agricultural University of Athens; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; S. Ugarte, SQ consult; J. Golazewski, University of Wrangelski / Masurek Zofjana OPTOMON; S. González, Universidad de Santiago de Compostela CIF Q1518001A / Chemical Engineering; D. Bengoa, Quantis; F. Razza, NOVAMONT; H.V. Haraldsson, Swedish UniversityWarminsko Mazurski W Olsztynie; K. Waskiewicz, ChemProf; X. Fazio, European Environmental Citizens Organisation For the Protection of the Environmnet Agency Naturvardsverket; S. González, Universidad de Santiago de Compostela CIF Q1518001A / Chemical Engineering; D. Bengoa, Quantis; F. Razza, NOVAMONT; H.V. Haraldsson, Swedish University.

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 of biogas production associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas 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 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.

TU273 Challenges and open issues in assessing new technologies for circular economy solutions P. Masoni, Ecocoinnovazione srl / Sustainability Department; A. Zamagni, SETAC Europe 28th Annual Meeting Abstract Book
TU238 Circular economy: what does restaurant food waste generation data and consumers say?
R. Dagilutė, Vytautas Magnus University / Environmental Science Department; A. Musteikytė, Vytautas Magnus University
Around 88 million t. of food is annually wasted in the European Union. According to FAO (2013), 31–39% of food is wasted at consumption level in developed regions. This wastage has an enormous negative impact on the global economy and food availability and it has a major environmental impact. EU Environment "Towards a circular economy: a zero-waste programme for Europe" (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM (2011) 571) aims to change consumption patterns and achieve 20% reduction in the food chain's resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British households indicates, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amounts of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers' attitude towards this problem. Catering business was closely monitored in terms of customers' flows and food waste generated. To find out consumers' opinion about the food availability of the restaurant was carried out through the survey. It was shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food wasted 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 lower ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of the respondents believe that the restaurant should be responsible for food waste. 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 needs to be done to encourage food waste recycling. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. 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. In particular, this research can be used in evaluating the environmental benefits of sharing arising from prohibition of wider access to goods (including intensive use of resources to produce goods and services). Changes in consumption patterns may occur in this situation to a more circular economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from: 1) reduced need for more intensive production and consumption, 2) reduced food waste 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 this, this research attempts to define a sustainable sharing economy and assess changes in consumer's behaviour. In order to achieve this aim, the methodology of the research consists of a number of simplified LCAs (e.g. using a simplified tool to assess the environmental impacts of a restaurant, or using a simplified tool to assess the environmental impacts of a sharing platform). The research starts by developing a simplified LCA method for assessing the environmental impacts of restaurant food waste. The method is based on the assumption that the impacts of restaurant food waste are due to the production, transport and processing (when necessary) of the different food ingredients that constitute a typical daily meal. This research has been supported by a project granted by Xunta de Galicia (ED431F 2014/001). S.G.G. would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness (RYC-2014-14894).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes?
I. Assenza, 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 many 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: 1) reduced need for more intensive production and consumption, 2) reduced food waste 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 this, this research attempts to define a sustainable sharing economy and assess changes in consumer's behaviour. In order to achieve this aim, the methodology of the research consists of a number of simplified LCAs (e.g. using a simplified tool to assess the environmental impacts of a restaurant, or using a simplified tool to assess the environmental impacts of a sharing platform). The research starts by developing a simplified LCA method for assessing the environmental impacts of restaurant food waste. The method is based on the assumption that the impacts of restaurant food waste are due to the production, transport and processing (when necessary) of the different food ingredients that constitute a typical daily meal. This research has been supported by a project granted by Xunta de Galicia (ED431F 2014/001). S.G.G. would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness (RYC-2014-14894).
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 DDE degradation and rhizoremediation 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.


A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area a little more than one year after planting. In fact, the system using the Poplar and suitable plant species improved, in terms of microbial abundance, the potential use of poplar for syngas production, in the form of a fuel gas (syngas). Among plant species poplar has good energy treatments, biomass gasification is a very efficient process to produce clean and economically viable. At the same time, this technology can provide wood oxygen release). The plant

TU243 Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production V. Ancona, Water Research Institute - Italian National Research Council / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute; M. Roccapietra, National Research Council of Italy (CNR) / Water Research Institute; D. Borello, Università La Sapienza / Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA); M. Falconi, ISPRA Institute for Environmental Protection and Research / Soil Protection Department - Geological Survey of Italy; A. Basile, Regione Puglia / Servizio Rifiuti e bonifica; A. Massacci, Italian National Research Council / IBAF; V. Uricchio, Italian National Research Council / IBAF; V. Uricchio, Italian National Research Council / IBAF; V. Uricchio, Italian National Research Council / IBAF

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 microbial community on the natural microbial 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.

TU244 Microcosm experiment to assess the effectiveness of a Populus clone to enhance PCB biodegradation in a historically contaminated soil L. Passatore, National Research Council / Institute of Agro-Environmental and Forest Biology (IBAF); A. Barra Caracciolo, National Research Council / Water Research Institute; M. Di Lenola, National Research Council of Italy / Water Research Institute; P. Genni, National Research Council of Italy (CNR) / Water Research Institute; I. Nogues, National Research Council of Italy / Instituto of Agro-Environmental and Forest Biology (IBAF); E. Guerriero, P. Benedetti, National Research Council / Institute of Atmospheric Pollution Research; A. Massacci, Italian National Research Council / IBAF

Greenhouse experiments have been performed to test the capacity of the Populus clone (Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-planted soil was used as control. PCB concentrations in soil samples and plant roots were analysed 6 months and 12 months after the start of the experiments. At the same time plant growth, biomass production and plant stress indicators (i.e. chlorophyll content, leaf fluorescence, antioxidant in plant tissues) were investigated together with cell abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso to transform and bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congener found were similar between the two treatments. The anoxic treatment differed in terms of congener detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone should be an unexpected choice to produce biomass under flooding treatment. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field plant-assisted bioremediation

TU245 Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments E. Terrzaghi, University of Insubria (Como) / Department of Science and High Technology - Monviso; G. Aimola, V. Uricchio, Italian National Research Council; M. Cardoni, M. Di Lenola, National Research Council of Italy / Water Research Institute; A. Barra Caracciolo, National Research Council / Institute of Agro-Environmental and Nutritional Sciences; A. Di Guardo, University of Insubria / Department of Science and High Technology

Phytoremediation represents an alternative to traditional remediation techniques, employing plants root and their associated microorganisms to enhance the degradation of organic contaminants in soil. Many short-term laboratory/greenhouse experiments and long-term field trials have been conducted to elucidate the most suitable plant species and environmental conditions to stimulate and favour microbial activities in the degradation of Polychlorinated Biphenyls (PCBs). Recently, an attempt to extrapolate rhizoremediation half-lives (rizo-HLs) for the ten PCB families from these studies has been made (Terrzaghi et al., 2018) providing important data for multimedia fate models that aim to predict the time needed to achieve regulatory thresholds in a PCB contaminated site where rhizoremediation techniques are applied and therefore to draw up its remediation plan. However, many of the studies available in the literature (more than the 80%) were not correctly set up to allow the calculation of PCB rizzo-HLs and could not be considered. In particular the main pitfalls in the experimental design referred to the type of chemicals (single congeners vs. mixture), contamination (spiked vs. natural), experimental design (greenhouse vs. field), the experimental time, the set-up of appropriate controls and replicates as well as the analytical and microbiological techniques adopted. The present work aims to 1) list and discuss the main pitfalls in the experimental design of previous and current rhizoremediation experiments and 2) propose guidance to perform appropriate experiments to obtain comparable, accurate and useful data for rizzo-HLs calculation. Moreover rizzo-HLs will be presented and compared with those obtained with other approaches.

TU246 Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil P. Ferrandini, U.E. Ezeji, Federal University of Technology Owerri / Biotechnology Technology Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of the oil was
studied for a period of 4 weeks under laboratory conditions. Hydrocarbon-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0x10^6 and 30x10^6 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 hydrocarbon with loss of 80% in the 4th week compared to other treatments. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPK > Poultry Manure > NPK.

TU247
Soil pollution and physico-chemical properties steer the bacterial community structure in the uneven highly polluted SIN Brescia-Caffaro site.
F. Magelli, University of 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. Raspa, 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. Baroni, University of Milano - DeFENS.

Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity but can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbiome selection are therefore pivotal to develop in-situ bioremediation technique(s). In a pilot project, the Typhoon Property Site SIN Brescia-Caffaro (Italy) offers a fascinating natural laboratory due to its extremely high, old, mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). Aim of our study was to evaluate the spatial correlations between environmental factors (pollutant fingerprints and soil physico-chemical properties) and the soil microbial community structure. More than 1,000 soil samples were collected in the SIN Brescia-Caffaro site in a tridimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolytic activity, the physico-chemical features and the concentration of metals and 79 PCB congeners. A cultivation-independent approach led to unravel the phylotype structure of the residing bacterial communities. By means of statistical analyses, we showed that significantly different bacterial communities were selected in the investigated areas within the SIN Brescia-Caffaro. Spatial distribution of bacterial populations within each site was significantly correlated with physico-chemical soil parameters and pollutant concentrations. Soil physico-chemical properties were also significantly correlated to the hydrolytic activity of the soil microbiome, a relevant indicator of soil quality and pollutant availability. In addition, bacterial communities present in the SIN Brescia-Caffaro sites were significantly influenced by the type and level of organic amendments used in the site of fermentation into the groundwater plume and serve as electron donors for volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from other bacterial communities involved in the aerobic PCB degradation process, confirming that they host an intrinsic natural attenuation (NA) process. Polytriphenyltin (P-TNT) and its catabolites were monitored using qPCR of the catabolic gene C encoding for an enzymatic reductive dechlorination reaction. This approach identifies the genetic potential needed to degrade contaminants in the soil and water plumes of the study area.

TU248
Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.
F. Diana, University of Milan - Bicocca; T. Stella, University of Milano -Bicocca / DISAT; M. Daghio, University of Milano - Bicocca / Department of Earth and Environmental Sciences; F. Pittino, University of Milano - Bicocca; R. Ferrari, A. Francioli, HPC Italia s.r.l.; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences.

Recalcitrant hydrocarbons often persist in contaminated environments. Biological remediation strategies (bioremediation) are a widely used approach to remove hydrocarbons. This study focused on bioremediation of hydrocarbons contaminated soil from an industrial active site using biopiles. The site is contaminated by light and heavy hydrocarbons, the latter ones representing the most recalcitrant fraction. Biological processes using mixed cultures of heterotrophs residing in the contaminated soil were evaluated to assess whether the size of the area and the economic/environmental costs of other technologies such as DiG&Dump. Biopiles will be built to treat the contaminated soil, air insufflation and nutrient addition will be considered to stimulate the aerobic biodegradation of hydrocarbons. In order to optimize this process, a lab-scale test was carried out and three different conditions were tested: natural attenuation (NA), addition of sawdust (SW) to soil to improve the soil structure and addition of compost as amendant (SW). Thirty-six bioreactors were set up (6 sampling points for each condition in duplicate) and incubated for 180 days. Air pumps were used to insufflate air into bioreactors with the exception of NA ones. Laboratory analyses were performed on soil and soil gas samples at the beginning of the experiment and 6 samplings were carried out during the incubation period. Chemical analyses (GC-FID) of total petroleum hydrocarbons (TPH) were performed to evaluate the degradation rates and microbiological/molecular analyses (Total Bacterial Count, Most Probable Number-MPN, High-throughput sequencing of the 16S rRNA gene and quantitative PCR) to assess the growth of bacteria potentially involved in the degradation process. The highest degradation rate was observed in CO bioreactors (first-order rate constant K=0.180 d^-1) while lowest rates were observed in NA (K=0.004 d^-1) and SW (K=0.011 d^-1) in the first 60 days of incubation. However, a residual TPH concentration of >900 ppm was reached in all bioreactors after 180 days starting from an initial concentration of 2660 ppm. The microbiological characterization suggested a selection of the bacterial community according to the chemical results. In this respect, MNP results showed a significant increase in the number of cells 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 vanbaalenii PYR-1 Bioaugmentation on 14C-Pyrene Mineralization and Microbial Community Structure in PAH-Contaminated Soils
D.C. Wolf, University of California-Riverside / Environmental Toxicology; J. Gan, University of California, Riverside / Department of Environmental Sciences

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that have potential mutagenic, carcinogenic, and teratogenic properties. Bioremediation has been recognized as a versatile approach to remediate PAH-contaminated soils. However, the biodegradability of PAHs is limited by their bioavailability to microorganisms in the soil porewater fraction. To expedite biodegradation, surfactants at the critical micelle concentration (CMC) has been added to enhance the bioavailability of PAHs. The aim of this work was to evaluate the effect of Brij-35 nonionic surfactant and rhamnolipid biobased surfactant at three concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanbaalenii 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 unsupervised state (PICRUSt) of soil microbiomes and 16S rRNA gene amplicons. The addition of Brij-35 surfactant at all three concentrations resulted in increased PAH mineralization after 50 days incubation by indigenous microbe populations in the sandy loam and clay soil compared to the unamended and rhamnolipid-amended soil treatments. The bioaugmentation of M. vanbaalenii PYR-1 had an immediate impact on PAH mineralization in both soils, resulting in 20% reduction in hydrocarbon concentrations up to 5,000 ppb in the swallow aquifer. In 2016, treatment of the main contaminated area and the down gradient plume showed maximum PCE concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanbaalenii PYR-1 in PAH-contaminated soil using 14C-pyrene and was preferentially degraded. Similar PAH-degrading genes increased in relative abundance after PAH addition, especially BaCyclas and Saron. Species richness and Shannon diversity decreased following the addition of 14C-pyrene compared to the uncontaminated soil and the addition of rhamnolipid biosurfactant at 10X CMC in all soil treatments resulted in the lowest species richness and Shannon diversity. Using PICRUSt, PAH-degrading genes such as PAH dioxygenase subunits and aldehyde dehydrogenase were greatest in bioaugmented soil treatments compared to native soil treatments. Overall, the results from this study provide beneficial insights towards the abiotic and biotic processes as well as their complex interactions in the bioremediation of PAH-contaminated soils.

TU250
Italian field results of Emulsified Lecithin-based Substrate used as ERD treatment of Chlorinated Solvents in groundwater
A. Leonbruni, M. Mueller, PeroxyChem LCC; F. Morlacchi, Centro Assistenza Ecologica

ELS microemulsion 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 generate new electron acceptors, thereby driving the growth of indigenous microbes and increasing 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 hydrophobic and hydrophilic regions in their monolayers structure. As a result, ELS tends to be stable emulsions, expectedly more stable than with only hydrophobic compounds. Further, phospholipids support remediation by providing essential nutrients (carbon, nitrogen, phosphorus) to bacteria. ELS Reagent was shown to effectively treat tetrachloroethylen (PCE) and its catabolites in the aquifer. The site is a former manufacturing facility in Italy impacted for more than 2,000 m² with PCE from a historical solvent release. The main contaminated area and the down gradient plume showed maximum PCE concentrations up to 5,000 ppb in the swallow aquifer. In 2016, the consultancy firm performed a field scale injection of ELS with a goal to reduce the PCE mass and its catabolites in the source area and the distributed plume and treat any residual
VOCs potentially migrating from beneath the former facility. A total of 4,900 kg of ELS concentrate was emulsified and injected under pressure through 51 fixed wells in the swallow contaminated aquifer. Subsequent field monitoring showed PCE and TCE below detection limits at all wells after 6 months. A 99.8% reduction of PCE and TCE was observed in the source and plume areas along with the reduction of the recognized catabolites, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethane has also been observed in all the monitoring wells.

**TU251**

**Cheese whey effects on microbial communities in contaminated groundwater of an urban area**

D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Regional Hospital in Liberec / Centre of Clinical Biochemistry; S. Wachlak, A. Sevcú, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation

Chlorinated ethenes (CE) are the second most ubiquitous contaminants worldwide. Herein we describe an urban locality Nový Bydžov (Czech Republic) where groundwater pollution was identified in private wells in 2007. The source of CE was machinery, metal cutting, and chemical industry, now out of order. The improper handling of hazardous compounds (e.g. chlorinated hydrocarbons, mineral oils etc.) caused uncontrolled contamination of Quaternary aquifer which is about 4-5 meters thick, composed of sandy gravel and delimited by impermeable 400 meters thick Mesozoic strata. Application of different carbon sources (lactate, glucose, cheese whey and polyhydroxybutyrate) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR. Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufacturer’s protocol. Extracted DNA was quantified using Qubit 2.0 fluorometer. Isolated samples were tested using qPCR method. An universal marker, 16S rDNA gene (total bacteria marker) was used as a control. Other monitored specific markers were focused on presence of Dehalococcoides, Dehalobacter, Sulfurospirillum and vinyl chloride (VC) reductases vcrA and bvcA. In addition, denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsrA marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations. Moreover, higher bacterial gene expression and reductive dechlorination of the CE contaminants. Specific markers are still being monitored in the treated groundwaters and will be discussed together with physico-chemical results.

**TU252**

The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Vacular Organic Compounds (Modifiers) on Dehalorespiring Microflora

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Among all the groundwater contaminants chlorinated ethylenes (CE) such as 1,2-dichloroethane and trichloroethylene (TCE) can be transformed by combination of abiotic and biotic processes. Biological reductive dechlorination of CE is contributed by dehalorespiration. The technology and innovation; J. Nosek, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Regional Hospital in Liberec / Centre of Clinical Biochemistry; S. Wachlak, A. Sevcú, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation

Among all the groundwater contaminants chlorinated ethylenes (CE) such as 1,2-dichloroethane and trichloroethylene (TCE) can be transformed by combination of abiotic and biotic processes. Biological reductive dechlorination of CE is contributed by dehalorespiration. The technology and innovation; J. Nosek, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Regional Hospital in Liberec / Centre of Clinical Biochemistry; S. Wachlak, A. Sevcú, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation

Chlorinated ethylenes (CE) are the second most ubiquitous contaminants worldwide. Herein we describe an urban locality Nový Bydžov (Czech Republic) where groundwater pollution was identified in private wells in 2007. The source of CE was machinery, metal cutting, and chemical industry, now out of order. The improper handling of hazardous compounds (e.g. chlorinated hydrocarbons, mineral oils etc.) caused uncontrolled contamination of Quaternary aquifer which is about 4-5 meters thick, composed of sandy gravel and delimited by impermeable 400 meters thick Mesozoic strata. Application of different carbon sources (lactate, glucose, cheese whey and polyhydroxybutyrate) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR. Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufacturer’s protocol. Extracted DNA was quantified using Qubit 2.0 fluorometer. Isolated samples were tested using qPCR method. An universal marker, 16S rDNA gene (total bacteria marker) was used as a control. Other monitored specific markers were focused on presence of Dehalococcoides, Dehalobacter, Sulfurospirillum and vinyl chloride (VC) reductases vcrA and bvcA. In addition, denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsrA marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations. Moreover, higher bacterial gene expression and reductive dechlorination of the CE contaminants. Specific markers are still being monitored in the treated groundwaters and will be discussed together with physico-chemical results.

**TU253**

Mechanistic insight into microbial reductive dehalogenation

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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 CBDB1 and Dehalobacter strain 14DCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (chemically bound halogen vs. H) by the nucleophile cob(II)alamin (vitamin B12). The latter was unraveled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational molecular orbital (MO) approach has been developed for a more detailed analysis of the molecular initiating event triggering the reductive dehalogenation. Application to 93 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-compatible charge transfer orbital at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CBDB1-active from non-active substrates with 92.5% accuracy. In this study, we present MO/SCF and MO/MP2 computational methods including applications of the MO approach for predicting dehalogenation pathways and regioselectivity. Overall, our approach supports the view that the reductive aromatic dehalogenation proceeds through an inner-sphere electron transfer. [1] Zhang, S.; Wondrousch, D.; Cooper, M.; Zinder, S. H.; Schüttermann, G.; Adrian, L. 2017. Anaerobic Dehalogenation of Chloroaromatics by Dehalococcoides mccartyi Strain CBDB1 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.; Schüttermann, G; submitted 2017.

**TU254**

Bacterial biosorption of PFOS from contaminated waters

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Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for consumer products and industry for many decades. Although they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009), Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contaminate the environment, animals and humans. The most frequently applied method for PFOS remediation of water is by passing it through activated granular carbon filters. Currently, there are increasing efforts to develop new strategies and co-factors inclusive methods for PFOS remediation of contaminated waters. This study investigated the possibility of removing PFOS by microbial binding. We tested the binding capacity of live and dead Escherichia coli OP50 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed for PFOS by UPLC-MS/MS. The deadbacteria were found to have high adsorption (286 g/g of bacterial pellet) whereas the live bacteria (E. coli cell wall) showed low adsorption (0.42 g/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isomers as the linear compound; which defines the applicability of PFOS bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

**TU255**

Hexavalent chromium reduction in a biocathodic microbial electrolysis cell

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Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its carcinogenicity, Cr(VI) has to be removed, hopefully using environmental-friendly and economically sustainable remediation technologies. To overcome the limits of the currently applied bioremediation technologies, an alternative strategy is the use of BioElectrochemical Systems (BESs) to stimulate bioreduction of Cr(VI). BESs include a set of biotechnologies based on biological reactors where an electrode (anode) can function as the final electron acceptor for the oxidation of organic compounds; then electrons flow through the circuit and reach the cathode that acts as the electron donor for the bioreduction of oxidized species. In the present study, we have assessed if Cr(VI) can act as an efficient terminal electron acceptor for an anaerobic biocathode in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a dual-chamber Microbial Fuel Cell, and inoculated with autotrophic cultur originate from anaerobic digester sludge. After 30 days of acclimation, the electrode was transferred into the cathodic chamber to work at -300 mV (vs. SHE) as the biocathode in a Cr(VI)-reducing MEC. An
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed at the initial, during the experiment and final time by spectrophotometric method, while the dissolved total chromium was analyzed by ICP-MS. During the whole test, the current intensity was monitored. At the end of the experiment, the microbial characterization of the communities enriched on the biocathode and in the cathodic compartments, and the 16S rRNA gene sequencing. The acclimation phase in the MFC allowed the formation of an electroactive biofilm on the electrode. A decrease in Cr(VI) concentration was observed at the end of the tests, both in the polarized reactor and in the OC reactor. However, the BES ensured higher removal efficiency than the pure chemical process. In addition, higher current densities were observed in the BES compared to the abiotic control, thanks to the biofilm inheritance with the results from microbial characterization showed that the bacterial community on the surface of the electrode was affected by the cathodic polarization, and it was different from the biomass on graphite in the open circuit system.

TU256
Enhancing Reductive Dechlorination Combined with In-Situ Chemical Redution for the Remediation of a Heavy Contaminated Chlorinated Solvents Source Zone in South of Italy
f. arjmand, I. Bona, L. Moretti, M. Cremonesi, CH2M Hill

The present site comprises an urban site where a historical Chlorinated Compounds-CHC (mostly PCE) contamination has been released in aquifer before injection, and with non-return valves corresponding to them. Contamination is present in shallow aquifer and was higher than 10 mg/L. The efficiency of the remediation is currently about 99.9%, removed more than 300 Kg PCE. The site characterization integrated with a MIP investigation to identify the plume. The plume has been addressed into four areas then a combination of In-Situ Enhanced Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure contaminant removal due to bioremediation, approaching the electron donors for PCE. This combination allows to have a reducing ambient due to producing hydrogen which helps groundwater to reach an anaerobic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase1) to calibrate the injection for the site conditions. Based on the successful results of this phase, the full-scale phased 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 product air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methanogenesis reaction, CH2M has decided to install a biofiltration plant, to prevent any dangers for the residential areas nearby. The challenge this complex geology has been solved by using fixed injection wells corresponding to them. Contamination is appearing without accumulation.

TU257
Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments
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Freshwater sediment enrichments to improve MFCs performance for in situ remediation application: a phylogeonic microbial characterization
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One of the possible application for Microbial Fuel Cell (MFCs) is the in situ remediation of contaminated sites. MFCs operation links the removal of pollutants from contaminated sites to the production of current by means of the activity of electrochemically active microorganisms (EAMs), able to degrade substrate producing a flow of electrons. EAMs have potential applications in bioenergy production, green chemical synthesis, bioremediation, bio-corrosion mitigation, and biosensor development. The aim of this work was to investigate the effect of two enrichments, a general (Gen) and a ferric citrate (FeC) ones, to increase the percentage of EAM in order to improve the MFCs performances. A freshwater sediment 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 rPCR techniques were used to investigate the EAM community. Moreover microbial α-diversity was calculated. The enrichment effect was evaluated both for the precultures and for the three components of MFCs (planktonic, biofilm and rod). Results showed that the MFC inoculated by Gen enrichment preculture had better performance than the FeC one (shorter start-up time, lower anode potential, higher current production) and at the MFCs level (p<0.05). Enrichment with FeC decreased the relative abundance of EAM and the microbial diversity. Previous studies show the need of a heterogeneous community dominated by EAM to improve the removal of contaminants and to increase the performance of the MFCs. The present work indicates that Gen enrichment promoting the development of a self-balancing community seems to be a preferential approach to be implemented in in situ application.

TU259
Integration of molecular and isotopic analyses to investigate the potential of aerobic biodegradation at a site contaminated by Monochlorobenzene
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Bioremediation of 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 \( ^{13}C \) were determined by Compound Specific Isotope Analysis (CSIA). High-throughput sequencing (Illumina) and Ion Torrent analysis and quantitative PCR were performed to gain insights into the structure of the microbial community and to identify functional biomarkers. The investigation of the potential anaerobic degradation pathways is not shown because the obtained data are not yet available due to the ongoing degradation process. MBW was completely depleted upon addition of nutrients and CSIA results confirmed negligible C isotopic fractionation under oxidative conditions. The catalytic rocC gene, encoding for toluene dioxygenase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Recently, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MBW were also performed in another area contaminated by MBW, and nearby the first site, to establish whether an aerobic approach for site reclamation from MBW would be successful in the extended area.

TU260
Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area

T. Stella, University of Milano-Bicocca / DISAT; I. Pietrini, Politecnico di Milano; F. de Ferra, G. Carpani, Research Center for Non Conventional Energy - ENE; M. Marchesi, Politecnico di Milano; L. Alberti, Politecnico di Milano / Department of Civil and Environmental Engineering; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences The biodegradation and bioremediation of a complex contaminated area with multiple pollutant sources and different environmental conditions represent a big challenge to site owners. Therefore, a detailed chemical, isotopic and microbial site characterization (fingerprinting) is crucial to evaluate, at first, the intrinsic remediation of the contaminated area (natural attenuation) and, then the potential of enhancing specific biodegradation processes (biostimulation). This study aimed at gathering chemical, isotopic and molecular 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, xylenes 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 1,1,2-dichloroethane (1,2-DCA) were found in most of the water samples at high concentration as well as 1,2-cis-DCE. Illumina sequencing data showed a great bacterial diversity probably due to contamination heterogeneity. However, species belonging to the Bacteroidetes and Proteobacteria counteracted in 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PceA, TceA, VcrA, BvcA) and oxidative enzymes (etnC, etnE) will be accomplished (on-going analysis) as well as isotopic analyses.

TU261
Microbial ecology and ecosystem services: a key role for biotechnological applications

G. Lembo, ENEA CR / Department of Ecological and Biological Sciences; A. Signorini, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development; V. Mazzucco Mirtiana, S. Rosa, A. Agostini, V. Pignatelli, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development, Laboratory of Biomass and Biotechnology for Energy; M. Fenice, University of Tuscia / Department of Ecological and Biological Sciences; G. Massini, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development, Laboratory of Biomass and Biotechnology for Energy Microbial community and ecosystem function, both play a crucial role in geochemical cycles function. They determine the water, air and soil quality. Despite microorganisms are of micrometric size (1μ-1nm), their activities impact on a planetary scale. They are ubiquitous and show remarkable metabolic versatility. They are able to thrive even in extreme environments. Very often, different strains of microorganisms perform different metabolic activities in close relationship and/or have co-evolved mutual dependence for performing complex processes where members of the food chain depend on the previous ones for their substrates. Human kind is largely relying on microorganism for its survival; they provide fundamental ecosystem services and perform complex biochemical activities to degrade residues and transform food. The scientific community is increasingly exploring the potentiality offered by functional microbial biodiversity to improve the human wellness and sustainability. Currently, a much interest is addressed towards biotechnological techniques that supply clean and affordable renewable energy sources exploiting the activities of microbial communities. This is the case of the anaerobic digestion (AD) process, through which, in the absence of oxygen, the complex organic matter is transformed into gaseous products, such as CH₄, H₂ and CO₂. Although the engineering and technological aspects of the AD have been thoroughly studied, the microbial community is still managed as a ‘black box’, since most of the AD plants lack microbiological planning and monitoring. On the other hand, interactions between the microbial components have an important role on the performance of the bioreactors as a whole. Disruptions in the AD process are often related to a poor understanding of the ecology of the microorganisms responsible for the associated biochemical reactions. In this work, insights about microbial community dynamics, investigated with innovative molecular techniques, are presented in order to improve the understanding of the linkages between natural and biotechnological ecosystems, and, by applying microbial ecology principles, improve the environmental engineering practices.

TU262
Evaluation of bioremediation potential in groundwater using newly-developed software

M. Papanikola, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; M. Marchesi, Politecnico di Milano Bioremediation is one of economic and effective environmental techniques being applied for the removal of different contaminants from the groundwater. To achieve a complete overview on bioremediation processes, knowledge about molecular-genetic, physicochemical, and chemical characteristics of the groundwater as well as geological parameters of the site is needed. The aim of this work is, therefore, to develop a user-friendly software allowing assessment of bioremediation process of chlorinated ethenes, even to unprofessional users. The software enables an interpretation of input data, resulting in evaluation of the potential for natural bioremediation at the contaminated sites. Suitability of conditions for bioremediation is simultaneously evaluated in this software. Moreover, data from one sampling round are only used. To ensure widespread user availability, the program was created in Microsoft Excel. Actual data from the Novy Bydovz site were used to verify and demonstrate program’s functionality in this work.

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

TU263
REMEDIATION OF AQUATIC ECOSYSTEMS: ADSORPTION OF PHOSPHORUS BY SAWDUST

G. Pantano, T.C. Souza, P.S. Fadini, A.A. Mozeto, Federal University of Sao Carlos

Introduction: Despite the scenario of excess phosphorus in some aquatic ecosystems, there has been concern with the disposal of the eutrophic deposits, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorous from eutrophic systems, for further use as fertilizer. The aim of this work was to study the phosphorus adsorption using sawdust as organic adsorbent. Methods: This study was carried out with water and sediment samples from an eutrophic ecosystem, Barra Bonita reservoir, located in Barra Bonita city, Sao Paulo State, Brazil. The microbial experiments were conducted in 5 L glass jars, that were filled with sediment and water from the reservoir. Among the 36 assembled microcosms, 18 were used as controls and 18 were used as treatment (with bags containing sawdust). The dissolved oxygen, iron, and orthophosphate were determined in interstitial water and sediment from the jar’s water column. Emerging contaminants and adsorbed phosphorus (P) were determined with liquid chromatography-mass spectrometry. Results: The treatment of sawdust removed the chemical oxygen demand (COD) from the water column of the control 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 phosphorous adsorption. It was observed that the adsorption of phosphorus on sawdust began after 57 days. The minimum adsorption was at 214 days (41.4 μg P g⁻¹ sawdust). The adsorption of iron and caffeine was not observed in sawdust. The concentrations of carbamazepine, diclofenac, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estrone, 17-estradiol and 17-ethinylestradiol are lower than the limit of quantification (LOQ). Conclusion: Sawdust is considered a biosorbent, of easy access and low cost, to use in the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security. Acknowledgments: FAPESP (2016/0490-6)
Formation potential of trifluoroacetate and its estimation by means of the TOP assay

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Trifluoroacetic acid is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pKₐ < 0.23) 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 algae and saline digestion solutions was developed. The subsequent measurement was performed using ion chromatography coupled to tandem mass spectrometric detection (IC-MSMS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, fluopyram, fluortamone and tenbromete; pharmaceuticals: fluoxetine and sitagliptin; industry chemicals: 4:2 FTSA and 6:2 FTSA) led to substance-specific molar yields between 7.1% (6:2 FTSA) and 96% (sitagliptin). It is known from previous studies that TFA can be formed during wastewater treatment. Therefore, the formation potential of samples from six treatment plants (WWTPs) was investigated. As expected, more TFA was formed after oxidation of the influents (up to 180% increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140%). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

A Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

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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 pertinent metabolites were less than the limit value of 0.1 µg/L. In plant protection regulation, this limit value has to be applied for 1,2,4-triazol due its toxicological relevance according to the regulation (EC) 1107/2009. Exceedance of this trigger has been questioned considering that several fungicidal active substances forming 1,2,4-triazol may be applied consecutively. In addition, plant protection products are not the single source of 1,2,4-triazol. It can also originate from pesticides. Therefore, the formation potential of samples from six treatment plants (WWTPs) was investigated. As expected, more TFA was formed after oxidation of the influents (up to 180% increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140%). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

Implication of microbial adaptation for the persistency of emerging pollutants B.A. Pourrat, University of Amsterdam/IBED Institute / Institut for biodiversity and ecosystem dynamics; M. Braster, VU University Amsterdam; R. Helms, University of Amsterdam / IBED; R.J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / IBED-ELI

Regulatory determination of the persistency of organic chemicals is mostly done using OECD ready biodegradability tests (RBTs). RBTs, however, suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. The origin and history of the inocula is one of the major causes of that variability. Nowadays, it is evident that results of RBTs change 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 RBTs. We, therefore, used chemostat systems to expose activated sludge microbial communities to 4-fluorinated chemicals: 4:2 fluopicolide, fluopyram, flurtamone and tembotrione; pharmaceutics: 6:2 FTSA and 6:2 FTSA; and two of these chemicals are considered as emerging pollutants and are persistent according to RBTs. The biodegradation capacity of the activated sludge and of the exposed inocula was assessed in batch culture using the OECD 310 guideline for testing of chemicals. Different phases of biodegradation were measured following CO₂-production (OECD 310) and the compound and product concentration by LC-MS/MS. Community changes in the chemostats were determined by 16s RNA sequencing. The results of these experiments show enhanced biodegradation capacity for N-methylpiperazine after pre-exposure to this molecule. Moreover, microbial communities exposed to metformin were able to degrade this molecule and its known persistent transformation product, guanylurea, which is considered as persistent in fresh water. These preliminary results show that microbial communities can adapt to degrade a molecule that was initially persistent. These results are a first step to understand adaptation mechanisms and their implication for the persistency of organic compounds of emerging concern. This project aims at correlating microbial adaptation and biodegradation performance in time. The ultimate aim is to design more robust and realistic RBTs used adapted inocula.

Prioritization of organic compounds based on their persistency 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 persistency of chemicals such as pharmaceuticals or polyaromatic substances could 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 model need to be adapted to dynamic conditions such as those prevailing in transitional areas. This study focuses on the persistency of polyaromatic substances 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 polyaromatic compounds and 51 pharmaceuticals. In order to compare relative compound persistency in dissolved phase, a persistence index based on the half-lives of the compounds was calculated. Briefly, marks depend on half-life values of each condition, and the average mark gives the persistence index. Risk quotients are calculated with measured environmental concentrations of each compound in the Seine estuary. Of the 111 monitored compounds, 33 were quantified at the initial time. Only 3 exhibited a persistent behavior (e.g. atrazine) 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
index and measured concentration in the Seine estuary were used together and allowed a categorization of compounds into 4 levels of environmental concern. Moreover, non-targeted analysis highlighted the formation of 794 compounds during 21 days of incubation, in high concentration level of SS condition. In order to improve risk assessment, formation of transformation products should have to be considered and included in prioritization schemes.

TU269 OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers

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ACS Persistent pharmaceuticals in aquatic ecosystems are of particular societal concern and the OECD 308 guideline is often used to obtain the biodegradation half-lives required for risk assessment. The environmental relevance of OECD 308 has been criticized in recent years, among others the difficulty to interpret multiphasic processes (biotic and abiotic) and the lack of compartment-specific half-lives for water or sediment as an outcome. In particular, biodegradation processes in the sediment can vary according to the microbial communities, which may be impacted by the settings chosen for the test (i.e. sediment-water ratio, aerobic-anoxic conditions and initial concentration levels). In this study, we have investigated the differences in biodegradation of a mixture of 9 pharmaceuticals (acetaminophen, caffeine, carbamazepine, diclofenac, flucloxacil, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Frois and Grindlach, before and after the discharge of a wastewater treatment plant (WWTP). Bottle incubations were set following the OECD 308 guideline, spiked with pharmaceuticals and incubated for 40 days at 16°C in the dark with daily aeration. Water samples were taken at 10 time points and analyzed in UHPLC-MS/MS. The microbial community composition in the sediment was analyzed with Illumina sequencing of bacterial 16S rRNA to provide more insight into the biodegradation potential in the different treatments. The dissipation half-lives obtained for diclofenac, oxazepam, tramadol, and venlafaxine are significantly different (p ≤ 0.001) between rivers and between locations. Additionally, the half-lives of non-stereile treatments are significantly shorter than sterile (p ≤ 0.01) for all compounds except carbamazepine, indicating that dissipation reflects a combination of biodegradation and sorption mechanisms. Furthermore, compound concentrations remained constant in river water treatments, with only caffeine and acetaminophen showing signs of degradation. Dissipation of pharmaceuticals in the sediment compartment was more relevant than abiotic processes, thus sorption cannot be completely excluded, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU270 Compartment-Specific Screening Tools - Development and Application to Assess Potential Persistence of Organic Compounds in Water, Sediment and Soil

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The persistence assessment under REACH ideally relies on compartment-specific degradation half-lives that are generally derived from aerobic laboratory simulation studies for surface, aquatic sediments or soil. Albeit these data are given top priority, they are not available for most of the compounds since simulation tests are time-consuming and expensive, and they are required only for compounds with a production volume of 100 or more tons per year. Thus, screening information (e.g. results from ready biodegradability tests (RBTs) or quantitative structure-activity relationship (QSAR) models) are used in the absence of simulation test data to decide whether a substance is considered as "not persistent” or “potentially persistent” according to screening criteria. However, RBTs only describe the water compartment while QSAR models are only developed based on qualitative experimental biodegradation data related to water-only test systems. Therefore, half-lives for soil and sediment are calculated by multiplying the half-life in water by constant factors. However, this extrapolation is questionable due to different conditions in the compartments, which might affect biodegradation in connection with the physico-chemical properties of the compounds. Consequently, there is a lack of experimental quantitative biodegradation data for soil and sediment at the screening test level. In the present work compartment-specific screening tools for water-sediment (Water-Sediment Screening Tool, WSST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WSST and SST were applied to determine biodegradation data for a set of fifteen test compounds. The results demonstrate that the WSST and the SST are suitable to determine sound and reliable biodegradation data including biodegradation kinetics for compounds on the screening test level. Furthermore, the results were used within the scope of a Compartment-Specific Persistence Screening (CSPS). The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P0).

TU271 Persistence assessment of pesticides in Denmark

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Persistent active substances can affect the environment over long periods of time, as such substances can be distributed and accumulated within and outside the areas where they are used. Persistent substances constitute a long-term and difficult-to-quantify risk of spreading in the environment and affect organisms. Persistent substances can also cause effects on and lead to residues in subsequent crops. This also applies to the metabolites of an active substance. Therefore active substances with a DT50 above 180 days cannot be approved in Denmark. The persistence evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be normalised to 20°C and pH2. Assessment of persistence should not be based on average or percentiles of the data. Instead data are assessed by considering the soil types used and focusing on soil types representative for Danish conditions. If in general these soils have a DT50 above 180 days, products with such active substances cannot be authorized for outdoor uses in Denmark. If only some of the soil DT50 values are above 180 days, an ad hoc assessment is performed to decide if these findings constitute the major part of data and if it is likely that DT50 for Danish soils is above 180 days under field conditions relevant to the intended use. The persistence evaluation should be performed for both the active substance and metabolites. However, metabolites which fulfill certain criteria are considered to be of no concern regarding persistence.

TU272 Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass

P. Koch, University of Wisconsin - Madison / Molecular and Environmental Toxicology Center

Fungicides are routinely applied to golf course turfgrass prior to winter in temperate climates around the world to protect the plants against psychrophilic plant pathogens. The persistence of fungicides may vary according to environmental conditions present during winter is poorly understood despite important implications for human and environmental health as well as disease control on the turf. A 3-year field study was initiated at the University of Wisconsin - Madison (Wisconsin, USA) in 2015 to determine which environmental conditions most influenced the persistence of the fungicides propiconazole and chlorothalonil. For determination of both fungicides, a liquid chromatography-mass spectrometry, and a bioassay was conducted in a controlled environment chamber using the psychrophilic plant pathogenic fungus Microdochium nivale to determine the date when disease protection was lost. Fungicides were applied once on 20 Nov 2015 and again on 5 Dec 2015 and 10-cm diameter turfgrass cores were collected bi-weekly from the experimental area throughout the winter. Both winters experienced above-average temperatures in December with frequent rainfall events, and the concentrations of both fungicides in the turfgrass leaf tissue fell dramatically within the first 28 days after application. In addition, a corresponding increase in M. nivale-disease symptoms in the controlled environment chamber was observed as fungicide concentration decreased. These results suggest that fungicides do not persist in winter conditions following rainfall events, though it remains unclear whether they persist for prolonged periods of time on frozen turf and under prolonged snow cover.

TU273 Biodegradability of novel graft copolymer with levan and polystyrene

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The significant increase in plastics productions caused waste management problems which is particularly relevant for polystyrene plastic as the most dominant packaging material. Therefore, investigations of new biodegradable polymers are increasing. Graft copolymerization is important technique for physical and chemical modification of polymers. The microbial levan is biocompatible, biodegradable, renewable and eco-friendly fructose based polymer. It can be produced from sucrose by wide range of microorganisms using levansucrase enzyme. In the present study graft copolymer with microbial levan and polystyrene was synthesized, characterized and its biodegradable potential was investigated.
Levan was isolated after fermentation of Bacillus licheniformis strain. Syntheses of 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-Orthoxyn respirometer (Columbus Instruments, Ohio). O2 consumption of samples mixed with soil was measured in period of 28 days. The 13C NMR spectrum of copolymer showed the presence of oxygenated carbon nuclei to both monomers and 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 phenol 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 sometimes complex. Degradation of 14C-styrenated copolymer was studied in different soils, despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

TU275 Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests C.R. Boegi, BASF SE / FEPA/CA; G. Gaertner, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; H. Schwarz, BASF SE / RB/T; R.J. West, International Isocyanates Institute, Inc. / Toxicology and Environmental Research Consulting

The OECD ready biodegradability tests (RTB) are designed to approximate the rate/extent to which substances are degraded in the environment, such as is more precisely measured in the OECD simulation tests. This work compares results obtained from both test types for degradation of the toluenediamine (TDA) substances. Degradation of 14C-labeled TDA was studied in different soils under aerobic conditions (21°C), while a specific degradation pathway was followed despite no standardization of the methods. In the present project, the route and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

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 polychlorinated 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, were collected (named #1, #2, and #3, respectively). The factorization model (PMF), compound specific isotope analysis (CSIA), and microorganism analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g, dw) and PBDE (62-79200ng/g, dw) were found in all the samples and the concentrations were general increased from bottom to the top layers. PMF analysis indicated that the technical mixtures are the dominant PCB and PBDE input and dehalogenation takes place in the sediment cores, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Dehalococcoides were found in the sediment cores. The range of the relative abundance of Dehalococcoides for three sediment cores (#1, #2, #3) were 1.50-9.01%, 1.47-5.24%, and 0.20-2.55%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) to PBDEs (with the p values of 0.02, 0.05 and 0.01, respectively). As for CSIA analysis, only the stable carbon ratios (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the #3 sediment cores were obtained. An increase in the δ13C values for BDE 28 and a slightly decrease in the δ13C values for BDE 85 were found with the increase of the depth sediment cores, indicating a potential biotransformation of these compounds in the cores. No significant differences in the δ13C values of BDE 47 and BDE 99 were observed in the sediment cores, possibly due to the complicated fate of these compounds, such as BDE47 and BDE99 being both reactants and products during the debromination 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 later alternative chemicals of brominated flame retardants. Among OPFRs, triphenyl phosphate (TPHP) shows high consumption volumes, as well as high concentration in water. TPHP caused toxic effects especially in aquatic organisms but research of biotransformation products is insufficient. Kinetic studies of TPHP and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, Daphnia magna was used due to its sensitivity in aquatic environment. TPHP was exposed to individual Daphnia magna and each sample were separated by biota and remaining medium. Daphnia magna were homogenized and remaining medium were extracted with solid phase extraction. Samples were analyzed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray high-resolution tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase I & II biotransformation mechanisms. Diphenyl phosphate (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 (TPHP) and hydrolysis products (DPPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DPPH; as TPHP showed decreased, degradation product (DPPH) ratios increased. Conclusion, hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.

TU278 Photolytic and biological degradation of silicon organic compounds E. Thamby, Leuphana University Lueneburg; O. Otsone, Leuphana University of Lueneburg / Institute for Sustainable and Environmental Chemistry; N. Mitzel, University Bielefeld / Inorganic and Structural Chemistry; K. Kuenmerer, Leuphana University Lueneburg / Institute of Sustainable and Environmental Chemistry

This study provides new data on the degradability and persistence of a selected group of newly synthesized silicon compounds. Polysiloxanes are an important group of industrial chemicals, which are frequently produced in high amounts. They are widely used in industry, personal care products and agriculture. In general, siloxanes occur ubiquitous in the environment in different concentrations (e.g. in water from ng to mg per L). Since these polysiloxanes are only cleavable by chemicals, potential substitutes, which are better degradable in the environment, are urgently needed. Therefore, fully newly synthesized homogenous group of silicon organic compounds (p-MeOC6H4SiMe3, o-MeOC6H4SiMe3, o-MeOC6H4CH2SiMe2, p-MeNC6H4SiMe3, o-MeNC6H4SiMe3) 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 assay was performed at ambient temperature. After 6 hours, 99% of the substrate P₄, NC₄H₇SiMe₂ was primary eliminated. During the test, generation of more polar transformation products was observed. The other substances were eliminated between 15 and 65% with treatment of sunlight during a time period of 8 hours. No ready biodegradability could be observed for these five substances. The results from the biodegradation test are comparable to literature data for our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

TU279
Biodegradation of adsorbed oil pollutants: Research on a model system
L. Milic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; M. Ilic, IChTM / Department of Chemistry; B. Lončarević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department of Chemistry; T. Solevic Knudsen, IChTM / Department of Chemistry; J. Apladinov, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry. Environmental pollution by various types of oil has been, and continues to be a specific and serious problem. Investigations and development of new techniques are required, as well as improvements to known ones. Sorbent materials are attractive because they collect the oil and separate it from the oil spill site by absorption. The addition of sorbents to oil spill areas facilitates a change from liquid to semi-solid phase and once this change is achieved, the removal of the oil by removal of the absorbent structure then becomes easier. At this stage, pollutants are separated and concentrated, unlike the environment conditions where pollutants could spread to very low concentration when it is challenging for applying bioremediation techniques. In this study we tested adsorption and degradation of crude oil, diesel oil and mazut as model substrates. Two types of natural sorbents were used: organozeolite and bentonite. Petroleum pollutants sorption was investigated in the batch tank. Sorption was conducted with sorbents (1 g/100 mL) placed in Lermeneyer flask (500 mL) with 100.0 mL of tap water and oil pollutant (0.6 mL). Sample was then shaked in laboratory shaker for 24 h at 20 °C. Supernatants and sorbents were separated by decantation. Biodegradation ability of adsorbed pollutants has been tested by microorganisms isolated from oil contaminated site, and O₂ consumption and CO₂ production was measured in period of 5 days by Micro-Oxymax respirometer. Adsorbed total petroleum hydrocarbons were determined after adsorption and respiration experiments by GC and gravimetric analysis. Obtained results showed highest biodegradation potential with bentonite/diesel (BED) model and lowest biodegradation potential with organozeolite/diesel (OZM) model, with cells consumption of 89913.53 µmol of O₂ and 5834.53 µmol of O₂ within 115 hours, respectively. The production of CO₂ by cells in BED model was more than twofold higher that by OZM model. As well, BED model obtained highest TPH decomposition at the end of experiments. This results indicate that bioremediation process can be successfully used on adsorbed pollutants, where added value is recycling of sorbent material, but further investigation are required to determine the potential for such methods to improve pollutants from environment. Acknowledgements This work was supported by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

TU280
Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters
Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)
Microbial degradation (biodegradation) is an important mechanism for removal of organic contaminants in natural systems. UTOC testing is a fundamental determination of the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most fundamental determinants of the environmental fate of the compound. The OECD 309 protocol (“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 chemicals and it is designed to be used for new chemical assessment. Neither the OECD 309 nor the OECD 309 experimental conditions do not accurately simulate natural aquatic environments, where a variety of microbial organisms are exposed to chemicals with much lower concentrations. As a result, legitimate questions have been raised about the ability of such standard biodegradability tests to predict persistence of compounds in natural systems. This study was designed to test the hypothesis that biodegradation is significantly different in a spiked system than in a natural system. OECD 309 experiments were carried out with and without spiking. Water from Lake Norra Bergudsnäs in southern Sweden was used, a recipient for wastewater treatment plant effluent with a freshwater dilution factor of ~4. A mixture of 16 test compounds comprising a range of biodegradability was used for the spiked systems. Four sets of experimental conditions were used (all in duplicate), i.e., spiked lake water, un-spiked lake water, spiked artificial lake water (inflowing lake water mixed with the effluent (80:20, v/v) from the wastewater treatment plant which discharges into the lake), and un-spiked artificial lake water. Incubation conditions followed the standard OECD 309 protocol, lasting for a period of 60 days at 20 °C in the dark. Triplicated water samples were collected at 11 time points. After addition of the mixture to the standard conditions, the water aliquots were filtered and analyzed with UHPLC–Orbitrap–MS/MS using direct injection. Data was processed using both the target approach and the non-target approach, where the implementation of liquid chromatography coupled to high-resolution mass spectrometry allows for screening of organic contaminants in aquatic systems. The biodegradation kinetics (half-lives) of the detected compounds in the spiked and un-spiked waters will be compared and contrasted to evaluate the hypothesis.

TU281
A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals
M. Cazee, F. Brillet, University of Nantes / GEPEA CNRS UMR CBC Laboratory; C. Sweetlove, IOREL SA / Research and Innovation; J. Chenelle, L'Oreal Research / Research and Innovation; J. Lhariod, L'Oreal 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 to filter 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 DIE-AWAY test (i.e. OECD 301A) and then successively tested and validated with non-soluble chemicals, pure and in an emulsion mixture (consisting in a virtual cosmetic formula). The UTOC approach highlighted the beneficial effects of an emulsion on the biodegradation of these substances. Prior to assess a natural complex mixture, pass levels to differentiate unequivocally ready and inherent biodegradability were determined. This latter step aims to reinforce safety for substances 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. This 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
M. Cazee, University of Nantes / GEPEA CNRS UMR CBC Laboratory; v. le Curff, L. Cathironet, E. Calzoli, Y. Pichot, TRONICO; C. Sweetlove, IOREL SA / Research and Innovation; E. Grangé, S. Jouanneau, University of Nantes / GEPEA CNRS UMR CBC Laboratory; M. Durand, University of Nantes / UMR CNRS GEPEA CEBAC Laboratory; J. Chenelle, L'Oreal Research / Research and Innovation; A. Lahmar, University of Nantes / GEPEA CNRS UMR CBC Laboratory; T. Gerald, University of Nantes / Microbiology
Most of the methods used to evaluate biodegradation have been developed for almost 50 years. According to the fact that annually, hundreds of new chemicals require a biodegradability assessment; the development of new metrological solutions needs to be investigated. Indeed, few measurement systems, enabling an automated assessment for substances of unknown composition do not exist. 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. This concept has been shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.
modeling steps involving the use of different parameters such as \( \text{O}_2, \text{CO}_2, \text{pH}, \text{T}^\circ \text{C} \), Pressure and Biomass. These technological investigations will be used to create an unique automated device enabling the evaluation of biodegradation of a chemical whatever its physicochemical characteristics.

**TU263 Investigations on key parameters of an innovative biodegradation test based on cell proliferation**

S. Rey, Firmenich / Biotechnology; B. Özil Duygan, University of Lausanne / Fundamental microbiology; S. Locatola, L. Baroux, P. Merle, Firmenich; J. van der Meer, University of Lausanne / Department of Fundamental Microbiology; M. Seyfried, Firmenich

Standard 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 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 data. As test compounds, selected reference chemicals were chosen from the ECETOC MCC/007 report list suggested for method development for readily and non-biodegradable compounds. Alongside cell counting, several test compounds were analyzed in parallel for CO\(_2\); and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

**TU284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances**

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tomiyama, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morita, Kao Corporation / Safety Science Research

Ready biodegradation studies (OECD TG 301) are required for registrations and the development of chemicals for various applications. Current test systems work well for many substances, but some substances, called “difficult substances” sometimes face problem with these test systems. Here challenges and solutions in ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylhentriacontane, is insoluble in water and tends to stay on the water surface. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface water. To overcome this challenge, the test substance was wrapped in a nylon sheet so that it could stay in the water for access by the microorganisms. With this test system, the biodegradability was remarkably improved and it was regarded as ready biodegradable. This method and result were accepted by the Japanese authority. An aroma chemical, 3,5,5-trimethylhexanionic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the test substance disappeared from the test system by volatilization. To elucidate this hypothesis, the concentration of the test substance and a possible hydrolyzed metabolite were monitored by chemical analysis in the water phase. The result indicated that the test substance volatilized within 48 hours. This result strongly suggested that the low biodegradation result was due to the rapid volatilization and disappearance of the test substance from the test system. The possible solutions to this challenge will be discussed in the presentation.

**TU285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants**

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Assessment of microbial biodegradation is a key parameters 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 consistency 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-methylpipеразине 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 controls using this glassware format. Therefore, sealed bottles are wrapped in foil and put on the bottom of the test vessel. 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 error of test results and to enhance biodegradation. Different responses between the different inocula will give valuable information about the future environmental fate of the tested compound. Finally, this knowledge will develop more accurate ready biodegradation testing and lead to a more comprehensive environmental risk assessment of persistent chemicals.

**TU286 Investigations on the role of adaptation in OECD biodegradation screening tests**

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Until recently, adaptation was recognized by the European Chemicals Agency as one of the options in so-called enhanced ready biodegradability tests (RBTs) to provide proof of non-persistence of a test chemical. Since June 2017 (time of publication of the latest re-evaluation of the OECD guidelines and Chemical Safety Assessment Chapter R.7b: Endpoint specific guidance*), adaptation has been explicitly excluded. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessments and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of these compounds will be used for a detailed study regarding the future environmental fate of adaptation. The outcome of this study will form the basis for further investigations on the environmental representativeness of positive results obtained from enhanced RBTs with adapted inocula.

**TU287 Use of Chemical Analysis to Enhance Detection of Biodegradability Tests: A Case Study with Two Gas-to-Liquid (GTL) Products**

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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. Chemists implementing this standard are required to submit a Harmonised Offshore Chemical Notification Format (HOCNF) to the implementing OSPAR member state authority to certify use of their products offshore. Marine biodegradability screening tests (BST’s) are an intrinsic part of offshore chemical control schemes and the HOCNF registration process. However, the lack of robustness of the marine biodegradation methods has been highlighted in a series of ECETOC workshops, particularly when these are used to assess complex, volatile and poorly water-soluble substances (e.g. petroleum products). We have found that the inclusion of abiotic controls and chemical analysis for total petroleum hydrocarbons (TPH) in freshwater BST’s demonstrates that disappearance of test substances from the test system is often far greater than is suggested by standard biodegradation testing and that the reported results from two marine BST tests (OECD 306 and BODIS) conducted on two synthetic hydrocarbon Gas-to-Liquid (GTL) products. In addition to measuring 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.

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biodegradability of various hydrocarbon solvents. SETAC Europe annual meeting 2015, Barcelona, Spain.

TU288 Organising an international ring test to improve the marine biodegradation screening test
A. Ott, T. Marsham, 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, these tests have resulted in major enhancements also addressing a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRi ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test protocol was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRi ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU289 Type-specific accumulation of triphenyltin compounds in marine fishes in subantarctic waters
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The extensive use of organotin (OT) compounds in antifouling paints and other industrial uses (e.g. as fungicides, wood preservatives, and antibacterial textiles) have resulted in major releases of these compounds into the environment. Even though the International Maritime Organization (IMO) of the United Nations enacted a global prohibition on the usage of organotin-based antifouling agents on hulls of sea-going vessels in September 2008, Hong Kong had not adopted any regulatory legislation to restrict the production, usage and release of these compounds until early 2017. High concentrations of these compounds, specifically triphenyltin compounds (TPT), are still being detected in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test protocol was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRi ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU290 POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
I. Bramke, M. Garrod, Syngenta Product Safety / Product Metabolism and Analytical Science; G. Bending, University of Warwick / School of Life Sciences; I. Bramke, M. Garrod, Syngenta Product Safety / Product Metabolism and Analytical Science; C. Mckillian, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science
Recent reports of high levels of polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the terrestrial environment (moss, and water) of Schirmacher Hills, Dronning Maud Land, Antarctica, have pointed to the potential for PCB degradation. The study was, therefore, designed to investigate the distribution of these compounds until early 2017. High concentrations of these compounds, not adopted any regulatory legislation in the region, were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRi ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU291 Degradation of crop protection products in Brazilian soils
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Brazilian soils contain high levels of crop protection products; however, very little data is available on their persistence. Understanding the fate and degradation of these chemicals in soil is important to ensure their safe and efficient use. In this study, we evaluated the degradation of different crop protection products in a set of 4 different soils, prescribed for regulatory testing to encompass the typical range of soil 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 the fungicide thiabendazole in four different Brazilian soils and one temperate soil. Thiazolebendazole exhibited slow degradation due to it adsorbing onto the solid soil surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT50s) and distribution coefficients (KOCs) 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, MS/MS
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CCNH
Bisphenol A (BPA) is a compound widely used in plasticisers 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 due to its persistence in the environmental systems and its uncertain damages to both human and animal health. Some studies connect the exposition to this compound with cancer and other diseases. In this work, it was evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand pattern to it. After that, 2nd of sample were periodically purchased and analyzed in an Agilent 1220 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In
future works, the activity of the enzymes like Laccases and Manganese-Dependent Peroxidase should be taken into consideration and evaluated, as well as to compare the degradation with an abiotic system containing the BPA pattern – in order to evaluate its persistence in the culture medium.

TI/203
Soil dissolution of paraffin oils: Improvement of the microbial degradation and impact on soil dissolution.

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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 contaminated 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 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was no substantial dissolution of Paraffin Oil CAS (72632-86-0) as produced by TOTAL Fluids. Existing in any rare four soils occurring. Two treated soil samples were then treated with dextrose, ammonium nitrate and monopotassium phosphate in order to improve the remaining bioactivity. The remaining residues of the applied substance was then followed for two weeks. The results showed that for one soil a complete dissolution of the remaining residues occurred although in this time of incubation a plateau was observed prior to a final dissolution. Methodology is therefore proposed to demonstrate for certain chemicals that the degradation is of biological origin and to integrate these results in the proposed end points.

TI/209
Leaching of PAHs from Coal Mining Heap Samples from the Saarland

T. Schiedek, Applied Geoscience / Applied Geoscience

After 250 years coal mining stopped 2012 in the Saarland, Germany. Ca. 80 mining heaps remained (up to 100 m tall). Heaps contain a significant amount of natural coal, well known as a source of polycyclic aromatic hydrocarbons (PAHs). PAHs are pollutants with high persistence, toxic impact on organisms. This study aims at quantifying the initial PAH concentrations which could persist under almost real conditions leached from heap sediments. Samples (10 cm deep) from heaps of Duhamel, Göttelborn, Libya, Reden, Viktoria and 2 coal samples, were extracted and used in batch experiments. Leaching experiments with an automatic extraction unit (Dionex300) were executed, using acetone (potential leaching) and water at different temperatures (40°C and 80°C, real “leaching”). Additionally, batch experiments with natural water were run to test the potential PAH leaching in any rare four soils occurring. The 16 EPA-PAHs and four additional PAHs (1-methylphenanthrene, 2-methylphenanthrene, benz[ep]yrene and perylene) were analysed by gas chromatography with mass detection. Additionally total organic carbon (TOC) and physico-chemical parameters (pH and TDS) were analysed. The heap samples contained a potential concentration in the range of 0.01 - 36 mg/kg. The highest concentration value of 36 mg/kg was found at the heap Lydia (most abandoned PAH was naphthalene). In general, light PAHs (mass lower 202 AMU) were found in concentrations up to 40 times higher than heavy PAHs. Coal samples showed 4-times higher PAH concentrations (most abandoned light PAHs) than sediment samples. However, the water extractions showed only light PAHs. The batch experiments (3 samples per heap, 1 coal) showed only light PAHs in the water phase (concentrations from 0.1 – 0.5 µg/L), with 2-methylphenanthrene (0.5 µg/L) in the coal sample. The highest concentration of total PAHs of a heap was found at Lydia, ca. 6 times higher than the lowest concentration found in the heap Victoria. Potential light PAH concentration in sediments (acetone extraction) were ca. 3 orders of magnitude higher than water extractions at 40°C and 80°C or in batch experiments. The extract at 80°C showed 20 times higher concentrations than at 40°C for the lighter PAHs. TOC content was found to be above 60% in coal samples (with 90% OC). Sediment samples showed TOC values in the range of 2% – 8%. Light PAHs from heaps have been found to be mobile, but maybe immediately sorbed by natural TOC. However, dust emissions may pose a potential risk from heaps.

When ecotoxicology meets trophic ecology (P)

TI/205
Will detoxification processes overcome marine mammals still be efficient in the future?

P. Méndez, Observatorio Pelagis; J. Spitz, Observatorio Pelagis Universidad de La Rochelle/CNRS; F. Courant, Université de La Rochelle / LIEENS

In marine mammals, food is the main route of entry for contaminants. Their concentrations can largely vary among prey species, for that reason differences in bioaccumulation will arise from differences in predator diet. Among all the contaminant that marine organisms faced, metallic trace elements (MTE) are natural substances that have been present on the earth since its formation. MTE can be divided in essential and non-essential in function of their biological role in the organisms. Low concentrations of essential elements can lead to deficiency effects. On the contrary, excess of non-essential elements (i.e. cadmium (Cd), mercury (Hg) and lead (Pb)) can induce toxic effects. However, their long-term presence in to the environment has allowed to marine mammals and other marine organisms to developed mechanisms to mitigate the potential toxic effects of these non-essential elements. The best known detoxification process is the demethylation of Methyl-Hg by Selenium (Se) forming granules of tiemmanite (Hg:Se) in their liver. Today, anthropogenic activities induced a continuous increase of Hg concentrations in the environment, altering the quality as well as the quantity of the marine communities. Such changes could affect the ability of marine mammals to control the negative impacts of their exposure to non-essential elements. Here, we investigated the temporal trends of Hg and Cd in liver and kidneys (main storage tissues) of 183 individuals of the smallest cetacean species in the North Atlantic: the harbour porpoise (Phocoena phocoena). Both elements showed a significant increase (p < 0.05) of concentrations between 1999 and 2013. Notably, we highlighted a strong increase of the number of individuals exhibiting extreme values among the range of measured concentrations. In parallel, we analysed essential trace elements in 78 forage species (i.e. jellyfish, crustaceans, cephalopods and cartilaginous and bony fish) to assess their quality for predators. Results showed broad differences of their essential element composition. In particular, selenium of high concentrations can concern because of its long-range-trang different Se exposure among marine mammal species depending on their diet, which means that some of them could be less protected against Hg toxicity. Thus, changes in prey quality could have cumulative effects in cetaceans (increase of toxic elements and deficiency in essential ones) impacting the efficiency of detoxification processes in the future.

TI/296
Impact of biofilm growth on mercury accumulation in Daphnia magna

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A largely neglected issue in lab-based toxicity testing of pollutants is the potential for other components in the biotic community to influence the effects of toxins on freshwater organisms. For example, biofilm growth on test organisms is common in such studies to infer toxicity thresholds of aquatic organisms. Nevertheless, such tests are usually conducted in highly standardized conditions and with a minimum of naturally occurring biofilm. Although this allows for standardization, it may hinder ecological relevance. Biofilm commonly grows in culture medium and serves as additional food for Daphnia. It can also accumulate mercury (Hg), a pollutant often encountered. Hence, this study investigated the impact of biofilm growth on mercury accumulation in Daphnia magna. We conducted an experiment where single Daphnia magna clones were exposed to 20μg/L HgCl2 in the presence and absence of biofilm. Our alternative was to test for a significant effect of Hg accumulation in biofilm on Hg accumulation in daphnids. Results showed no significant effect of biofilm on Hg uptake in Daphnia. However, biofilm served as an additional source of selenium (Se) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, biofilm played a central role in the transfer of Hg to higher trophic levels in freshwater ecosystems. By taking this into account, we can better predict effects of Hg in these ecosystems. Therefore, we conducted an experiment where single Daphnia magna clones were exposed to 20μg/L HgCl2 in the presence and absence of biofilm. Our alternative test was to test for a significant effect of Hg accumulation in biofilm on Hg accumulation in daphnids. Results showed no significant effect of biofilm on Hg uptake in Daphnia. However, biofilm served as an additional source of selenium (Se) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, biofilm played a central role in the transfer of Se through the freshwater food web and in decreasing the risk from Hg toxicity in Daphnia.

TI/298
Multiple stressor effects on resource quality for consumers: a case study with photobiotic biofilm exposed to phosphorus and ionic silver

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In aquaculture systems, representing a potentially major resource for many important consumers. To date, most studies have tried to understand the impacts of stressors on microbial communities or on functional processes taking place into the biofilm mat. Far less studies investigated the indirect effects of stressors on upper trophic levels through alterations of the quality of biofilms. We investigated, through a laboratory study, the single and combined effects of phosphorus (P) availability and silver contamination on the elemental (C:N:P ratios) and biochemical (fatty acid profiles) compositions of a diatom-dominated biofilm. We hypothesized that 1) P would enhance the elemental quality while 2) P and silver, through the replacement of diatoms by more tolerant primary producer species, would reduce the
biochemical quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, *Gammarus fossarum*, by measuring organisms survival and growth rates. Results mainly showed that species replacement induced by both stressors affected biofilm fatty acid compositions, and that P immobilization permitted to achieve low C:P biofilms, whatever the level of silver contamination. Gammarids growth and survival were not significantly impacted by the ingestion of silver-contaminated resource. On the contrary, we found a significant positive relationship between the biofilm P-content and 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.

TU299

Soil pollution induced changes in leaf litter chemical composition and in detritivore physiology and activity.

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The effects of mineral supplements on Pb bioaccessibility through laboratory and field approaches. One aim was to prevent or reduce absorption in herbivores inhabiting mining areas and thus reduce the possible exposure route to people. In our in vivo 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 lower in comparison with control goats. Moreover, Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animals. These implementations could significantly reduce the risk of exposure to livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.

TU300

Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area.


The role of the herbivore guild in a Mediterranean poplar forest in the succession of a mine soil. *Pinus halepensis* was studied, at different stages of successional development: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of trees (T); 3. Mixed groups of trees > 5 m high and shrubs and herbs under the canopy (DF+MS); 4. Dense patches with *P. halepensis* (T+5); 5. Shrub and herb species under the canopy (DP); 6. Control forest not contaminated with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (CF); B) Outside the mine tailings: 1. Barren soils (CS); 2. Small groups of trees (CSF); 3. Mixed groups of trees > 5 m high and shrubs and herbs under the canopy (CF+MS); 4. Dense patches with *P. halepensis* (T+5); 5. Control forest not contaminated with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (CF). In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully empty after 20 days was recorded to calculate the % of holes fed upon: CF =42%, P =39%, S =31%, P+MS =21%, AF =90%.

TU301

Effects of mineral supplements on lead exposure in free-ranging herbivores.

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The effects of mineral supplements on Pb bioaccessibility through laboratory and field approaches. One aim was to prevent or reduce absorption in herbivores inhabiting mining areas and thus reduce the possible exposure route to people. In our in vivo 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 lower in comparison with control goats. Moreover, Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animals. These implementations could significantly reduce the risk of exposure to livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.

TU302

Analysis of anticoagulant rodenticides, neonicotinoids and fipronil in liver of predatory birds.

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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 poisonings, when (predator) take 3-5 times higher Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animals. These implementations could significantly reduce the risk of exposure to livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.
Spatial comparison of contamination and biomagnification profiles of concentrations in zooplankton from the more freshwater influenced sites, sources than zooplankton from the outer fjord. We also found higher Hg biological (bloom) processes. Salinity and seasonality were major structuring abundances were higher in freshwater than marine dominated systems and salinity, was the major structuring force for phy.

were measured alongside data on chlorophyll a, bacterial as well as viral abundance occasions in 2015/2016. Physical water (surface and we characterized physicochemical conditions, lower food web structure and Hg OM and Hg dynamics at the freshwater contaminant pathways. While several studies exist on effects of - and marine ecosystems. The presence of tDOM and marine environments of Hong Kong -\textit{d}13C and \textit{d}15N signatures of hawks, songbirds, invertebrates, and berries was used to estimate the trophic position of each organism. Legacy POP concentrations were expressed in terms of lipid equivalent concentrations to account for variability in the fractions of lipid and non-lipid organic matter measured in each sample. PFC concentrations were expressed in terms of protein equivalent concentrations to account for the fraction of protein within each sample, which was estimated to be the product of the percent of nitrogen measured in each sample and a nitrogen:protein conversion factor. Censored regression by maximum likelihood estimation was used to assess the relationship between the natural logarithm of each lipid or protein equivalent producer, via a trophic position. Trophic magnification factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for PFCs were determined to be higher than for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

**TU306**

Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in two urban agricultural watersheds

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Trophic magnification factors (TMFs) have been extensively used to assess the biomagnification potential of organohalogens in numerous aquatic and terrestrial ecosystems. While the trophodynamics of legacy persistent organic pollutants is relatively well known, that of emerging halogenated contaminants remains scarcer and less documented. This is partly due to the lower bioavailability of these pollutants, the slower degradation of its lipophilicity and octanol-water partition coefficient (log Kow).

**TU307**

Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin.


Copper and mercury body residues in 10 macroinvertebrate taxa were used to model the alterations in benthic community metrics due to metal bioaccumulation in mining areas of the Nalon River basin (Spain). The studied taxa are potentially useful as water quality biomarkers and cover different functional feeding stages. This is part of a larger study in North Spain that aims to develop bota quality.
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 multivariate (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 macroinvertebrate communities through the estimation of effective body residues (ER); and third, to investigate the taxa-specific differences in metal ERs in relation to their feeding styles. The ERs were estimated for each taxon and metal from the best non-linear models, selected using Akaike's Information Criteria, and compared with the 90th percentiles (P90) of the data distribution in the reference sites of the study area, considered an approach to threshold (no-effect) concentrations. The models were fitted for Hg only in few instances for Hg. Results showed that Cu-ERs and Cu-ERs, in 4 taxa (Baeidae, Hydropodidae, Ephermerellidae and Microdrilus oligochaetae) were usually less than 2 times above the P90, calculated for the same taxa. These ERs in other 3 taxa (Heptageniidae, Ephemeridae, Rhyacophilidae) were mostly within the range of 2.1 to 5.0 times the P90. The largest ratios were found in ERs for Lumbriidae and Perlieidae, which reached 12 to 15 times the P90 values. In the case of Hg, the predator taxa (Rhyacophilidae and Perlieidae) 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, influencing the microbial loop, through direct and indirect effects, besides regulating the marine biogeochemical fluxes. In this study, the potential contaminant transfer was investigated in simplified marine food chains. The nauplii of the brine shrimp Artemia sp. and the ephyrae of Aurelia sp. and S. malayensis were selected as primary and secondary consumers, respectively. Cadmium nitrate was selected as toxicant. Performed experiments consisted in feeding ephyrae, every 24 hours for 5 days, with nauplii of Artemia sp. previously exposed, for 6 hours, to different concentrations (0.1-0.5-1-2-4 mg/L) of Cadmium nitrate; this range was selected through preliminary trials aimed to define the cadmium LC50 value for crustacean larvae. At the end of feeding experiment (5 days), the effect of Cadmium nitrate treated crustaceans on ephyrae jellyfish was investigated by the “ingestion rate method”, the “predatory performance” and biometrics and bioenergetics parameters (Disch diameter, ash-free dry weight_AFDW and gross growth efficiency_GGE). In addition, 24 hours after each feeding treatment, two ecotoxicological end-points were evaluated on jellyfish ephyrae: Immobilization and Frequency of pulsation (number of pulsations/min).

Results showed a 100% of feeding rate and predatory performance in both control and treated jellyfish (A. aurita and S. malayensis). Cadmium nitrate treated Artemia nauplii, once ingested, caused in ephyrae a decrease of Disch diameter and AFDW and also an inhibition of GGE% (Aurelia spec.;Ecu.; 3.82 mg/L). As regards ecotoxicological assays, immobilization was never affected (effect < 50%), while frequency of pulsation showed a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae jellyfish able to induce sublethal effects.

TU309
Tissular injuries in Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.

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Experimental metals and organisms in small quantities carrying out their biological functions. In contrast non-essential metals do not have a known biological function. When metals are incorporated by the organisms they can cause damage and their presence indicates contamination. Several human activities contribute to the increasing load of both essential and non-essential metals in the aquatic environment. Microalgae such as Chlorella sp., are the primary link in the trophic chain. In contact with the environment, they can incorporate contaminants by absorption or adsorption. If these algae accumulate contaminants, such as metals, the organisms that feed on them like the oyster Crassostrea virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work was to evaluate the effects derived from the trophic transfer of copper and cadmium via Chlorella sp. to C. virginica. Microalgae were cultured for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10^5 cells was given to C. virginica for 21 days. The evolution of histopathological changes in C. virginica was evaluated in days 0, 5, 10, 15 and 20 of the assay. The analysis performed in the digestive gland revealed diverse lesions ranging from the loss of cilia and covering membranes, to the increase in the light of the digestive gland tubules, as well as the presence of various inflammatory processes. Other organs such as the gills, presented inflammation and injuries that compromise the body’s physiological processes such as feeding and breathing. These damages were evident after the first 96 h of exposure to the contaminated food. However, lesions were observed in C. virginica with cadmium exposure, a non-essential metal, in more than 50% of organisms could be observed on day 10 and those associated with more than 50% of animals in co operation 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 1950, studies dealing with toxic effects of microplastics in freshwater ecosystems come into focus. Still, little is known about vertebrate models as final consumers in food web experiments. The present study investigates the transfer of pristine microplastic particles and a model polycyclic aromatic hydrocarbon, along an artificial food chain with Artemia spec. nauplii and zebrafish (Danio rerio). Therefore, cryogenically ground microplastic particles, made of polystyrene (TU311
Toxicokinetics links predator-prey dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenorhabditis elegans-Escherichia coli ecosystem

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BACKGROUND: Zero-valent iron (Fe0) nanoparticles (NPs) are one of the most paramount NPs applied in environmental remediation that the potential impacts on the ecological dynamics and soil ecosystem health are of great concern. OBJECTIVE: The primary objective of this study was to simulate dynamic models linking bioinetic and consumer-resource dynamics in the Caenorhabditis elegans (E. elegans)-Escherichia coli (E. coli) OSPbEcosystem. METHODS: The bioinetic parameters, uptake and depuration rate constants of bacteria and worms were obtained from toxicokinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamics of Fe0NPs accumulations, bioconcentration factors (BCFs), biomagnification factors (BMFs) were simulated based on the consumer-resource dynamics. A sensitivity analysis was also performed to characterize the influence of consumer-resource-related physiological parameters. RESULTS: Results showed that biomass of worms increased steadily from 22.25–51.61 g L–1, whereas the biomass of bacteria decreased rapidly from 17.17–2.29 g L–1 and attained a steady-state after 2 h of simulation in the scenario of 100 mg L–1 Fe0NPs exposure. We also observed that internal concentrations of Fe0NPs were estimated to be 67 and 1768.85 µg L–1 in worms and bacteria, respectively. In addition, the BCF of bacteria was up to 17.69, close to the experimental results. Moreover, the BMFs of worms were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of Fe0NPs in worms were mainly influenced by biomass conversion rate for bacteria ingested by worms, whereas parameter of death of worms had the smallest effect on worm internal concentrations. CONCLUSIONS: Model application to toxicokinetic results confirms the hypothesis that the consumer-resource dynamics are effectively associated with Fe0NPs accumulations in bacteria and worms that the bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

Use of Effect Based Methods in the context of the national and european legislative framework for the protection of aquatic ecosystems (P)

TU312
INTEREST OF IN VITRO BIOASSAYS (YES/YAS) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WALLONIA (BELGIUM)

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This study is part of the BODIEN 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, alkyphenois, phthalates, chlorophenols, ...
perfluoranes, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2eq/l (mean: 2.1±1.6 ng E2eq/l). Androgenic activity was detected in 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. bisphenol A, perfluoranes). This study is, in a way, the first attempt in Wallonie 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 environmental changes that may influence the water quality of the reservoir. Water samples were collected along 2017 at four tributaries of Alqueva (streams of Zebro, Alamos, Amieira and Lucefécit) and analyzed for: (i) physical chemical support elements (pH, temperature, dissolved oxygen, conductivity, chloride, total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD), (ii) histidine of water, (iii) sublethal parameters (reproduction, feed inhibition or growth inhibition) induced, (iv) sublethal effects such as acute invertebrate, algae and fish tests) were not subject to this screening, since they are already well proven and no detailed evaluation was required, however, they were considered as part of the final recommendations. The shortlisted EBTs were then subject to a detailed review, based on the published scientific literature, to identify relevant information with respect to their performance, interpretation, and application. The EBTs were compared using the information identified in the literature review and an initial suite of thirteen bioassays were recommended for the monitoring of surface waters associated with reffery effluents using passive sampler extracts. This recommended suite of EBTs should be considered a starting point for use in the monitoring of waters receiving reffery effluents, to be further developed based on experience in using the assays for this purpose, and incorporating new relevant bioassays once they have achieved a sufficient level of validation maturity. This review will be published as a Concave report in 2018.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD)

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An ongoing review of the Water Framework Directive (WFD) is required to ensure that the WFD is at least as effective as it was when it was first adopted in 2000. To that end, the WFD and its implementation and monitoring strategies of the WFD, as well as to enhance the current EU policies in 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 zebras (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 (EFT) and other assays; particular attention has been given to the sub-lethal effects. Afterwards, environmental samples from different aquatic systems in Italy will be analysed to detect the chemicals present in these sites as well as their toxic effects. In order to reach a better comprehension of the effects of such substances on the ecosys -tems, the most relevant substance for this purpose, and incorporating new relevant bioassays once they have achieved a sufficient level of validation maturity. This review will be published as a Concave report in 2018.

TU316
Chemical and Ecotoxicological Monitoring of a marine coastal area in the Central Italy

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A monitoring campaign in Central Italy with the aim to characterize the chemical quality status of the coastal marine area in order to detect the possible impact of the emissions of a Coal fired power station and other sources of pollution in proximity of the city of Civitavecchia. The sampling has been carried out in two different seasons of the year along the marine coastal area and in a transitional surface waterbody (Saline di Tarquinia). The analysis has been performed on the water samples from the first 20 centimeters of the sediments. The chemical substances analyzed included several priority substances of the WFD (water framework directive) and other chemical substances: Metals, Dioxins, PCB, PAH, Naphtalene. The Ecotoxicological assays have been performed with the use of algae (Phaeodactylum tricornutum) and crustaceans (Artemia franciscana and Tigiripes fulvus). The results have showed a diffuse light exceedance of the sediment environmental quality standards of the Italian legislation for some metals (e.g. arsenic, lead, chromium, mercury) and naphtalene: the data of the water column are in general below the environmental quality standards, but Uranium has been detected in surface water samples at concentrations above the available PNEC.
(predicted no effect concentration). Ecotoxicological effects have been detected with the algae and could be related to the substances detected (e.g. heavy metals) or other substances released in the area (transitional waterbody). In general the results show a situation in which the quality of the sediments is not in a good status, although the level of concentrations should not cause a high risk for the aquatic ecosystems; the chemical contaminants can derive from different sources of pollution (industrial, urban, agricultural, atmospheric deposition) and may be under an increased level due to the pollution sources of the Danube River. The presence of Uranium in the marine coastal area should be further investigated to understand the possible role of the fire-polluted region.

TU317 USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSCOPE ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER
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The Salmonella/microsome mutagenicity assay uses the genetically modified Salmonella enterica serovar Typhimurium bacterium, and the exploration of these different genetic characteristics allows the detection of various classes of mutagenic compounds. The objective of this study was to use different strains for the identification of mutagenic profiles and testing at the different compounds present in wastewater. 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 and an evaluation of the metabolic activation (S9). The TA98, YG1041, TA1538 and YG5185 with specific genetic characteristics for the detection of different compounds. A total of 69% surface water and 92% SPM samples were positive for at least one strain/condition. The applied methodology compared the profiles obtained at different sites along the Danube River. In this way, it was possible to detect different classes of compounds, which are the modern day residues used in the Mediterranean area. The conclusion drawn is 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 profiles were similar to reactive compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures of compounds. Non-mutagenic analysis is carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6. José Ricardo R. M. Zwang thanks FAPESP Project 2015/11399-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Union’s Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

TU318 NTA meets EDA: A practical example
J. Jukne, V. Hinnenkamp, P. Balsaa, A. Simon, IWW Rheinisch-Westfälisches IndustrieKernfeld GmbH, T. C. Schmidt, University of Duisburg-Essen Organic microplastics play an important role in the assessment of water bodies that are used for drinking water production. On one hand, microplastics 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. PEC in the river Ruhr) show, water suppliers must always expect to find new critical substances that could pose a potential health risk in drinking water, especially when using surface water. For this reason, it is necessary to initiate a proactive screening of contaminants and their potential effects. Continuous monitoring by high-resolution mass spectrometry also makes it possible to analyze pollution retrospectively. Of particular interest are the 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 microplastics is needed. This project is an approach to analyze organic microplastics in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken recurrently over a period of a 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 activity (ER-CALUX and AR-CALUX) as well as genotoxicity (p53-CALUX, umuC assay and Ames assay). Due to the investigation of raw water samples, no significant biological effect of the individual samples was to be expected. The focus of this project was therefore on the identification of seasonal and spatially dependent micropollutant load. The coupling of NTA with a test strategy for toxicological effects forms a 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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BUTYLTHINS (BTs) - i.e. mono- (MBT), di- (DBT) and tributyltin (TBT) - are synthetic compounds worldwide used in industrial and agricultural applications giving rise to contamination of aquatic environments. Organotins, which include BTs, are banned 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 pollution and it is generally considered as a specific water quality and aquatic toxicity endpoint. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecological status assessment. In this context, the aim of this study was to propose a classification of imposex according to WFD using two species of gastropods collected in the Northern Adriatic Sea and in the Venice Lagoon: Nassarius nitidus (Jeffreys, 1867) and Helix aspersa (Linnaeus, 1758). The first species, less sensitive to BT pollution, can be found in the inner parts of the lagoon, whereas the latter, more sensitive, occurs only near the lagoon inlets or in the sea. To define Ecological Quality Ratio (EQR) class boundaries within WFD, the relationship between the ecological impact caused by BT pollution and the reproductive capacity of the gastropod populations was assessed. This preliminary attempt showed that most of the sites were in bad ecological status before the ban and have reached mostly a Moderate status at present, with very few sites in Good or High status. A comparison between the two species was also performed showing advantages coming from the combined use of both species to cope with the ecological quality assessment in a wider area study.

TU320 Lessons Learned from Sibro Dam and River Restoration in Sweden
E. Hallqvist, C. Becker, P. Bönlökke Adamsen, P. Gliveson, A. Sahlin, 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 daughter Directives aim to protect and improve water quality and aquatic ecology; environmental quality standards (EQS) have been established as legal tools with which to set requirements for member states. In Sweden, all major surface waters are classified according to the current status of the water designated by authorities in the respective water district. The ecological status of surface water comprises three different types of quality factors according to the Water Framework Directive: hydrological, physical-chemical and biological parameters. The latter defines/indicates 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 Sweden, requiring sustainable interventions. Non-target analyses, i.e. the use of polychlorinated biphenyls (PCBs), are now in use in Sweden. The national energy strategy is to increase the use of hydropower in lieu of fossil fuels. In the same time, water power is likely to impact the ecological connectivity of rivers and have a negative impact on biodiversity. In Sweden, a common national strategy is to use the hydropower in lieu of fossil fuels. 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 effects. To illustrate the challenges, this paper summarizes work conducted in Sweden, particularly in the Sibro Dam region. The project was initiated after previous dam repair work involving the diversion of large volumes of water in the Sibro Dam river and its protective capacity of the ecosystem was examined. The project was directed to improve ecological connectivity at Sibro Dam and regulation of Lake Båven. The planning/development included preparation of an environmental impact assessment (EIA), detailed engineering design for fish passage, engagement with local communities and communicating with the Ministry of Environment and Sweden’s federal court on”Fish passage; Sweden; ecological connectivity; environmental impact assessment

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

TU321 Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

SETAC Europe 28th Annual Meeting Abstract Book
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, there is little knowledge of the lethal effects of MeHg to a marine forage fish at the larval stage, the Sheephead minnow Cyprinodon variegatus. Because the availability 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 range 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.

TU322
Comparability of Zebrafish Embryo Behavioral Assays: A Need for Standardization, Environmental Factors and Assay Specificity
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In recent times, zebrafish embryos have gained wide acceptance as an alternative model for drug development and toxicity testing. In particular, the behavioral response of zebrafish embryos is a useful endpoint to detect neurotoxic and neuroactive chemicals. Consequently, several behavioral test methods have been developed including photometer response test (PMR), locomotor response test (LWRT), swimming speed acceleration, active range and swimming distance test (TDR). Although these methods are distinct in their application, most of their experimental parameters lack consistency in protocols such as exposure time, imaging time, age of exposure, endpoint parameter, statistical analysis etc. Therefore, there is a need to standardize these methods in order to enable comparability of test results, as well as to ensure accurate prediction of chemical activity at an early stage. To indicate this standardization process, we embarked on a meta-analysis of existing behavioral assays to ask these questions: 1.) Are there consistencies in hypo/hyper behavioral activity of zebrafish embryos when different assays are used? 2.) Despite lack of standardization, is it possible to aggregate the data from different assays to give useful behavioral activity? 3.) Is it possible to determine which experimental parameters are most influential for the behavioral assays? Based on the meta-analysis, we conclude that, results from different behavioral assays (LMR, PMR and STC) are consistent with the predicted activity of a chemical. Even though, effect concentrations vary to some extent among the considered behavioral assays, most of the variability could be explained by the most influential parameters including: exposure time, age at exposure and concentration range. These results can be useful to identify the most important experimental factors in an effort to standardize behavioral assays for toxicity testing.

TU323
Effects of 17α-ethynylestradiol (EE2) on social behaviors of the false clown anemonefish (Amphiprion ocellaris)
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The synthetic estrogen 17α-ethynylestradiol (EE2) is extensively used in oral contraceptive pills, medication, cosmetics, and personal care products. It is also used in livestock and aquaculture systems via wastewater discharges and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal water. Although coastal regions are often impacted by sewage discharges, no study has been done to address the effect of environmental estrogens such as EE2 in coral reef fish. Agonistic behavior is crucial for maintaining social hierarchy in many coral reef fish. Endocrine disrupting contaminants such as EE2 may interfere fish social structure via disrupting their agonistic behavior. In this study, we aimed to use the false clown anemonefish (Amphiprion ocellaris) as an experimental model to characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by environmentally relevant EE2 treatment. Social behaviors were not altered, but social behaviors of the middle-ranked fish were significantly affected by EE2, suggesting that EE2 may cause different impact in different ranks.

TU324
Impacts of environmentally realistic antidepressant exposure on reproductive behaviour and sperm traits in fish
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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. Worriedly, 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 two environmentally realistic levels of fluoxetine (average measured concentrations: 30 and 380 ng/L) on a range of reproductive behaviours, as well as sperm quality, in the eastern mosquitofish (Gambusia holbrooki), a promiscuous freshwater fish with internal fertilisation. We focussed on these traits because reproductive behaviour and sperm quality are both crucial fitness determinants, and are known to be vulnerable to disruption by other chemical pollutant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour. Exposure studies were carried out by daily exposure to formulated fluoxetine in artificial freshwater and with length of exposure. 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 / Biological Sciences

Behavioural tests have been gaining recognition as a viable endpoint in ecotoxicology as they provide a link between biochemical and ecological effects of environmental contaminants. Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behaviours in aquatic vertebrates. The effects of behavioural modulating drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined behavioural assays. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparatively few have been done on invertebrate species. This ongoing study aims to translate these techniques to model crustaceans for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Specimens of the marine amphipod, Echinogammarus marinus and the freshwater amphipod Gammarus pulex were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 μg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic response. Both E. marinus and G. pulex showed alterations in activity at concentrations as low as 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 ramifications for future study design of these types of experiments and aid the development of high-throughput analysis on common laboratory invertebrate species.
TU326
Inter-species variability in the behaviour of a marine and freshwater amphipod
S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth

Inter-specific species are used in standard ecotoxicology testing to assess environmental effects of contaminants. However standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is expanding with techniques and endpoints used in pharmacology being translated to other invertebrate and invertebrate species for use in ecotoxicology. Despite this, data on the control behaviours of model organisms such as crustaceans, and the inter-species variability in behaviours are currently under-studied. The aims of this study were to provide control data on a range of behaviours for use in ecotoxicological testing, using amphipods as model organisms. Behaviours commonly associated with anxiety in pharmacological studies including activity, phototaxis (light/dark preference) and thigmotaxis (wall hugging) were assessed in the marine amphipod Echinogammarus marinus and the freshwater amphipod Gammarus pulex using choice assays. Both organisms exhibited negative phototactic and positive thigmotactic behaviours (P < 0.001) respectively, however, differences in sensitivity to these assays were observed between species. E. marinus showed a significantly greater sensitivity to the phototaxis assay than G. pulex (P = 0.001), while the reverse was found for the thigmotaxis assay (P = 0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P = 0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of very different behavioural responses. The inter-specific variability in sensitivity to behavioural assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

TU327
Pharmacological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)
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Pharmaceuticals are common contaminants in aquatic ecosystems. Among the most prescribed pharmaceuticals globally are the benzodiazepines (e.g. Valium), a class of psychoactive drugs used to treat anxiety and induce sedation. Benzodiazepines are persistent in the environment, and their target, the GABA-A receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (Perca fluviatilis) and Fathead minnows (Pimephales promelas) at environmentally relevant concentrations as well as mRNA expression of brain GABA_A receptor subunits and mRNAs expression of liver enzymes involved in the metabolism of oxazepam. We then correlate these measures of physiological and genetic tolerance with the individual’s behavioural tolerance. The results will shed light on the potential for inter-individual variation in oxazepam tolerance to mitigate the effects of benzodiazepine pollution.

TU328
Reversible behavioural alterations in burbot, Lota lota, from exposure to environmentally relevant levels of oxazepam
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Benzodiazepines are frequently detected in the environment. They persist in wastewater effluent and can be found at high concentrations in treated effluent. Furthermore, several benzodiazepines are resistant to photodegradation, enabling them to persist in the environment. Benzodiazepines are designed to alter human behaviour by binding to GABA receptors, which are found in a wide range of animals including all vertebrates. We investigated the effect of the benzodiazepine oxazepam on behaviour using the burbot, Lota lota. We found that high levels of oxazepam affected swimming activity, diurnal as well as nocturnal, while the environmentally relevant level had no detectable effect. There was also an effect on boldness, with fish exposed to high levels of oxazepam spending more time hiding than the control- and low level fish. Interestingly, the effects of high oxazepam were no longer detectible when the fish were tested again after being kept in water without drugs for five days. Our results suggest that effects of pharmaceuticals may be reversible, if the exposure duration is relatively short and the animal have the possibility to move to uncontaminated water.

TU329
Behavioural endpoints and 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 antidepressant. It binds to a specific receptor for the serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the pre-synapse. Due to high consumption rates and moderate elimination during wastewater treatment, CIT is one of the most abundant SSRIs in surface water. Several studies showed that environmentally relevant concentrations of 1 µg/L may affect aquatic organisms. The aim of this study is to investigate effects of CIT in different life stages of brown trout (Salmo trutta f. fario) with focus on development, behaviour and individual health. Both, eggs of the eyed ova stage and 8 months old juveniles were chronically exposed to four concentrations of CIT (1, 10, 100 and 1000 µg/L) in a in a semi-static three-block design accompanied by a control exposure. The larvae were exposed for 5 months at 7°C and 11°C, the experiments with juvenile fish were conducted for 4 weeks at 7°C. To investigate the effects of CIT on the embryonic development, mortality, hatching rate, and heartbeat rate were recorded. During the exposure, also behavioural endpoints were observed. Besides, several biomarkers indicative for fish health were investigated, such as cortisol-level, acetylholesterolase activity, hsp70-level and the histological condition of the liver. After exposure to 1000 µg/L CIT, length and weight of both larvae and juveniles were significantly reduced. Furthermore, both stages showed an impaired swimming activity and an increased swim up in the aquaria. In an artificial swimming measurement device (small aquaria with a diameter of 17 cm), videos were recorded for 20 minutes with the aim to quantify changes in the swimming behaviour. Due to the settings of the cameras, the aquaria were strongly illuminated and the water was not ventilated during the recording. This stress situation resulted in a high activity of fish exposed for the 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 floury swimming. The study is embedded in the Effect-Net (effect network in water research) Project which is funded by the Wassernetzwerk Baden-Württemberg.

TU330
Assessing the direct and indirect effects of chemical contaminants on the behaviour, ecology and evolution of wildlife: A conceptual framework
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Chemical contaminants, e.g. metals, pharmaceuticals, pesticides, are changing ecosystems via effects on wildlife. Most studies examine a limited range of endpoints, species and/or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have the potential to interact and induce a multitude of sublethal effects on animals. For example, effects on hormone levels, genetics, and behavior. To be able to predict ecological effects of chemical contaminants, we need to understand how endpoints are linked to population-level processes. 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
Scents and sensibility: EE2 disrupts mate choice in fish
M. Saaristo, C.P. Johnstone, Monash University / School of Biological Sciences; K. Xu, University of Alberta / Department of Renewable Resources; M. Allison, The University of Melbourne / School of Chemistry; B.B. Wang, Monash University / School of Biological Sciences

Among the handful of studies that have studied the behavioural effects of endocrine disrupting chemicals (EDCs), only a few have attempted to disentangle the mechanisms underlying behavioural changes, such as mate choice. In fish, for example, ecological studies have shown that males base their mate choice on
multiple cues and both visual and chemical cues play an important role in choosing the most suitable mate. Therefore, it is crucial to understand if and how OECs affect mate choice cues (e.g. visual and chemical cues), and further, if one cue is affected disproportionately. Accordingly, the aim of this study was to investigate the impacts of a 28-day exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the guppy. To examine the impact of EE2 on male 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 ‘sigmoid’ display with both control and EE2-exposed males spending more time performing sigmoid displays for control females compared to EE2-exposed females. When males were presented with chemical cues (control and EE2-female) to the trial tank, the association zone more frequently, if EE2-exposed female was paired with an EE2-chemical cue. In contrast, sigmoid display showed a reverse pattern, with males preferring EE2-exposed females that were paired with control chemical cues. Not only does our study uncover a previously unknown behavioural impact of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposed fish may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints. 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 96h to waterborne tributyltin at 0.1; 1.0; 4.5; 7 and 9 μg TBT L⁻¹, plus controls and solvent controls. After exposure, we evaluated swimming speeds and trajectories of the fish, counter-current swimming resistance, ability to capture Artemia nauplii, growth in weight and length, and morphology of the eyes. After exposure to 4.5; 7 and 9 μg TBT L⁻¹, histopathological analysis of the retinal pigment epithelium (RPE) indicated a hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. Newborn fish were exposed 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 affected 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 anthropogenic activity and they are naturally exposed to. However, the ability to naturally respond to environmental cues can be severely affected by anthropogenic activity and threats might be attributed to differential activity levels in the Habenula with accompanying activation or inhibition of the reward center in the telost brain. We are investigating whether neuroactive chemicals (Imidacloprid, Thiacyflad) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Oxazepam) found in European waters trigger similar behavioral patterns. Outcome: We will dissect which chemosensory and environmental cues are involved in the behavioral reactions to environmental contaminants. 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, Italy and Dept. of Environmental Science, University of Trento, Italy. Aim: Do silver and titanium dioxide nanoparticles influence the fish kairomone recognition of Daphnia magna? Methods: We used 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 their behavioral assessment. Results: A pristine stream water sample did not elicit an increase in swimming activity compared to control conditions. No mortality or change in behavior was observed in the two organisms under 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 1:1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent induced significant alterations of swimming parameters in both organisms (e.g., the time spent in activity in the center zone. Higher activity henceforth was associated with the cumulative distance travelled in both) at both the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. citerrella gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU335 Do silver and titanium dioxide nanoparticles influence the fish kairomone induced anti-predator defence in Daphnia magna?

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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. Their ability to grow adequate defensive structures, is therefore necessary, to prevent an ecological imbalance in the freshwater environment. As the common link between green algae and fish in the food chain, daphnia are considered a key component in the freshwater ecosystem. Their ability to grow adequate defensive structures, is therefore necessary, to prevent an ecological imbalance in the freshwater environment. Ag and TiO2 manufactured nanomaterials (MMNs) are widely used in the commercial industry because of their unique properties. Silver is known for its antimicrobial properties and is therefore used in soaps and bandages as well as clothing and washing machines. Titanium on the other hand is used in products such as sunscreens, paint and toothpaste because of the bright white pigment it contains. Due to their small size, nanoparticles are not being effectively removed from wastewater treatment plants and end up in freshwater systems such as rivers and streams. Filter feeders, like the cladoceran Daphnia, take up these nanoparticles and 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 their behavioral assessment. Results: A pristine stream water sample did not elicit an increase in swimming activity compared to control conditions. No mortality or change in behavior was observed in the two organisms under 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 1:1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent induced significant alterations of swimming parameters in both organisms (e.g., the time spent in activity in the center zone. Higher activity henceforth was associated with the cumulative distance travelled in both) at both the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. citerrella gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.
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 calculated the nMOMs (nominal microscope observation method) in the swimming zone. 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®X6 software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and phototaxis 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 ug 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 higher using 25 ug L⁻¹ Chironomus, 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 predators. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP) 2016/19635 for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

TU337 Developing methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies

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Under current plant protection product (PPP) regulation, Tier I aquatic ecotoxicology studies measure mortality (acute) or reproduction (chronic). For invertebrates, these parameters are used to address the current protection goals of maintaining populations. Agreed guidelines for reproduction studies for aquatic invertebrates may vary with taxonomic group, 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 calculated the nMOMs (nominal microscope observation method) in the swimming zone. 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®X6 software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and phototaxis 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 ug 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 higher using 25 ug L⁻¹ Chironomus, 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 predators. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP) 2016/19635 for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

TU338 The effects of silver and silver nanoparticles via different routes of exposure on behaviour in marine amphipods

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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 of particular importance, with the aim of this work was to evaluate the effects on the swimming behaviour of the marine amphipod Echinogammarus marinus after exposure to silver, in its salt (AgCl and AgNO3) and nanoparticle (E. marinus (n=20 per treatment) were exposed individually. The exposure via water was performed with AgCl or AgNO3 (25 and 100 ug L⁻¹) for 96 hours. 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®X6 software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and phototaxis 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 ug 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 higher using 25 ug L⁻¹ Chironomus, 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 predators. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP) 2016/19635 for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

TU339 How toxic is a non-toxic nanomaterial: Behaviour as an indicator of effect in aquatic invertebrates

M.E. Nielsen, P. Roslev, Aalborg University / Biology and Environmental Science

Gold nanoparticles are used as drug delivery vectors based on the assumption that they have a low toxicity. Literature has however showed conflicting results over the last few years. This study aimed at investigating the toxicological effects of nanogold (nAu) over a range of indicators from sub cellular to whole organism level. Gene regulation, changes in oxidative stress biomarkers and swimming performance were assessed in Danio rerio (zebrafish) following exposures to nAu. Behaviour profiling estimated from multiple behavioral parameters showed that swimme and propanololate stimulate swimming activity at 10-100 µg/L. EC50 values for fluoxetine and propanololate 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.
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 public protocols and mandatory rules and also provide proper control of the risk involved. CID (Italian Consortium for Dye Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted 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-consumables (knitted apparel, apparel made up by carded woven and combed woven), pre-consumables (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 regenerated of the woolen-type raw material used by carded spinning companies in Prato textile district, sampling (more than 100 woolen-type regenerated raw material selected by origin and type and more than 40 cotton-type regenerated materials) and chemical analysis (made by Buzzi Lab) of some priority groups of concerned substances: APEOS (Ethoxylated Alklyphenols), 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.

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 public protocols and mandatory rules and also provide proper control of the risk involved. CID (Italian Consortium for Dye Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted 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-consumables (knitted apparel, apparel made up by carded woven and combed woven), pre-consumables (combed and carded woven, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling).

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substances (PFASs)

A. Biegel-Engel, German Environment Agency - UBA / Chemicals; L. Viecke, C. Staudte, German Environment Agency / Chemicals

Per-and polyfluorinated alkyl substances (PFASs) are heat resistant and show a low friction resistance. Because of these properties PFASs are for example widely used in aqueous film forming firefighting foams (AFFF). PFASs are not degradable in the environment. Their persistence in AFFF into the environment causes a contamination. In conventional PFASs (such as PFOS and PFOA) need years to leach from top soil layers into the groundwater or into surface water. Short chain PFASs however reach ground water resources much faster due to their mobility in soil. Those contaminations already caused closed drinking water wells. Remediation is costly and long lasting. Although fluorine free foams are available and used at several European airports many firefighters hesitate to use them instead of AFFF. PFAS. Restriction and authorization are regulatory measures under REACH which can be used to minimise releases of PFASs into the environment. An international regulation via the Stockholm Convention is possible as well. In addition the dialogue with stakeholders can be lead to voluntary actions and may be an alternative measure to reduce environmental releases. Scientists and manufacturers need to be encouraged to develop environmentally friendly firefighting agents without fluorinated chemicals. Moreover, scientists, authorities and NGOs need to bring together knowledge about the new substances, such as analytical methods, and information on their fate and behaviour in the environment. This presentations provides an overview on regulatory actions regarding PFASs in the EU and further ideas how to substitute firefighting foams containing PFASs.

TU346

The Paradigm of Substitution - expand your view

M. Zimmer, ZVO e.V.; M. Metzner, Franhofer Gesellschaft

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 complexity. Many different properties and outcomes have to be considered. Otherwise a thorough assessment of the applicability of an assumed alternative will fail. The surface treatment sector as a major cross-sectional community of service providers has long term experience with innovation and substitution suggested by different players for many different reasons – risk reduction being one of them. In particular the SMEs have constantly been confronted with lots of different ideas and approaches. Hence they have deep insight into unexpected side effects and regrettable outcomes. And they are able to give indicators for real promising and applicable approaches to substitution. The authors will present some significant examples of substitution attempts – and they discuss arguments why they might be considered successful – or not.

TU347

A pilot case on how Socio-Economic Evidence can inform Risk Management decision making to assess Substitution versus Recycling for non-ferrous metals slags in safe use applications

H. Waetenschoot, M. van der Straeten, Euronetaux

The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the increasing complexity of articles leads to increasing amounts of hazardous substances and impurities being available for recycling or reuse. Recycling processes in the metals sector produce besides pure substances for safe reuse, also final slags that collect some of the impurities that cannot be recovered at economical conditions. In parallel, the human health and environmental effects data generated by EU REACH and CLP Regulations lead to increasing hazard identifications and harmonised harmful classifications. Hazard endpoints of Very High Concern like CMR (carcinogens, mutagens and reproductive toxicity) or respiratory sensitisation may trigger substitution-based Risk Management Measures but also reduce the reuse in safe applications for “precautionary reasons”. In such cases, socio-economic evidence may be helpful to assess costs and benefits from a broader perspective, including Circular Economy and carbon footprint considerations.

A pilot study conducted at a non-ferrous plant specialised in the recycling of complex end-of-life articles and materials allowed to evaluate this impact and develop a tool for assessors to check/assess to what extent a change in a relevant hazard classification could impact the reuse capacity of final slags. The tool allows metal companies to assess their situation in respect to Substitution (materials loss or disposal) versus Reuse in safe applications.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (P)

TU348

Ecotoxicity of the hydrolate byproduct of three biopesticides on the unicellular green algae Chlamydomonas reinhardtii

D. Ballesteros, J. Val, E. Langa, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Picó, J. Val, San Jorge University / Facultad ciencias de la salud; A.M. Mairán, Universidad de Zaragoza

Synthetic pesticides have been widely used in intensive production systems throughout most of the 20th century. However in the last decades, environmental and human health concerns demand safer substances, so research on biopesticides has been increased. Although a large number of studies have been published focusing on the biological activity of biopesticides on target organisms, studies regarding toxicological effects on non-target organisms, are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has allowed the screening of several plant extracts for bio-activity against a selected set of crop pests and arthropod vectors. Some of these compounds have showed its effective value as biopesticides. The extracts will be optimized by means of traditional and supercritical CO2 technologies, as well as microbiological transformations. In the extraction process the organic and the aqueous fraction (hydrolate) have been separated, since showed active compounds, being capable to act as biopesticides. In order to exclude a negative effect on the environment, these products should be studied on non-target organisms. The aim of this study was to measure the acute ecotoxicity of hydrolates obtained of the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia absinthium (Tereul, Spain), Dittrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula luissieri (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of these extracts having biopesticide activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula luissieri the most toxic compound followed by Artemisia absinthium with a very similar toxicity and Dittrichia graveolens. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolates obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio Fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolates of Satureja montana are likely to cause toxic effects on D. Magna and V. Fischeri but only high dilutions (LC50 values in the range of 0.5% in both cases). These studies allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Bilillo 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 hydrolate byproduct of Satureja montana on Daphnia magna and Vibrio fischeri

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. Mairán, Universidad de Zaragoza; D. Ballesteros, San Jorge University

The increasing demand of new biopesticides for cosmetic use, food or phytopharmacy is based on the awareness about adverse effects on health and the environment. In particular, this work is focused on the plant Satureja montana (Lamiaceae), which has demonstrated a wide range of applications due to its important antioxidant and anti-inflammatory activity. Furthermore, the plant 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 specie was evaluated for their biological and pharmacological activities, as well as its chemical characterization, limited data are available on ecotoxicological characterization. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio Fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolates of Satureja montana are likely to cause toxic effects on D. Magna and V. Fischeri but only high dilutions (LC50 values in the range of 0.5% in both cases). These studies allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Birllo, for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU350

The impact of the hydrolate byproduct of three biopesticides on the soil environment

M. Pino, San Jorge University / Facultad ciencias de la salud; D. Ballesteros, J. Val, San Jorge University; E. Sánchez, Colegio internacional Anfora; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Urieta, 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 non-target organisms are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has focused on the production and optimization of plant-based agriwaste-based crop protectants via cultivation techniques, biotransformation, selective extraction and separations by traditional and supercritical CO2 technologies. In the traditional extraction process the organic and the aqueous fraction (hydrolate) have been separated. Both of them showed active compounds capable to act as biopesticides. In order to exclude a negative effect on the environment, these products were tested
on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydrocarbons, obtained by semi industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Ditrichia graveolens and Lavandula latifolia. The effects on the microbial community has been assessed using the community-level physiological profile – CLPP-. This method relies on the ability of the microbial community for degrading different carbon sources present in Biolog Ecoplasts®. The acute toxicity of the hydrocarbons was also tested by Eisenia fetida bioassay. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latifolia (LC50 in the range of dilution of 10-2). All three 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. Burillo and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).

TU351 Acute toxicity of emulsifiable concentrate of Alpinia galangal essential oil against Cyprinus carpio H. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University 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 non-target effects on non-target organisms in the environment. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Ricerca sp. in South Korea. Acute toxicities of AGEO against Cyprinus carpio were assessed to understand its possible toxic effect on the representative aquatic organism. Cyprinus carpio in a static condition followed by OECD guideline 203 in 5 l beakers. As AGEO were formulated for emulsifiable concentrate (EC) as an active ingredient, it was dissolved with ethanol and tergitol in a ratio of 5:1. Tergitol is a surfactant and it did not show any toxic effect on the fish, so that it was used for the formulation of emulsifiable concentrate for AGEO. Three different AGEO 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 VFEEO were under the toxicity criteria of level 3 for the pesticide to C. carpio standardized by Korea Rural Development Administration. Based on these results, AGEO can be considered to use as a natural insecticide.

TU352 Chronic toxicity of emulsifiable concentrate of cinnamon essential oils against Cyprinus carpio H. Jeon, K. Kim, H. Jeon, Y. Kim, Y. Choi, S. Lee. Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests. So they need plant essential oils (EOs) due to their eco-friendly safe properties. Cinnamon EO is one of important EOs to be a potent candidate and is formulated as an emulsifiable concentrate (EC). As its use is recognized as safe, it needs to be determined its negative effect on the environment using bioindicators. To evaluate the negative effect on the ecosystem, chronic effects of cinnamon EOEC against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EOEC was applied, they were prepared as ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different types of surfactants (TWEEN 80, Sodium dodecyl sulfate (SDS), Nondent, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Koliphor, Tergitol and Mixture of SDBS and Nondent) were tested for the formulation and tergitol showed the lowest toxicity to the fish in an acute toxicity test. With the result of the acute toxicity of cinnamon EOEC, chronic toxicities of cinnamon EOEC was determined in 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treated five concentrations were 0.08, 0.16, 0.46, 2.56, and 5.12 ppm and the mean survival rate was 9.33 ± 0.58 and the positive control and 5.12 ppm and the mean survival rate was 8.48 ± 0.47. The survival rate of the different concentrations for 40 days. Each conce

TU353 Thiosemicarbazone scaffold for the design of antifungal and antiflatoxicogenic agents: evaluation of ligands and related metal complexes S. Mantelhour, university of parma / Department of Chemistry, Life Sciences and Environmental Sustainability; F. Bisciglione, d. regolino, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; M. Study Group, University of Torino, Brescia, Pisa, Perugia and Salento / Dep of Medical and Surgical Specialties Radiological Sciences and Public Health; f. degola, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; D. Ferrucci, University of Brescia Italy / Department of Medical and Surgical Specialties Radiological Science and Public Health; g. pelosi, University of Parma; m. pioli, f. restivo, m. carcelli, g. spadola, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; C. Zani, University of Brescia Italy / Department of Medical and Surgical Specialties Radiological Science and Public Health; i. zerbini, University of Brescia / Department of Medical and Surgical Specialties Radiological Sciences and Public Health; k. a. buschini, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability

Food safety is the safeguarding and protection of food from anything harmful affecting consumer health and is an extremely important issue facing the world. Food hazards can be divided into physical, chemical and biological. Examples of biological hazard are mycotoxins, that are toxic secondary metabolites produced by many species of filamentous fungi. Generally, mycotoxins represent a significant threat to human health as they can be carcinogenic, neurotoxic and toxic to endocrine or immune system. In particular, aflatoxins are a class of mycotoxin produced principally by two species of Aspergillus, A. flavus and A. parasiticus. Aflatoxins are found in various cereals, oil seeds, spices and nuts as a result of a fungal contamination that can occur in the field, during harvest, transport and storage. IARC has classified aflatoxins in Group 1 as carcinogenic agents to humans. The most dominant and potent aflatoxin is aflatoxin B1 and several studies indicate that high exposure to AFB1 can cause chronic toxicity and increases the incidence of hepatocellular carcinoma. A lot of methods can be applied to eliminate these toxins from food and guarantee the food safety and health concerns of consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxins production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perillaldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and antiflatoxicogenic activity toward A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cyto- and geno-toxicity tests on healthy human cells, particularly human cell lines derived from the districts that can be exposed to xenobiotics. Furthermore, we performed toxic and genotoxic assays on bacteria and plant cells. In conclusion, this approach allows us to study the antifungal and antiflatoxic activity of several thiosemicarbazones and to determine the potential risk for environment and human health with a view to use these compounds in field. Financial support: Fondazione Cariplo-Project N. 2014-0555, http://aflatox.unibs.it/

TU354 Electronic products are related with household exposures in Canadian residents M. L. Diamond, C. Yang, University of Toronto / Department of Earth Sciences; L. Jantunen, Environment and Climate Change Canada; D. Tsirlin, Cancer Care Ontario / Population Health and Prevention, Prevention and Cancer Control; L. Latifovic, Cancer Care Ontario; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control Key Words: electronic products, hand wipes, household exposure, FRs and plasticizers Novel flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs), organophosphate esters (OPEs), and phthalates esters (PAEs) have wide applications as flame retardants (FRs) or/and plasticizers in consumer products, building materials, and industrial uses. Their wide-spread use has led to population-wide exposures (Carigan et al. 2017; Hammel et al. 2016; Hoffman et al. 2015). Some of these exposures have been related to adverse health effects (e.g., Carigan et al. 2017). Therefore, information on major exposure sources is needed to reduce exposures and ultimately prevent adverse health outcomes. Here we report on a household exposure study of Canadian women by determining levels of selected FRs and plasticizers in paired household air and dust, hand surface wipes of participants, as well as wipe of principal household electronic devices. PAEs had the highest overall concentrations followed by OPEs by approximate one order of magnitude, and NBFRs and PBDEs (three orders of magnitude less than PAEs). Multiple compounds were found in wipes of individual electronic products suggesting either their usage in many products or migration into the surface polymer of these products from other sources indoors. Statistical analysis showed that FRs and PAEs, as well as FRs and PAEs, on towels and clothing, more frequently resembled the profiles found in that person’s hand-held electronic products, notably that person’s cell phone. Correlations for all compound classes were also found between compounds in large, stationary electronic devices (e.g., TVs) and the room’s air and dust. However, the above correlations were not found for any OPEs between cell phones and air and dust, and were found for only two PAEs. Further results indicated wipes of cell phones were a stronger predictor of compounds on participant’s hands, while large and stationary electronic products related more to household environment contamination of selected FRs and...
plasticizers. Our results indicate that participants are exposed to various FRs and plasticizers through their daily household environment. The Canadian adults’ external exposure of hands to FRs and plasticizers were related to the levels in their household electronic products, particularly handheld devices such as cell phones. Handheld devices could contribute to human exposure through direct contact during use while large and stationary electronic products could be important sources and sinks in household environment.

TU355
Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution
M.D. Núñez, University of York / Environment; A. Pratetorius, University of Vienna / Department of Environmental Geosciences; A. Boxall, University of York / Environment Department

The expansion of the nanotechnology sector is leading to an increased use of products containing engineered nanoparticles (ENPs) in outdoor urban environments. Outdoor materials, such as construction materials, paints and coatings, are subject to weathering and ageing processes and will consequently lead to emissions of ENPs to the surrounding environment over time. Data on measured environmental exposure concentrations are still lacking for ENPs. Until analytical and monitoring techniques for ENPs in environmental matrices become available, modelling tools are the best approach to estimate exposure levels. Furthermore, models can analyze a wide range of potential scenarios and predict possible future trends of urban exposure which cannot be achieved by monitoring. In this study we present a new modelling approach that combines an emission and a fate model for ENPs with high spatial and temporal resolution for an urban environment. The model was applied to the study of titanium dioxide (TiO2) ENP emissions when incorporated in outdoor paints in the city of York (UK). The model emission calculations are based on locally collected data on outdoor paint usage (outdoor paint application ratios and frequency of application for York) and information about the sewage network connectivity around the city. Reliable and official sources of information, such as Yorkshire Water and York City Council, and surface water characteristics acquired from an extensive and local monitoring campaign performed in the rivers Ouse and Foss, helped to parametrize the river fate model. Using the model, the transport and fate of TiO2 ENPs in the rivers circulating within the city (the Ouse and the Foss) could be studied and spatially resolved results obtained. The identification of hot spots of emissions within the city and the study of ENP transport and fate are accomplished by this approach.

TU356
Occurrence and human exposure of parabens, triclosan and triclosan in personal care products from Korea
S. Mok, Hanyang University / Marine Sciences and Convergent Technology; J. Lim, Hanyang University; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science; K. Lee, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

Parabens (p-hydroxybenzoic acid esters), triclosan (TCS) and triclocarban (TCC), have been extensively used in various cosmetics and personal care products (CPPCs) as preservatives due to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC associated with the consumption of CPPCs in our daily life. In this study, ten parabens and their metabolites, TCS and TCC were measured in 243 CPPCs, which comprised of leave-on products (n=157), rinse-off products (n=59) and baby care products (n=31), collected from Korean market during 2016-2017, using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Among ten parabens, methyl paraben (MeP) showed the highest detection rate (57%), followed by propyl paraben (PP, 49%) and butyl paraben (BuP, 41%). TCS had only 20% of detection rate and TCC was rarely detected in the samples. Total concentration of parabens widely varied with ranging from <LOQ to 10200 µg/g. Concentrations of TCS and TCC ranged from <LOQ to 340 ng/g and <LOQ to 14.0 ng/g, respectively. Higher concentrations of parabens (> 1000 µg/g) were found at skin cares, sunscreen, face cleanser, eyeliners, body/hand lotions and lipstick. The daily exposure levels of parabens and TCS were calculated based on the consumption data for CPPCs, exposure factors, obtained from questionnaire-based survey and previous studies, and concentrations measured in our study. The mean daily exposure levels of parabens were 16.2 and 0.14 µg/kg body weight/day for mothers and their infants of Korea, respectively. Among CPPCs, some leave-on products such as skin cares, body/hand lotions, and sunscreens were the major contributors (> 80%) to total exposure levels of total parabens.

TU357
Characteristics of exposure factors for consumer products in Korean infant and caregivers pair
K. Lee, Seoul National University, Graduate School of Public Health; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science

Concerns about potential health risks of chemicals in consumer products like cosmetic, personal care products, food containers are growing. Especially infant and children are more vulnerable to chemical exposure compared to adults. Since exposure to these chemicals could be determined by consumer products usage pattern, an accurate measurement of the usage patterns of consumer products is important for realistic exposure assessment. The aim 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 proportional stratified based on age and sex distribution ratio in children’s sex and age distribution from 0 to 4. All cosmetics investigated in this study were used on a daily basis and usage rates ranged from 52.1% to 98.0%, except 9.9% for hair styling product and 7.7% for deodorant. The frequency of food intake by food containers ranged 2.52 to 17.39 times a month. The use of children's oral supplies varies according to the age of the child. There were a significant difference in the mother’s usage rates of lotion, hair products and vinyl package food by age of children. These exposure factor characteristics could be useful input data for exposure risk and assessment for chemical regulation.

TU358
Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children
N. Bravo, CSIC-IDAEA / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; B. Bocca, G. Calamandrei, A. Alimonti, Istituto Superiore di Sanità

Organophosphate (OP) and pyrethroid (PYR) pesticides are commonly used in agriculture, domestic environments and gardening. They eliminate insects because of their strong potential to disrupt the brain and nervous system of these organisms. Unfortunately, this neurotoxic effect is not selective enough as to avoid potential damage to other non-target species, including humans. OP and PYR pesticide exposure has been related to several human health effects, including respiratory, digestive, productive and neurological problems, among others. Children are more vulnerable than adults to environmental pollutant exposure because their organs and metabolism are still under development. Thus, their detoxification mechanisms are not yet mature. Once in the human body, OP and PYR pesticides are typically metabolized and excreted in urine within 4-48 hours after exposure, depending on the compound. Organophosphates are metabolized into dialkyl phosphates (DAPs) and their metabolites, such as oxon, diethyl phosphorothioate (DEP), 2,4-dichlorophenyl ethyl phosphonate (TCPY, metabolite of chlorpyrifos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-hydroxycoumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pirimidinyl (IMPY, metabolite of diazinon) and 2-dihexylamino-6-methyl pyridin-4-ol (DEAMYP, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxycarbonyl acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxycarbonyl acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as a biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using isotope dilution solid phase extraction (SPE) and liquid chromatography tandem mass spectrometry (LC-MS/MS). Human urine samples (n=199) from Italian children at 7 years were analyzed. Neuropsychological and psychomotor development of the children was assessed at 18-40 months by using the BAYLEY scales. In addition, neuropsychological development and intelligence were assessed at 7 years by using the NEPSY-II and the WISC, respectively. The compounds detected the most were DEAMYP (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMYP with a median of 3.0 ng/mL followed by PNP, 3-PBA and TCPY with medians of 1.3, 0.56 and 0.47 mg/mL, respectively.

TU359
PaH levels in parturient and newborns from Aveiro region, Portugal
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Environmental exposure to humans may be critical in some residential and working environments. Outdoor materials, such as paints, plastics and electronics are major contributors of PAHs. In small urban regions, PAHs atmospheric concentrations could be studied and monitored as they are considered carcinogenic and teratogenic. In the present study we aimed to monitor human fetal exposure to PAHs by measuring concentrations of naphthalene, phenanthrene, pyrene and BaP equivalents in placenta, umbilical cord and mother’s blood (plasma and blood cells) of 49 parturient from Aveiro region, Portugal. Information organized in questionnaire forms, tissues and organs were collected following the
parturient consent. Levels of PAHs equivalents were measured by a fluorescence methodology and were correlated with exposure to tobacco smoke as well as with other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). In general, the studied group presented higher PAHs levels in the placenta and lower PAHs levels in the umbilical cord blood. The low molecular weight PAHs (naphthalene and phenanthrene) measured in placenta presented higher concentration than high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of phenanthrene and phenanthrene equivalents were associated with exposure to vehicle exhaust, while higher levels of benzo[a]pyrene were associated with exposure to tobacco smoke at work. The highest naphthalene, pyrene and BaP equivalents levels were found in homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant differences were found between PAHs levels and anthropometrical data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventative medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity
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The aggregate exposure pathway (AEP) model is a conceptual framework to help align chemical exposure 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 exposures to indoor emissions. Following the same exposure scenario, unit emission rate based whole body concentrations (exposure potential) range from 3×10⁻⁹ to 5×10⁻⁶ mmol/kg. The differences in ranking chemicals for exposure based on either external (intake fraction) or internal (exposure concentration) exposure metrics are substantial due to chemical-specific differences in toxicokinetics. In absence of well-defined chemical use information, the model calculated critical emission rate can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span by 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBOYNI STATE IN SOUTH-EASTERN NIGERIA
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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 Bukkyuym and Anka LGA of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontieres (MSF, Holland) to the health authorities (UNEP/OCHA 2010). The cause of the high mortality was acute and chronic lead poisoning as a result of massive environmental contamination from artisanal mining and processing of gold in Pb-rich ore by poor headsmen and farmers. This outbreak was reported as the worst in modern history (UNEP/OCHA 2010). Open-pit mining of lead in the Ishiaugu 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 Ishiaugu town and environs. Soil, water, grasses/plants, food, fish and quary dust were collected between March and May 2017, processed and analysed 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 Ishiaugu 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
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Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhales fine particles, is a promising indicator of air pollution and urbanization. In fact, it is extensively used as a 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 three studies demonstrated many chemical elements. The soft tissues of P. papillaris (purged of the gut contents) showed the highest Cd, Cu and Zn concentrations at the most trafficked sites. Data from faeces suggested that this species ingests large amounts of inorganic particles scraped from the stone surfaces, as indicated by the very high Al, Cr, Fe, Mn, and Pb concentrations. Most lithophile elements and Pb are scarcely absorbed in the snail digestive tract and soft tissues mainly accumulate Cd and essential elements such as Cu, Zn and Mn. Although the chemical composition of the shells was characterized by low concentrations of all analyzed elements, the samples collected at the most trafficked sites had significantly higher Cu, Fe, and Zn concentrations. This bioaccumulation in P. papillaris shells likely remains after death, potentially providing a historical record of the snail exposure to metals over lifetime.

TU363 A stomatal snail as a new biomonitor of metal contamination in the urban environment
E. Rota, B. Braccini, R. Dei, University of Siena / Department of Physical Sciences, Earth and Environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Department of Physical, Earth and Environmental Sciences; E. Meroni, University of Siena / Department of Physical, Earth and Environmental Sciences; R. Bargagli, University of Siena / Department of Physical, Earth and Environmental Sciences

The aggregate exposure pathway (AEP) model is a conceptual framework to help align chemical exposure 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 exposures to indoor emissions. Following the same exposure scenario, unit emission rate based whole body concentrations (exposure potential) range from 3×10⁻⁹ to 5×10⁻⁶ mmol/kg. The differences in ranking chemicals for exposure based on either external (intake fraction) or internal (exposure concentration) exposure metrics are substantial due to chemical-specific differences in toxicokinetics. In absence of well-defined chemical use information, the model calculated critical emission rate can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span by 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada
M. Dodd, Royal Roads University / School of Environment & Sustainability

This study was conducted to determine heavy metal distribution in surface soils 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 those of 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 primary attributed to the use of lead paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automotive...
repair and old orchards. An interactive map of metal distribution based on the data obtained was developed and made available to the public. Metal bioavailability was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated ED99 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. Leturcq, University of B. Roubaud, Paul buteli, A. Larrivée, Roger Aglyhe Unit
Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomerations and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. We have analyzed the main physicochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban fields was above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies are needed before planning urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU366
Vertical movement of PCBs in agricultural soils impacted by an historical contaminated site: using SoilPlus model to predict discharge, dynamics of movement in soil, and rhizoremediation potential
A. Di Guardi, University of Insubria / Department of Science and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Terzaghi, University of Insubria (Chemical Dep.); F. Di Fabio, University of Milan / DEFENS; F. Mapelli, University of Milan; E. Zanandri, C. Morosini, University of Insubria / DSAT; S. Armiraglio, Municipality of Brescia / Museum of Natural Sciences; V.M. Sale, S. Ameli, P. Nastasio, ERSASF
Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from the activities of the former Caffaro s.p.a., a chemical factory among the largest of former polychlorinated biphenyls (PCBs) producer in Europe, which produced such chemicals for more than 50 years up to mid 80’. About 100 Ha of agricultural areas were contaminated by a mix of Persistent Organic Pollutants (POPs, mostly PCBs, dioxins, furans) and heavy metals (Hg, As) in variable concentrations, often exceeding the standard values. This contamination of runoff irrigation with contaminated waters. PCBs were measured in three different agricultural areas and in three different points per area, in vertical cores up to 1 m depth. The resulting samples were representative of 0-10, 10-20, 20-30, 30-40, 40-60, 60-80, 80-100 cm. The results of concentration measurements with depth (for about 80 PCB congeners) confirmed a general tendency of PCBs to be confined to the first meter of soil. The concentrations on the top of the site were about 100 µg/kg, whereas in the bottom section the PCB 28 ranged from 150 to 250 µg/kg in the top 30 cm to about 0.6 µg/kg at 1 m depth; PCB 209 (peculiar of Caffaro production) ranged from 15000 to 13000 µg/kg in the top 30 cm, descending to about 13 µg/kg at 1 m depth. A gradient was also observed along the runoff water flow direction. These concentrations of PCBs were then compared to those obtained by the SoilPlus model (a layered dynamic multimedia fate and transport model) and used to predict discharge amounts and conditions regulating vertical movement. The objective was to reconstruct soil concentration profile during the historical contamination to predict discharged amount, potential for additional vertical movement, and conditions regulating chemical bioavailability for future PCB rhizoremediation.

TU367
Metals and metalloids in inhalable fractions of urban road dust
C.L. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Rasmussen, Health Canada
Road dusts are highly enriched with trace elements 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, focussing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air sweepers: the bulk hopper debrs and finer dust box samples. The 50th percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 inhalable and 32 bulk samples) were subjected to a 4-acid digestion (HF, HClO4, HNO3 and HCl) followed by multi-element determination using Inductively-Coupled Plasma Mass Spectrometry (ICP-MS). Results showed that the inhalable fractions of road dust were enriched with metals and metalloids relative to the bulk debrs, 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 relative to the city-wide Pb burden in the urban market gardening area. However, the city raises questions about the future management of this last area already cultivated for many years. We have analyzed the main physicochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban fields 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.

TU368
Sequential extraction and particle size distribution of Cd, Cu, Pb and Zn in street dust of Belgrade (Serbia)
T. Djordjevic, Faculty of Chemistry, University of Belgrade; N. Zaric, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Solevic Knudsen, ICHTM / Department for Chemistry
The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb, and Zn in mobile phases extracted from different size-fractions in street dust particles from Belgrade, the Capital of Serbia. The metals investigated were chosen as some of the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractioned into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier at al., 1979): adsorptive and ion-exchangeable phase (using ammonium acetate at pH 4.5), the moderately reducible phase (using a 0.1 M sodium hydroxide solution), and organic sulphide phase (using hydrogen peroxide acidified with nitric acid). These fractions were analysed by inductively coupled plasma optical emission spectrometry (ICP-OES) using an ICP iCap6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the Serbian national Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were higher than the maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bounded mainly in the second phase. Pb and Cd were predominantly associated with the third phase. Pb and Cd were in one sample predominantly associated with the third phase while Cd was in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. References: Regulations about allowed quantities of dangerous and harmful materials in soil and irrigating waters and methods about their analysis. Official Gazette of the Republic of Serbia, No. 23/94 (in Serbian) Sequential extraction procedure for the speciation of particulate trace metals. A. Tessier, P. G. C. Campbell, and M. Bisson. Analytical Chemistry, 1979, 51 (7), pp 844–851

TU369
"New" OPEs: isopropylated, tert-butylated and di-tert-butylated Trithiophene Isomers in E-waste, House, Car and NIST SRM Dust
L. Juntanen, Environment and Climate Change Canada; T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; V.H. Arrandale, Cancer Care Ontario; S. Bernstein, Environment and Climate Change Canada; J.
Measurement of Particle Oxidative Potential of Ambient Water in the Southeastern United States: Contrasts in Sources and Health Associations between Dusts in marine and terrestrial environments are demonstrated. This study used a combination of aerosol mass spectrometry and chemical analyses to identify the sources and chemical composition of PM2.5. The results showed that the aerosol mass spectrometry profiles were consistent with the chemical composition of PM2.5, suggesting that the aerosol mass spectrometry can be a useful tool for identifying the sources and chemical composition of PM2.5.

The scientific world is still quest for understanding the effects of airborne particulate matter (PM) on human health. The recent studies have shown that PM can cause respiratory and cardiovascular diseases, and may even increase the risk of cancer. However, the mechanisms by which PM cause these effects are not fully understood. This study aimed to investigate the effects of PM on the immune system and the inflammatory response.

The results showed that PM can activate the immune system and induce inflammation. The activated immune cells can release pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which are involved in the development of chronic inflammatory diseases. The activated immune cells can also promote the recruitment of neutrophils and macrophages, which are involved in the formation of inflammatory lesions.

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Organisms.

TU374 Joint Annual Meeting of the International Society of Exposure Science and the International Society for Environmental Epidemiology (ISES-ISEE 2018)
M.L. Diamond, University of Toronto / Department of Earth Sciences

Challenges in setting, meeting and measuring specific protection goals for plant protection products (P)

TU375 French Phytopharmacovigilance: a national scheme for monitoring the adverse effects of plant protection products
F. Botta, ANSES / DER; F. Eyemyer, T. Quintaine, M. Hulin, J. Rety, O. Yamada, M. Merlo, ANSES

Phytopharmacovigilance is the latest complement to ANSES’s existing missions concerning the assessment of the risks associated with plant protection products before marketing, and the issuing and withdrawal of marketing authorizations. It is also fully in line with the third component of the Ecophyto plan. This national plan, established for the first time in 2008, was recently renewed. It aims to reduce pesticide uses in accordance with the requirements of Directive 2009/128, establishing a framework for Community action to achieve the sustainable use of pesticides. A specific scheme for funding these studies is planned through a tax on sales of plant protection products payable by the marketing authorisation holders. To meet this objective, phytopharmacovigilance relies on three fundamental and complementary methods of data collection and knowledge production: a network of surveillance or vigilance bodies, collection of spontaneous reports and ad hoc studies on the adverse effects of plant protection products. These studies are financed by NPAs to report three different needs: 1) to collect 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 Modelling Aluminium Bioavailability and Toxicity to Aquatic Organisms
W.J. Adams, Red Cap Consulting; P. Rodriguez, PHR Consulting; B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; D.K. DeForest, Windward Environmental LLC; R. Genser, GEI Consultants / Ecological Division; E. Nordheim, European Aluminium Association (EAA)

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 Al concentration, and pH. Due to its complex environmental chemistry, measurement of the “toxic” form of Al in natural waters cannot be performed using the conventional “total” or “dissolved” analytical approaches. Studies have recently been completed which allows 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/groupworkinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic impacts of the effects of chemicals and other stressors from impacts on individual organisms to the delivery of ecosystem services [3]. The first case study applies an individual-based model (IBM) [4] to quantify impacts of potential endocrine disrupting chemicals on services provided by trout populations in a mountain stream in Colorado, USA. The second case study uses an aquatic ecosystem model [5] to evaluate impacts of an insecticide on multiple ecosystem services delivered by a lake ecosystem, modified to represent a reservoir in Iowa, USA. The first case study is an example where managing for provision of the service GCT population provides will differ depending on the level of E2 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 differently 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 fruiteel; F.M. Bakker, Eurofins-Mito
tox

Sulphur is a key fungicide of 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 objectives 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 an small and minor role of 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)
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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 methodological tools included, derived from means of operation, the coexistence, modelling and monitoring, and the selection of the 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 interactions across more than one scale of analysis caused by natural and anthropogenic factors, a systems approach is required. The systems approach allows the integration of the various species, environmental factors, scales, and stressor-relaxed 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’s Scientific Committee. Recovery in environmental risk assessments at EFSA. EFSA Journal 2016: 14(2):4313. 85 pp

TU380 Habitat Equivalency Analysis for a Restoration Resilience Model of the Rio Doce Basin
P.N. Booth, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomez, R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ

A Resilience Model was prepared to support environmental, economic, and social restoration of the Rio Doce Basin after the Fundão Dam failure in Mariana, Minas Gerais State, Brazil. A Habitat Equivalency Analysis (HEA) was applied to quantify lost ecosystem services resulting from the disaster and was intended as a means of maintaining ecological habitat functions of the river. The HEA is being refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services that should drive the resilience restoration goals for each reach of the Rio Doce River. HEA is a well-accepted spatially and temporally explicit method for integrating multiple complex and difficult to measure environmental variables into a few metrics to determine overall losses and gains in ecosystem services resulting from impacts or restoration actions. The HEA method is adaptable to any ecosystem and its flexibility allows for variability in the valuation of ecosystem services between communities and cultures. This paper focuses on the development and application of HEA within the context of the Resilience Model, and how selection of VECs as indicators to guide the restoration process, and local scale of restoration is aimed at developing an overall ecosystem restoration program that is at once cost-effective and results in a more resilient Rio Doce Basin.

TU381 Using recovery and information in environmental cost-benefit analysis for determining appropriate risk management actions at major industrial facilities
A.E. Bartram, Ramboll Environ / Product Safety, Ecology and Sediment Management; S. Decar, Ramboll Environ & Health Limited

Operators of chemical manufacturing plants and fuel storage depots are required to undertake site safety assessments, with specific emphasis on the control of major hazards and the management of site emergency plans. SEVESO (substances exposed to severe accident scenarios) facilities 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 site-specific conditions and types of receptors. 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 that 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 level of investment that would provide the greatest possible damage avoided. The method incorporates site-specific baseline ecology, other receptors and ecosystem services provided to society. The poster will also reflect upon lessons learned by both regulators and industry in the method development. References: Energy Institute (2017). Guide to predicting environmental recovery durations from major accidents. Supporting guide to the Environmental risk tolerability for COMAH establishments guidance

TU382 Addressing Resilience in Ecosystem Services Assessment
K. Mordvintsev, Ramboll E&H / Ecological Services; R. Wenning, Ramboll Environ / Ecology & Sediment Management; B. Bizzotto, Ramboll E&H / Ecological Services; R. Wenning, Ramboll E&H

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 and ecosystems caused by natural and human-caused disasters. Associated with this challenge is the added complication of shifting baselines in the context of climate change, which generates considerable uncertainties for projecting future recovery of services. The second challenge relates to the establishing the relative values of different ecosystem services, and associated changes to projected value and utility in society in the future. The third challenge is the limited ability of current ecosystem models to provide defensible projections of the complex and intertwined social-ecological relationships defining a future sustainable flow of goods and services.

TU383 Use of cost modelling techniques to manage environmental subsurface risks, liabilities and uncertainties in Spain
P. Wouters, M. Ferrera, I. Harper, Ramboll Environ / Environment and Health; R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ

Companies owning large portfolios of properties are often faced with a high degree of uncertainty in relation to the subsurface conditions of their sites. This makes it difficult, if not almost impossible, to develop and implement 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 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 Excel. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle®’s Crystal Ball® add-on to Excel was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsoil investigation being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that might be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately-high risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventive maintenance to those sites which could give rise to the highest financial and reputational liabilities.

TU384 Quality stakeholder involvement for resilience in environmental risk
This study measures the indoor particulate matter (PM) in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM$_{10}$ samples and indirectly coupled plasma mass spectrometry was used to determine the concentration of heavy metals. The concentration of indoor radon was measured using a radon detector model DOSEman PRO. The potential human health damage due to the inhalation of radon is a major concern. The equilibrium equivalent radon (EEC$_{10}$) concentration in two university buildings was determined based on the US EPA standard. The equilibrium factor and the annual effective dose on the lung cancer risks of each occupant were calculated and a correlation of the radon concentration was made with the annual inhalation dose of the occupants at the university stations. The results showed PM$_{2.5}$ concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 µg m$^{-3}$ and 23.4 to 159 µg m$^{-3}$, respectively. In Building 1 and 2, the annual inhalation doses were 0.014 ± 0.005 mSv y$^{-1}$ and 0.020 ± 0.013 mSv y$^{-1}$, respectively. For trace metals, the ECLR and HQ values were found to exceed the permissible limits suggested by US EPA. However, the values of equilibrium equivalent radon concentration were still below the standard recommended by ICRP.

TU388

Paradigm for PM$_{2.5}$ Chemical and Biological Characterization: Paired Home and Personal PM$_{2.5}$ Samples in Kheri, India

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The global public health impact from household fine particulate matter (PM$_{2.5}$) is extremely large however, there is a limited understanding of health effects associated with specific PM$_{2.5}$ chemical constituents as well as the underlying mechanisms of these adverse health effects. These research gaps can be addressed through use of a high-throughput screening platform to quickly gain biological response data. A subset of homes in Kheri, India that participated in the Prospective Urban and Rural Epidemiologic Study (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM$_{2.5}$. In 6 households, personal air monitors collecting PM$_{2.5}$ were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM$_{2.5}$ filters for each household. PM$_{2.5}$ was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM$_{2.5}$ samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM$_{2.5}$ from DMSO extraction was prepared for developmental toxicity testing performed in zebrafish (n=32/treatment) starting at 6 hours post fertilization (hpf). Aliquots of the pooled samples were used for chemical analysis (polycyclic aromatic hydrocarbons (PAHs, n=20), elements (n=20)) and oxidative potential assessment with methods identified those used for development. Significant differences were noted in oxidative potential between personal and home PM$_{2.5}$ for both individual and pooled samples. Significant mortality in zebrafish was observed starting at 24 hpf in personal PM$_{2.5}$ samples and by 120 hpf in home PM$_{2.5}$ compared to blank filter controls. Chemical analysis is underway to allow for correlations to be investigated between these biological responses and chemical constituents. This research is the first study to use paired home and personal PM$_{2.5}$ samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM$_{2.5}$. Importantly, it outlines procedures for large-scale analysis of the PURE-AIR study which includes planned PM$_{2.5}$ measurements in 4,000 homes and will ultimately allow for correlation of human health effects with chemical and biological data to identify improved health metrics for PM$_{2.5}$ exposures.

TU389

Toxicity of airborne particulate matter as a factor to choose the most convenient school

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One of the critical decisions parents have to face is choosing a good school for their kids. Proximity, high ratio of teachers to students, and access to convenient 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, toxicity of PM$_{2.5}$ on lung cells has been widely studied. However, most of the publications on this topic are focused on studying PM$_{2.5}$ effects on human alveolar cells for short periods of time after applying doses far higher than environmental levels. To surpass this gap, we conducted a representative study. On it, we collected two fractions of fine PM (PM$_{10}$ and PM$_{2.5}$) in 10 classrooms of 10 schools located under the influence of three different environments: urban, petrochemical, and chemical. Subsequently, we exposed human alveolar epithelial cells (AS49) to IC$_{50}$ doses obtained from a previous study. Then, apoptosis and release of 17 cytokines from the cells was studied after five different exposure times: 0, 6, 24, 48, and 72 hours. Preliminary results showed no differences in cytokines released for 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 school managers and parents.

TU390

Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Visits

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Abstract: The purpose of this study was to assess the effects of extremely high air temperatures on hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using health and climatic data from 2000 to 2010 in Taiwan. A national health insurance database, temperature database, and air quality surveillance database were used for this study. Relative risks (RRs) for increases in emergency room (ER) visits were estimated for alcohol addiction and other mental illnesses after exposure to extremely hot temperatures (99th percentile) and the 99th percentile of the daily mean temperature as reference. Poisson regression models using a distributed lag non-linear model (DLNM) were used. We adjusted for the effects of humidity and outdoor air pollutants. We found an association between alcohol addiction and other mental illnesses and mean daily temperature at 23.67°C on ER visits. The association was strongest within 0–7 days after exposure to hot temperatures. Increases (RR 1.02, 95% CI 1.01–1.04) in major depressive disorder (MDD) ER visits was observed over a cumulative period of 7 days after exposure to high ambient temperature (99th percentile vs. 50th percentile). The opposite association was reported for alcohol addiction (RR 0.99, 95% CI 0.98–0.99). No significant associations with anxiety, dementia, and delirium were estimated. Our findings suggest that extreme temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU391

Characteristics of Polybrominated Diphenyl Ethers Released from Primitive E-Waste Treatment

Li, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment

Abstract: 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 substances (by volatilization and pyrolysis) and the upper limit of emission factors (UL = RL -6.14 × 10$^{-3}$ g$^{-1}$ 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 affiliated with fine particles, with geometric mean diameters at 0.61–0.83 µm in thermal degradation and 0.57–1.16 µm in open burning from plastic 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 evaporation and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implicated a noteworthy redisposition process during atmospheric dispersal.

TU392

How risky is the schoolyard? An approach from chemical composition of particulate matter

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According to last estimations, there are globally around 6.5 million deaths as a consequence of exposure to air pollutants. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers TSI 8970-DV, Tisch) and inside the classroom (low volume Siotas 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 tend to have higher shares of carbonaceous materials. Our results will be useful not only to school 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

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Abstract: One of the main consequences of exposition to air pollutants 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; 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 in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers TSI 8970-DV, Tisch) and inside the classroom (low volume Siotas 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 tend to have higher shares of carbonaceous materials. Our results will be useful not only to school managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.

TU394

Occupational Cement Dust Exposure: effect on blood level of some antioxidant enzymes and vitamins in Owerri, Nigeria

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ABSTRACT: Despite that cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among Cement workers, especially in cement factories in Nigeria. The effect of some antioxidant enzymes and vitamins has not been adequately addressed specifically in black-African environment since Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and Controls (non-cement workers) were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELISA while antioxidant vitamins such as vitamin E and vitamin C were determined by spectrophotometric techniques. There were progressive significant increases in blood level of vitamin C, vitamin E, catalase and glutathione peroxidase from Cement Workers to Dealers and Controls (non-cement workers), (P=0.0010, P=0.0011, P=0.0006 and P=0.0010, respectively).
There were significant decreases in blood levels of vitamin C, vitamin E, glutathione peroxidase and catalase (P=0.002, P=0.004, 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=0.0001), Vitamin E (P=0.0058, P=0.256 and P=0.13) respectively, but there was a positive significant correlation of catalase with SOD (r=0.4173). This study suggest that Exposure to cement Dust may lead to reduction in blood levels of vitamin C, Vitamin E, Catalase, Glutathione Peroxidase, and SOD in Cement workers/Dealers. The observed reduction/decreases in the antioxidants were progressive from control to Cement Dealers and to cement Workers. Key words; Cement dust, antioxidant, enzymes, vitamins.

**TU395**

Implementing NH3 mitigation strategies in a pig farm: different approaches to evaluate the environmental impact.

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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 (PM2.5,3) 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. Both a main source of ammonia emissions, the agro-zoootechnical 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 silo exhausters and pig exhausters. In the EU, available Technologies Reference document for the Intensive Rearing of Poultry and Pigs. Different strategies can be applied to determine the effectiveness of mitigation options: the SHERPAPI model or other approaches like Life Cycle Assessment can indicate the environmental benefits achievable with the different scenarios analyzed. Although techniques may be implemented and managed separately, they produce synergistic effect on the farm’s environmental performance. In all integrated emissions of NH3 from pig farming will lead to a higher amount of nitrogen in the manure and to the amount that potentially be emitted to air as NH during the downstream process of manure storing and spreading. The reduction of NH3 emission from pig farming management steps can have a positive effect in NH3-related impact categories, such as PM formation, teratogenic-acidification and eutropification.

**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. Liu, Jinan University; L. Bao, E.Y. Zeng. Jinan University / School of Environment

Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study develops an in vitro method to estimate the inhalation bioaccessibility of particle-bound hydrophobic organic compounds using lung fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmitoyl-sn-glycero-3-phosphocholine with Texan as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results have shown that the bioaccessibilities of individual PAH compounds increased with the increasing incubation time and reached the steady state within 10 days. None of significant difference was found for the individual PAH bioaccessibilities between with and without adding glass microfiber membrane into the incubation system. Furthermore, the PAHs absolute recoveries, calculated by sum of PAHs masses in Tenax, artificial lung fluid, and residual particle dividing the initial masses, were from 92% to 112% in ALF and 75% to 99% in Gamble’s solution, suggesting that this developed in vitro method could be well appropriate to evaluate the inhalation bioaccessibility to particulate hydrophobic organics matter. In addition, the PAHs bioaccessibilities were found to increase with particle size, but decrease with the increasing hydrophobicity. It is noteworthy that via the human lung parenchyma, the bioaccessibility of particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

**TU397**

Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixture toxicity.

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Air pollutants are no longer considered to be toxic only upon oral or dermal exposure, but now via inhalation. Although inhalation is considered a minor route for chemical exposure, the inhalation exposure is of high relevance since inhaled pollutants are distributed to many targets and metabolized into toxic products. Air pollutants are mixtures composed of hundreds of 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 major 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 particulate matter (PM10, coarse particulate phase, and fine PM2.5 size fractions) were sampled. Moreover, samples were also fractionated according to polarity. Human-based in vitro bioassays were employed to study endocrine-disruptive potentials. AhR-mediated induction of detoxification mechanisms, and cyto-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-polyyclic aromatic hydrocarbons (oxy-PAHs). This study confirms that several molecular mechanisms of toxicity may be active in complex mixtures and highlights the complexity of pollutant mixtures. For further understanding, the results will be discussed together with the results of the chemical analysis which focused on PAHs and their derivatives, nitro- and oxy-PAHs. This research was supported by project GACR 503 16-115378.

**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 epidemiologic dose-response data to assess contribution risks of air pollutant-associated TB incidences in Taiwan regions. The contribution concept was quantified by using the population-attributable fraction (PAF). The air pollution-PAF relationships were assessed by employing a three-parameter Hill model based on hazard ratio data of TB exposed to air pollutants. The contribution of air pollution exposure to TB was evaluated by applying multiplications of PAF likelihood and TB incidence rates. RESULTS: Both under severe and moderate scenarios, the results revealed that the most likely air pollutants significantly contributing to TB incidences were carbon monoxide (CO) and nitrogen dioxide (NO2) in regions of Taiwan. Additionally, the 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. Inhalation of contaminated air and airborne particles is definitely the main route of exposure to the most important pollutants, secondary only to the diet. Several respiratory and cardiovascular diseases are associated with air pollution. Air pollution is responsible for 400,000 deaths per year in EU28. In 2013 outdoor air pollution was classified as carcinogenic to man (Group 1) by the International Agency for Research on Cancer, with a special attention to airborne dusts. In addition, powders can alter aquatic and terrestrial ecosystems when they reach the surface waters and soils as a result of transport and deposition events. Road transport and traffic contributes greatly to emissions of PM2.5 and PM10 and an important contribution to the non-exhaustive emission is due to the wear of brakes. The European Life+ COBRA (LIFE13 ENVIT000492) project aims to create a safer alternative to the pads currently on the market, replacing the phenolic binder with a new cementitious hydraulic binder. The study here presented evaluated the eco- and toxicological potential of particulate matters generated in laboratory conditions using test benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-transformed 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 particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

Source apportionment study of PM10 and PM2.5 using selective wind direction sampling technique in the area of Civitavecchia (Italy)

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The concentrations of air particulate matter (PM) and their attribution to specific sources through the source apportionment methodologies is an important research topic in air quality study; in fact, the possibility to discriminate between different emission sources and between natural and anthropogenic contribution is a key issue for planning efficient air pollution reduction and mitigation strategies. Moreover, the knowledge of the chemical composition of PM for the different size fractions is recognized as increasingly important, in particular with respect to health effects of exposed population. The aim of the study is the characterization of PM10 and PM2.5 main sources located in the Civitavecchia harbour-industrial area (Central Italy), namely a large coal-fired power plant, a natural gas power plant, the harbour area, the vehicular traffic (due to both the local traffic and the highway crossing the area) and small industrial activities located in the town. To this purpose, the approach based on the use of PM samplers coupled with a wind-select sensor, allowing a selective PM10 and PM2.5 sampling downwind to specific emission sources, has been used. Furthermore, the chemical characterization of the PM collected has been carried out in order to explain specific emission patterns, and to assess the concentration levels of the micro-pollutants emitted by local sources and particularly toxic for health. Two sampling sites have been identified in the area, respectively urban and urban background site, equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic species. A descriptive statistic analysis of data was performed, also verifying the occurrence of legislative threshold exceedances. Moreover, in order to highlight the contribution of specific sources, the differences in the measured micro pollutants concentrations between wind directions, PM size factions and sampling sites have been investigated, as well as the seasonal trends of pollutants concentrations. These results allow to highlight that the applied methodology represents a valid support in source apportionment studies. Keywords: source apportionment, wind select-sampling device, PM10, PM2.5

Forecasting global atmospheric visibility based on air quality and meteorological data

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Simultaneous and continuous measurements of visibility, meteorological parameters, including relative humidity, and the concentrations of six atmospheric pollutants (PM2.5, PM10, SO2, NO2, CO and O3) were obtained for several cites around the globe. The characteristics of visibility and relationships with air pollutants and meteorological factors were investigated using multiple statistical methods. Analysis demonstrated that within a certain relative humidity range, visibility is the exponential function of the PM10 concentration. Thus, non-linear models combining multiple linear regressions with exponential regression were subsequently developed to describe the hygroscopic growth and the attenuation effect of the air pollution. The derived models can quantitatively describe the relationships between visibility, air quality and meteorological parameters around the whole globe.

Analyzing the Asian supply chain structure of health impacts with PM2.5 including secondary particle

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Countries and regions in Asia have played an important role in producing intermediate products and final commodities today and supplied their products around the world. Productions and consumptions of goods and services in the Asian countries have clearly contributed to the economic growth in the world, whereas those economic activities brought about environmental loads. Particularly, China’s emissions of air pollutants such as fine particulate matter (PM$_{2.5}$) have caused severe environmental and health harm. The large-scale industrial and research manufacturing of different products, the health impacts associated with the PM$_{2.5}$ through the Asian supply chains have been estimated in the previous researches. While these analyses showed what production activities induced these health hazards caused by “primary” PM$_{2.5}$, almost of these results doesn’t include the effects of “secondary” PM$_{2.5}$. This study developed the secondary PM$_{2.5}$ concentrations emitted on every industrial activities using Emission Sources Database for Global Atmospheric Research (EDGAR) emission inventory data, Weather Research and Forecasting (WRF) model and CMAQ modeling system, and then estimates the induced mortality data in Asia. We further applied structural path analysis (SPA) to the Asian International Input-Output Table (AIIOIT) to clarify the critical supply chains for the reduction of health impacts in Asia. The result shows that the Japan’s consumption contributed to the secondary PM$_{2.5}$ emissions in Asian are estimated 815 t.C and we revealed top ranking supply-chain paths for PM$_{2.5}$ emissions induced by Japan’s final demand. The most significant supply-chain path with the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand --> food crops sector in Thailand --> Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollution 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 objective of this work is to fill the lack of knowledge about the impact of emissions resulting from the marine compartment. It includes natural emissions such as sea salts [1] and anthropogenic emissions linked to the marine traffic especially in the English Channel, that forms a narrow corridor with one of the greatest concentrations of shipping in the world (up to 800 vessels sailing per day). PM$_{10}$ sampling and measurement campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM$_{10}$ levels were measured using MP101 analyzer (Environment SA®) and collected using the DAB0 sampler (Digitel®, 30 m$^3$/h) on a daily basis. The characterization of PM$_{10}$ was performed considering major and trace elements, water-soluble ions, EC/OC as well as tracers of biomass burning (levoglucosan), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanethiol, fumaral, heticoulfines). These chemical parameters were used to explain PM$_{10}$ levels on the coastal site, identify PM$_{10}$ sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (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 PM$_{10}$ 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 PM$_{10}$ limits values.

TU406 Source-to-exposure assessment of industrial pollutants in Australia, using the Pangea multi-scale framework

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Effective planning of airshed pollution mitigation is often constrained by a lack of integrative analysis ability to relate the relevant emitters to the receptor populations at risk. Both emitter and receptor perspectives are therefore needed to consistently inform emission and exposure reduction measures. This presentation aims to extend the Pangea spatial multi-scale multimedia framework to evaluate source-to-receptor relationships of industrial sources of organic pollutants in Australia. Pangea solves a large compartmental system in parallel by block to determine arrays of masses at steady-state for 100,000+ compartments and 4,000+ supply chains, and further computes population health exposure by inhalation and ingestion. From an emitter perspective, the spatial distribution of population sources 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 different marine source locations and 40,000+ shipping in the world (up to 800 vessels sailing per day). PM$_{10}$ concentrations were measured using MP101 analyzer (Environment SA®) and collected using the DAB0 sampler (Digitel®, 30 m$^3$/h) on a daily basis. The characterization of PM$_{10}$ was performed considering major and trace elements, water-soluble ions, EC/OC as well as tracers of biomass burning (levoglucosan), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanethiol, fumaral, heticoulfines). These chemical parameters were used to explain PM$_{10}$ levels on the coastal site, identify PM$_{10}$ sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (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 PM$_{10}$ 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 PM$_{10}$ limits values.
Geochemistry; J. Mueller, C. Paxman, X. Wang, The University of Queensland / Queensland Alliance for Environmental Health Sciences

Polyurethane foam passive air sampler (PUF-PAS) are the most commonly used passive air sampler for a range of semivolatile organic compounds (SVOCs) such as regulated persistent organic pollutants and polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are used in global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use simple double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for specificity and trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variabilty in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sampler configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU409 Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin - μFT-IR Imaging Quantification

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Extensive research has been performed on indoor air quality (IAQ) over the last decade. This includes investigating the properties of microplastics in indoor air and on surfaces, as well as determining particle types and sizes. However, microplastic research in indoor air has been lagging behind. With the strides in microplastic research in the last years renewed interest has now arisen on microplastics as a form of indoor air pollution. This research focusses on microplastics in indoor air, with emphasis on the potential exposure to humans as a result of inhalation. This is simulated on a mannequin breathing chamber. The mannequin takes in air through the mouth, which is led through a copper pipe to the filtering unit. The copper pipe meets a filter holder on which a 0.8 µm cut 20 mm SteriTech silver membrane filter appropriate for μFT-IR imaging analysis is mounted. This is connected to a dual piston pump which simulates natural breathing. Samples have been taken in actively lived in apartments, as well as in the Universities’ work environment. Samples have been divided up into continuous sampling and intermittent sampling under active living/working conditions. All samples have received active sampling for approximately 24 h, either continuous or intermittent collection. In each environment a catalogue and accompanying material for spectral identification is kept of the interior. The aim of the research is to ascertain the contribution of materials from the indoor environment as a function of activity, and to determine possible exposures as well as contamination levels coming from indoor air. For identification and quantification of microplastics contained in the samples, an Agilent Technologies micro-Fourier Transform Infrared (μFT-IR) imaging system equipped with a 128x128 Mercury Cadmium Telluride (MCT) Focal Plane Array (FPA) is used. Samples are directly scanned on the double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. While the majority of PUF-PAS use simple double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for specificity and trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variabilty in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sampler configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU411 Determination of Cross Compartment Concentration Gradients of Polycyclic Aromatic Hydrocarbons using PE Passive Samplers

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Several polycyclic aromatic hydrocarbons (PAHs) are considered as human carcinogens or toxic to reproduction, and are thus a relevant class of “substances of very high concern” according to the European Chemicals Legislation REACH. Emission of PAHs to the atmosphere is mainly due to the combustion of fossil fuels. Due to the hydrophobic behaviour of these compounds a significant accumulation within soils has been observed. Recently decreasing atmospheric concentrations could trigger a change of equilibrium conditions between soil and atmosphere. This illustrates the main objective of the study: The determination of the actual flux direction of PAHs across the soil-atmosphere interface. Polyurethane foam passive air samplers have been used to determine sensor concentration gradients of the 16 EPA PAHs at this interface as well as the respective flux direction. Atmospheric monitoring have been conducted seasonally for two subsequent years using 80 µm thick PE sheets at three rural sites. During the second year an additional height has been implemented as well as active sampling. Soil samples were taken at each location at several intervals up to 50 cm depth and equipped in situ with 30 µm thick PE sheets. A numerical approach, based on the double film diffusion model, was applied to the experimental data in order to deduce the atmospheric concentration over time. Seasonal deployments illustrate significant variations with 10 fold higher PAH concentrations in the atmosphere during winter compared to summer monitoring. Concentrations within the soil depicted homogenous profiles, considering PE as representative PAH concentrations in the soil were in the range of 100 ng/g PE after equilibration. In contrast concentrations on the PE in the atmosphere vary between 70 ng/g during summer and 1200 ng/g during winter monitoring. This explicit difference between soil and atmosphere during colder months indicates a main flux direction into the soil.

TU412 Evaluating Computational and Structural Approaches to Predict Transformation Products of Atmospheric Polycyclic Aromatic Hydrocarbons

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Polyaromatic hydrocarbons (PAHs) undergo transformation reactions with atmospheric photochemical oxidants, such as hydroxyl radicals (OH*), nitrogen oxides (NOx), and ozone (O3). The most common PAH-transformation products (PAH-TPs) are nitro-, oxygenated-, and hydroxylated-PAHs (NPAHS, OPAHS, and HOPAHS, respectively), some of which are known to pose potential human health concerns. We sampled four approaches for predicting the location of reactive sites on PAHS (i.e., the carbon where atmospheric oxidants attack), and hence the chemoselectivity of the PAH-TPs. The four approaches are: 1) Clar’s prediction of...
Kekulé resonance structures, 2) thermodynamic stability of all possible OH-PAH adduct intermediate, 3) electron density at each carbon on the PAH and 4) average local ionization energy (ALIE) at atom or bond sites. To evaluate the accuracy of these approaches, the predicted PAH-TPs were compared to published laboratory observations of major NPAH, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clár’s resonance structures were able to best predict the alkyl substituents of the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches provided a lack of 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 unreported PAH-TPs that are likely to form in the atmosphere. Furthermore, the results suggest 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. Arevelo, Instituto Federal do Rio Grande do Sul; K.S. Miglioranza, University of the Andes; M. Del Plata/La Plata State University 680 GC-MS). The following PAHs were analyzed: naphthalene, 2-methyl-naphthalene, 1-methyl-naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(ah)anthracene and benzo(ghi)perylene. Results, reported a prediction to screen for PAH TPs that are likely to form in the atmosphere. Furthermore, the results suggest 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.

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 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 significantly 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 roots and top for mane and tail. A significant correlation between age of hair and concentration of TBARS was noticed. Although further research is needed, a concentration of TBARS in horse hair could serve as a simple and inexpensive method for monitoring air pollution by oil industry.

TU417 Morbidity for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates.
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Background. La Spezia Province, northwest Italy, is a potentially high risk area because of the intensive presence of industrial and harbor activities. Only controversial evi

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)

**TU418**

Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut pudding (Okpaka) Samples prepared using Alternative Cooking Materials

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Polyethylene 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 pudding (Okpaka) a well-cherished food, especially among the inhabitants of the Eastern part of Nigeria may pose more danger than envisaged. The use of banana leaves in cooking food has been in existence in Nigeria before the introduction of the technological cooking materials such as polyethylene, cellophane plastic, tin and foil. In this study, we evaluated the risk assessment of polyethylene residues (volatile organic compounds - VOCs) and organoleptic attributes of Bambara nut pudding (Okpaka) samples prepared using alternative cooking materials. Purge and trap method using Gas Chromatography and Mass Spectrometry instrument were used to estimate the concentrations of VOCs in the different pudding cooked using some alternative cooking material (cellophane, tin, foil and plastic) while banana leaves were used as control. Organoleptic evaluation was done using A-Poin 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, Buteninonitride, 2-Butenal, Thirane,Nonanoic acid, Ethylenediamine, Furfural, Hydrogen azide, 2-pentene, Formic acid, and acetic acid; with Acetic acid occurring the most and Argon, Allene, and Difluormethane occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohexulose, 45% hexanoic acid, 25% propane-1- ethylthiol and had other VOCs ranged from 4-9%. All the cooking materials had hexanoic acid at high concentrations of 25-42%. The result also showed that acetic acid and 2-butenenitrile ranged from 4-7% in all samples except Banana leaves pudding. Organoleptic evaluation of the Bambara pudding samples with different alternative cooking materials were generally acceptable (p<0.05) but pudding wrapped with banana leaf was significantly (p<0.05) rated low for colour and taste while others were comparable (p>0.05). In conclusion, bambara nut pudding cooked with alternative cooking materials contained polythene residues

**TU421**

SETAC Human Health Risk Assessment Interest Group

B. Mulhem, Ensafe Inc.

Eco- risk assessment of conazole fungicides in arable soils of the Czech Republic

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The objective of the present study was to investigate 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 20% of soils, respectively). Most CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by flusilazole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CF fungicides are of environmental concern because they exceeded risk based thresholds, tend to form long-termed residues in soil and rank among suspected carcinogens and endocrine disruptors. [1] EU pesticide database: ec.europa.eu/food/plant/pesticides/eu-pesticidest database. [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 combined sampling techniques to provide a more complete assessment of fungicide exposure in vineyard catchments.

TU423
Assessment of secondary exposure to fungicide residues in fruit-growing workers
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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 characterize external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, we assessed the doses of Korean victims which were exposed in several apple handling, situated in south-west of France. Dislodgable foliar residues (DFR) and pesticide residues on equipments or apples (wipe sampling) were studied during the different activities of apple growing (treatments, re-entry tasks, harvests). Atmospheric levels of pesticides (outdoor and indoor) were also determined using passive samplers (Polyurethane Foams, PUF) and low-volume sampling (cv. in this study). This study was mainly focused on two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry (NRGC-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
Intra-tracheal administration of the disinfectant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model to evaluate a causal association with death
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GC-MS, GC-OC-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.

Objectives: The deaths of Korean victims who were exposed to the disinfectant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model to evaluate a causal association with death

Methods: Groups of experimental and control C57BL/6 mice were instilled in the trachea with 25 μL of 100 mg/mL of chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), using a visual instillation dot. CMIT/MIT was instilled over a period of 3 days and 8 weeks, respectively, to achieve acute and chronic exposure. A threshold dose-response model was applied for estimating the threshold level as one line of evidence for a causal association between CMIT/MIT and death. Results: An acute exposure of 1.2 mg/kg/day of CMIT/MIT was estimated to reflect the threshold for death. The dose-response curve with this threshold showed a very steep slope and a narrow range of CMIT/MIT exposures. A narrow range of CMIT/MIT exposures, in particular, indicated an evident boundary between survival and death, thus implicating a strong causal association. A similar threshold dose-response relationship observed following acute exposure was also seen following chronic exposure to CMIT/MIT. Airborne disinfectant exposure was visible as minimal or mild lung damage with no fibrosis, as shown by histopathological tests. However, many observations are considered to be functional respiratory tract, as observed in necropsies of the mice that died due to CMIT/MIT exposures. Conclusions: There are two strong lines of evidence for a causal association between death and CMIT/MIT exposure: 1) the threshold dose-response curve, with a very steep slope and a narrow range of CMIT/MIT exposures showing a visible boundary between survival and death, and 2) functional respiratory tract failure except lung fibrosis. Thus it is concluded that CMIT/MIT exposure would cause the death without lung fibrosis.

TU425
Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione

The use of fungicides represents one of the most important factors in the control of pests, 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 as a marker of oxidative damage, the equivalent content of glutathione (GSH), the activity of antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) and from detoxifying enzyme GSH-S-transferase (GST), in 3 concentrations of Iprodione (1.5, 7 and 25 μg/ml). The cell division index, the replication index, the frequency of chromosomal aberrations and micronuclei were also determined in the presence of 7.5, 17.5 and 25 μg/ml of Iprodione. The cells were cultured for 48 hours in serum-free 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 (7.5x10^6 cells) and for genotoxicity parameters in agarose plates. From the MTT assays, the LC50 was determined (29.88 (25.98-34.37) μg/ml of Iprodione), while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces tripalp and micronuclear divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

TU426
Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations
T. Campani, I. Calaini, C. Pozzuoli, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Cusini, University of Siena / Science E. The cells were cultured for 48 hours in serum-free 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 (7.5x10^6 cells) and for genotoxicity parameters in agarose plates. From the MTT assays, the LC50 was determined (29.88 (25.98-34.37) μg/ml of Iprodione), while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces tripalp and micronuclear divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

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TU427
Potential Salinity Enhanced Impacts of the Phototoxicity of the Fungicides to Inland Silversid, Menidia beryllina
329
SETAC Europe 28th Annual Meeting Abstract Book
soil. The evaluations were done using a database of high quality sorption specifically needs to be evaluated. We therefore evaluated a range of multitudinous soils. However, these models are typically based on training sets containing a can become charged. Speciation can alter the fate and behaviour of a chemical in the intrinsic rate of natural increase \( (r) \) and 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 cholinesterasease 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

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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 recognized within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of ionisable chemicals in soils. However, these models are typically based on training sets containing a multitude of organic chemicals and their ability to predict ionisable pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches, that take into account sorbent properties (i.e. soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of ionisable chemicals (i.e. cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anionic pharmaceuticals still performed poorly \((r < 0.5)\). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values while prediction was considerably worse for ionisable organic matter and to clay minerals. As sorption of neutral and anionic compounds were not well explained by the evaluated models, further model development was required for adequate prediction of soil sorption coefficients for these classes of molecule. A decision tree framework to guide the selection of appropriate sorption models by taking into account soil pH and ionisable functional groups has been created. This incorporates previously published models that performed well in our analysis and the development of new sorption models. Work is currently on-going to review sludge sorption models and will be presented. The authors acknowledge EU/EFPIA Innovative Medicines Initiative Joint Undertaking (iPIE grant n° 115735) for the financial support.

WE002 Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change

D. Vione, M. Minella, C. Minerco, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play a major role in water quality, in particular in the case of a wide range of pharmaceuticals (APIs) and other xenobiotics (i.e. persistent organic pollutants). Sunlight illumination of surface waters induces several photochemical reactions that play a major role in water quality, in particular in the case of a wide range of pharmaceuticals (APIs) and other xenobiotics (i.e. persistent organic pollutants). Many companies producing APIs can enter the environment due to insufficient treatment or improper disposal practices, the BBN region remains prone to antibiotic pollution. Many companies producing APIs can enter the environment due to insufficient treatment or improper disposal practices, the BBN region remains prone to antibiotic pollution. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrite) to produce several specific phototransformation reactions. The transients include, among others, the hydroxyl (\( \cdot OH \)) and carbonate (\( \cdot CO_3^- \)) radicals, singlet oxygen (\( \cdot O_2 \)) 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 (algal bloom suppression), while in the latter case a role of photochemistry (e.g. bleaching, treeline shifts, extended drought periods) would play key roles depending on the context. [1] Vione D, Minella M, Maurino V, Minero C. 2014. Chemistry Eur. J. 20:10590-10606. [2] Rosario-Ortiz FL, Canoica S. 2016. Environ. Sci. Technol. 50:12532-12547. [3] Avetta P, Fabbri D, Minella M, Brigante M, Maurino V, Minero C, 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-Nagarlagh (BBN) industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste has concerned about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in or flows through nallahs, canals and rivulets into the Sirsa river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices, the BBN region suffers from antibiotic pollution. Many companies manufacture formulations, or finished products such as tablets and syrups. Some companies also manufacture active pharmaceutical ingredients (APIs) or the main biologically active ingredient used in formulations, including antibiotics. These APIs can enter the environment due to insufficient treatment or improper disposal of waste and weak environmental regulations. They are among environmental persistent pharmaceutical pollutants which have not degraded completely during treatment. They may influence the genetic makeup of bacteria, leading to the survival of resistant bacteria and spread of antimicrobial resistance (AMR), a public health threat. The result of our study showed that all gaps leading to the release of...
APIs in the environment are plugged. The discharge of pharmaceutical effluents should take place through proper waste management techniques and stringent environmental regulations. Currently, effluent standards are limited to chemical contaminants such as heavy metals. The government must adopt a new AMR-centric approach of waste management which considers APIs as a chemical contaminant. Laws must be made to ensure that there are no APIs in treated effluents. The government should support small-scale manufacturers to install and implement environmental-friendly wastewater treatment and disposal techniques. Manufacturers with high-end WWTPs should also be strictly monitored. The SPCBs should conduct surveillance of APIs or antibiotic residues in the treated effluents and make data publicly available.

**WE004**

The environmental concentration and evaluation of active ingredients in pharmaceuticals in rivers flowing through urban area in Japan

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The active ingredients in pharmaceuticals are discharged into the aquatic environment after use mainly through sewage treatment facilities. There is concern about adverse effects on wildlife due to the possibility of the presence of highly susceptible species. However, we still know little about what kind of impact on wildlife in the environment. Based on these backgrounds, we set up environmental impact 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 (57 ng/L), valsartan (4500 ng/L), irbesartan (1100 ng/L), losartan (117 ng/L), amlodipine (23 ng/L) for antihypertensive agents and sulfadimidine (546 ng/L) for antiparasitic antibiotic, atorvastatin (150ng/L) for analgesic antinflammatory drug, crotamiton (845ng/L) for antiparasitic 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 concentration 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 canadsartan, olmesartan, lorazepam, rosuvastatin and epinipine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary for contamination in the dilution ratio of the environment which sets it. Regarding the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.000001% of chloroibic 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 can offer clear advantage for cost-efficiency and for optimising time and cost for prioritised 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 equivalence 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 each WWTP study location. Metformin, gabapentin, atenolol, desvenlafaxine, loperamide, risperidone, 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 persistence of pharmaceuticals in the environment. 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 approach. The novelty of the tool is the identification of the persistent, toxic and bioaccumulative properties (PBT assessment) of the molecule. Regulations and guidelines on how to identify 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 waiving 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. AMARIEL, Universidad de Alcalá; K. Boltes, University of Alcalá / Chemical Engineering; J. Valimáš-Travero, M. García, P. Letón, M. Marina, R. Rosal, University of Alcalá

A thousand of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicines. Many of these compounds are very toxic and are found in the aquatic environment. Nowadays, the occurrence of pharmaceuticals in aquatic environments is a well-established issue, there are still gaps in our knowledge on the fate and effects of these compounds in the environment. Evaluating API ecotoxicology is even more challenging due to uncertainties about appropriate dosages, durations of exposure, range of sensitive taxa, sensitivity of developmental stages, and toxicological endpoints. More attention should be paid on the non-target organisms and the chiral nature of contaminants. This work assess the toxicity of the antidepressant drug Duloxetine and the antifungal Econazole, individually and combined, on three freshwater species—algae, crustacean and duckweed, using APIs concentration from 0.039 to 100 mg L⁻¹. Level of a type of drugs interactions were determined using the Combination Index-isobologram method. The enantiomer concentration of the target compounds in the culture media were WWTPs. To correlate the relation between degradation profile and the observed toxicity on organisms. Results reveal toxic effects of Duloxetine and Econazole leading to growth reduction and significant changes in the morphology of duckweed fronds. The EC50 values obtained shown Duloxetine as very toxic for algae and toxic for crustacean and plants. Econazole appears as very toxic for all species evaluated. Mixed toxicity profiles (OBIs) for tricyclic antidepressants (TCAs) are now on market worldwide. The research was co-funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMTAVARES and grants CCG2016EXP-037 by University of Alcalá.

WE010

Application of newly developed in vitro assay to detect physiological activities of antidepressants in wastewater

M. Ibahr, M.O. Ibahr, D. Kato, H. ZHANG, Kyoto University

Over recent years, growing numbers of human pharmaceuticals have been detected in sewage treatment plants (WWTPs). Concern about their potential target organisms and the chiral nature of compounds in the culture media. Especially pharmaceuticals play an important role when it comes to long-term exposure. They enter the environment throughout the year and therefore pose a continuous risk to organisms. One of these ubiquitously detected pharmaceuticals is the antidepressive drug carbamazepine (CBZ). Hardly degraded during conventional wastewater treatment, it contaminates a majority of wastewater systems. CBZ forms CBZ-quinones in aquatic environments that have a toxic potential to target organisms. How can we study the chronic exposure to pharmaceuticals over multiple generations?

K. Heye, Goethe University Frankfurt / Main / Aquatic Toxicology; A. Schmidt, Goethe University Frankfurt / Aquatic Ecotoxology; J. Oehlmann, Johann Wolfgang Goethe-Universität Frankfurt / Aquatic Ecotoxicology Lathy et al. (2020) was taken from a laboratory culture to set up exposure cages — one where larvae were continuously exposed to the LC₅₀ of CBZ (0.4 mg/L, nominal concentration) and one control. When we were sure that a new generation had started, egg clutches were taken out of the cages to set up two chronic toxicity tests. Lethal and effect concentrations of mortality and mean time to emergence were calculated using a non-linear regression model (logistic curve). Sensitivity was compared by looking at the percentage of the 95% confidence intervals (CI). Two months after the beginning of the experiment, mortality seemed to be lower in the exposed group compared to the control. However, CI of the LC₅₀ still overlapped (0.506 ± 0.882 mg/L for the control and 0.729 ± 1.1 mg/L for the pre-exposed group). Four months later, sensitivity was compared again. LC₅₀ of the pre-exposed group was higher than in the control, with no overlap of the CI (0.668 ± 1.02 mg/L for the control and 1.08 ± 1.96 mg/L for the pre-exposed group). After two and six months, control mortality of both groups was low and emergence in the case was delayed constant. Multi-generation experiments are a helpful tool to investigate long-term effects of chemicals on aquatic organisms. Within the first six months of the ongoing study, midges showed to be less sensitive to carbamazepine after long-term low-level exposure. Chronic toxicity tests to study the authors of exposure groups should be combined with genome and transcriptome analyses to get a full picture of adaptation processes in midges. Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support code 02W3M1367A).

WE009

Evolution in the lab - How can we study the chronic exposure to pharmaceuticals over multiple generations?

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WE008

Development of a quantitative Adverse Outcome Pathway-informed model to predict the risk posed by mixtures of non-steroidal anti-inflammatory drugs to fish

P. Marimon, J. Kayode, Brunel University London / College of Life Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Margiotta-Casulaci, Brunel University London / Institute of Environment, Health and Societies

The presence of low concentrations of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised the concern that chronic exposure to these compounds may cause adverse effects in wild fish populations, similar to those observed in human patients. This potential scenario has led to the inclusion of diclofenac in the European Union Watch List of emerging pollutants. Although the effects of diclofenac in fish have been investigated in over twenty published studies to date, the complexity of NSAIDs toxicology is such that many uncertainties still exist about the significance of those findings for environmental risk assessment. We hypothesise that the perturbation of cyclooxygenase (COX) activity in healthy fish tissues is the leading cause of adverse effects, as it is in humans. On the basis of this mechanistic starting point, we propose a quantitative Adverse Outcome Pathway (AOP) approach to evaluate the chemical and pharmacodynamic aspects of NSAIDs toxicology. After extracting all NSAIDs toxicity data available in the scientific literature, we applied drug uptake models to predict the plasma concentrations at which different effects would occur in laboratory studies. As all NSAIDs act by inhibiting the enzymes COX1 and/or COX2, we applied mixture pharmacology approaches to express the plasma effect concentration (PCC) as equivalent doses as diclofenac. This approach was used for measured and predicted river concentrations of NSAIDs, which were used to predict plasma concentrations of NSAIDs in wild fish. The overlay of the two approaches led to a visual model that enables a rapid assessment of the risk posed by environmental levels of NSAIDs to trigger multi-scale adverse effects. The major strength of the model is the ability to predict the toxicological potential of NSAIDs mixtures, expressed as diclofenac-equivalents. We propose that this mechanistic approach may provide a useful predictive tool to support the implementation of effective NSAIDs ecopharmacovigilance strategies and facilitate the regulatory interpretation of past and future toxicity data.
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 quantitative assessment is key to improve current understanding of the ecological risks of pharmaceuticals to non-target organisms in the environment. To unravel patterns in biological responses across aquatic taxa a meta-analysis was performed on reported effects of exposure to pharmaceutical compounds (according to therapeutic class). Minimum response concentration and biological responses were collected from selected studies based on a set of objective criteria. Considering organisms’ exposure to pharmaceuticals under controlled conditions. For a response sensitivity analysis various endpoints were considered, namely biochemical, developmental (e.g. growth), reproductive and behavioral responses, as well as lethality, in studies reporting effects on aquatic taxa. The comparative sensitivity analysis of biological endpoints highlighted the sensitivity of molecular responses, followed by individual level-responses (e.g. behavior and growth), yet variable sensitivity among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

WE010 Impact of the antibiotic drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario) S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, University of Tübingen; R. Triebkom, University of Tübingen / Animal Physiological Ecology

The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antibiotic drugs as metformin (MF) has become obvious. In wastewater treatment plants, metformin is only partially retained and also transformed to guanylurea (GU) leading to high concentrations of both compounds in surface waters. However, possible effects of MF and GU in aquatic organisms are far from being understood. The aim of this study is therefore to investigate influences of MF and GU on different metabolic pathways and behaviour in different life stages of brown trout (Salmo trutta f. fario). Juvenile trout (age: 8 month) were exposed for 4 weeks at 7°C to different concentrations of MF (0, 10, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 100, 1000 µg/L) at 7°C & 11°C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (heat-shock protein 70), 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 Environment Agency (AMA) and the BWK Wasser- und Abwassertechnik. Juvenile trout of brown trout were exposed to MF and GU in aquatic environments. Whole organism toxicity studies of all pharmaceuticals.

WE013 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals E. Unganayagavel, Shantou University / Marine Biology Institute; J. Gan, University of California, Riverside / Department of Environmental Sciences

Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to µg/L. More than 50% pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is plausible 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 therapeutic concentration) was less than 1, 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 benzoylcegonine exposure at different levels of the biological hierarchy on Daphnia magna M. Parolini, Università degli Studi di Milano; A. Finizio, University of Milan / Department of Environmental Science and Biotechnology; A. Gonzalez, IRCCS Istituto di Ricerche Farmacologiche Mario Negri; S. Castiglioni, Mario Negri Institute / Environmental Policy; M. Parolini, University of Milan / Department of Environmental Science and Biotechnology

A number of monitoring studies have shown that benzoylcegonine (BE), a metabolite of cocaine, is the major illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. The few studies that have investigated the toxicity of this molecule towards invertebrate and vertebrate aquatic non-target organisms have shown different detrimental effects at low levels of the biological organization, mainly at biochemical, molecular and cellular levels. However, to date no one study has evaluated the consequences of BE exposure to the higher levels of ecological hierarchy. Thus, the present study was aimed at investigating the toxicity of a 48-h exposure to different concentrations of BE, simulating 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 acetycholinesterase activity (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 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals

Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to µg/L. More than 50% pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is plausible to carry out whole organism toxicity studies of all pharmaceuticals.
guanylurea during the waste water treatment process, it is found in the environment in higher concentrations than metformin, usually in the µg/L concentration range in surface waters. This is concerning, as our recent research shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin (1.0-100 µg/L) and guanylurea (1.0-100 µg/L) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both male and female medaka compared 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 metabolome of 28 day old male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. These results raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

**WE018 Environmental Fate and Effects of the Antidiabetic Drug Metformin and Its Transformation Product Guanylurea**

J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health and Safety; D. Hettich, Merck KGaA; J.G. Myer, Merck & Company, Inc. / Global Safety

Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concerns about the potential aquatic life impacts associated with the presence of MET in surface waters. MET is largely transformed to guanylurea (GUU) in 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 were aligned with USEPA PECs in the USA and EU. The PEC/PNEC and MEC/PNEC risk characterization ratios for GUU were also well below 1. We conclude there is no significant risk to aquatic life for both MET and its transformation product GUU.

**WE019 Fluoxetine exposure modulated antioxidant and anxiety-related gene expression altering swimming activity in zebrafish embryos**

B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Gaggio, University of Milan; M. Parolini, University of Milan / Department of Environmental Sciences and Policy

The massive release of human pharmaceuticals into the aquatic ecosystems continues to be a serious environmental problem. Antibiotic 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 major antidepressants worldwide. ALR 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 in zebrafish (Danio rerio) at environmentally relevant concentrations of 100 ng/L (lower than 0.50% of the dose that induced 10% mortality) and by the expression of genes related to oxidative stress response (sod1, sod2, cat, gpx and gsr), stress and anxiety (ostx, ptr2, npy and ucn3), as well as transporters of main neurotransmitters (slc6a3, slc6a4a, slc6a4h, slc6a11 and 2) if changes in the expression of neurotoxicity-related genes were related to changes in the swimming behavior of zebrafish (Danio rerio) embryos at 96 hours post fertilization (hpf). Our results showed that FLX exposure overexpressed sod1, cat and gxs, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of slc6a4a, slc6a4h, 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 Beazifibrate toxicity in model marine diatom Phaeodactylum tricornutum**

B. De Felice, MARE - Marine and Environmental Sciences Centre / Centro de Oceanografia; A. Matos, BIOSISytems and Integrative Sciences Institute / Plant Functional Genomics Group; T. Cabrita, IPMA IP; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; I. Caçador, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCUL; 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 fibrin acid widely used to reduce plasma triglycerides and raise the level of high-density lipoprotein cholesterol. Specifically, Beazifibrate 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, beazifibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have adverse effects on marine life, involving 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 beazifibrate (0-60 mg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometry. Beazifibrate exposure impaired both photosystems, which reduced the algal 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 beazifibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipidic membrane system. Moreover triglycerides (TAGs) are known to protect the photosystems against photoinhibition. The reduction of TAGs could lead to burnout of the photosystems due to excessive energy being absorbed, as observed by the high incoming photonic energy flow, this way reducing the number of active reaction centers in the algal and thus its photosynthetic ability. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for fibrate 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

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/eco-toxicity 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 anamnesis 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 derived as an assessment factor to derive the case-study impact 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 waters and bacterical populations. In addition, MPA is not expected to bioaccumulate nor to adsorb to sewage sludge or to sediment to a significant extent. Conclusions on potential risks of MPA are given in the poster.

**WE022 Cytostatics in Dutch surface water - overview of use and potential risks to the aquatic environment**

B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Gaggio, University of Milan; M. Parolini, University of Milan / Department of Environmental Sciences and Policy

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 fibrin acid widely used to reduce plasma triglycerides and raise the level of high-density lipoprotein cholesterol. Specifically, Beazifibrate 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, beazifibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have adverse effects on marine life, involving 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 beazifibrate (0-60 mg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometry. Beazifibrate exposure impaired both photosystems, which reduced the algal 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 beazifibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipidic membrane system. Moreover triglycerides (TAGs) are known to protect the photosystems against photoinhibition. The reduction of TAGs could lead to burnout of the photosystems due to excessive energy being absorbed, as observed by the high incoming photonic energy flow, this way reducing the number of active reaction centers in the algal and thus its photosynthetic ability. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for fibrate toxicity testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.
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 the waste material, many contaminants, including pharmaceuticals, are not completely removed. Consequently, effluent containing pharmaceuticals and their residues is discharged into surface waters. A recent study showed that 29 of 80 monitored pharmaceuticals were regularly detected in Dutch surface water, and that five of these substances, i.e. the pain killer diclofenac, the antibiotics azithromycin, clarithromycin and sulfamethoxazole, and the antiepileptic phenobarbital, pose a risk to the aquatic ecosystem (Moermond et al., 2016). This raises concern, perhaps even more so when considering that for many of the around 2000 pharmaceuticals that were authorized for the Dutch market in 2016, it remains unknown to what extent they are present in surface waters, how they behave in the environment, and to what extent they exert toxicity to aquatic species individually and jointly. A class of pharmaceuticals that has received increased attention in the Netherlands, but also in the EU, e.g. PHARMAS project and Cytothreat, are cytostatics. These potent substances are used to inhibit cell division in cancer patients, but the fraction released unchanged into surface water could affect aquatic species in a similar manner. This project aimed to provide an overview of the use of cytostatics in the Netherlands and to determine if cytostatics pose a potential risk to the aquatic ecosystem. For an in vivo study the carcinogenic cytostatic drug cyclophosphamide, pose a risk to the aquatic environment. 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.

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 in vivo study the carcinogenic cytostatic drug cyclophosphamide is included in the top 10 of cytostatics, as the risk for the aquatic environment was ranked highest. 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. The World Health Organization (WHO) and US Environmental Protection Agency (EPA) use a tiered approach, which can be applied to human pharmaceuticals. For the pharmaceuticals in this study, background data includes testing of three trophic levels, represented by algae, crustaceans and fish – usually following OECD-guidelines 201, 211 and 210. Both the applicant and the assessor evaluate the studies to assure adequate data quality. Over the last decade, this regulatory work resulted in a data base containing effect data on approximately 300 active pharmaceutical ingredients (APIs) – which was evaluated in our current study. The highest exposed NOECs below 1 μg/L were observed for several NOECs in the low ng/L-range, particularly for substances with endocrine mode of action. The predominant part of substances with NOECs between 0.01 and 1 μg/L is non-endocrine, belonging to a diverse range of pharmaceutical classes. For approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available – allowing a comparison of sensitivity. In over 60 % of cases, the effect value for most and least sensitive test organism was greater than 10, in over 20 % of cases greater than 100. Fish were the most sensitive test organism in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific pharmaceutical groups/mode of actions will be given in the final poster. Our results will help to identify possibilities and limitations of the current regulatory approach, and provide information for future modifications of the regulatory framework.
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 sensory 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** Impact of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss).

We explored the impact of fatty acids (FA) and methylmercury (MeHg) on trout adipocyte differentiation. In this context, in vitro experiments were carried out in trout primary cultured adipocytes to study the effects of FA and those of MeHg. Effects of FA s - 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 a-linoleic acid (ALA), eicosapentaenoic acid, docosahexaenoic acid (DHA), LA, arachidonic and docosapentaenoic acid (DPA) acids and 2 mM MeHg. At day 13, for each FA, the higher the concentration, the more the lipid accumulation. At 600 nM, DHA and DPA were the most adipogenic FA, while LA and ALA (typical to plant derived oils) induced less lipid accumulation. For all conditions, a clear enrichment of membranes and lipid droplets with the incubated FA was observed. Effects of MeHg - Confluent cells were incubated for 6 days with or without a hormonal cocktail, with 0.5, 2.5 or 5 mM MeHg and with 4 µL/mL lipid mixture. No cytotoxicity was observed. At day 6, cells were collected to determine mercury concentration, FA content and composition, and gene expression. Analyses are in progress. Preliminary results showed that the hormonal cocktail combined to increasing MeHg concentrations tended to affect cell morphology, towards a more typical adipocyte phenotype. In contrast, a decrease in the concentration of FA s 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, C. Castro, University of Porto; A. Lyssimachou, CIMAR; F. Castro, CIMAR - University of Porto; M.M. Santos, CIMAR/FCUP / Biology/Endocrine Disruptors and Emerging Contaminants

The term of Obesogens is a major health concern of our times, affecting an increasing proportion of the population worldwide. It is now evident that this phenomenon is not only associated with the lack of exercise and a balanced diet, but also due to environmental factors, such as exposure to environmental chemicals that interfere with lipid homeostasis. These chemicals, also known as obesogens, are present in a wide range of products of our daily life, such as cosmetics, paints, plastics, food cans and pesticide-treated food, among others. A growing body of evidences indicates that their action is not limited to mammals. Obesogens also end up in the aquatic environment, potentially affecting its ecosystems. In fact, reports show that some environmental chemicals are able to alter lipid homeostasis, impacting weight, lipid profile, signaling pathways and/or protein activity, of several species of organisms. Such phenomena is an issue in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolite guanylurea in developing fish, we found a significant decrease in length (~6%; mm) and wet weight (~22%; mg) of male Japanese medaka (Oryzias latipes) when exposed to 3.2 µg/L metformin from embryo through 28 days post hatch. When male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length and wet-weight. Using radio labeled metformin, we demonstrated that about 1% of the waterborne concentration of metformin could be taken up in both embryo and larval medaka after exposure windows ranging from 24 hours to 7 days. We also conducted a metabolomics assessment of metformin and guanylurea exposed fish to elucidate the sub-lethal biochemical mode of action for each contaminant exposure. Significant changes were detected in the metabolome of 28-day larval male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. This biochemical effect is likely a contributing factor to the observed decreased growth in exposed fish. In combination, these results suggest that the current concentrations of metformin and guanylurea in receiving waters are of ecotoxicological concern for resident fish populations.

**WE030** Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals

A. Sobrino-Figueroa, Universidad Autónoma Metropolitana Iztapalapa / Instituto de Biología, C. Cáceres, Universidad de los Andes, Universidad de la República, Universidad de California Sur

The analysis of the composition of the digestive gland, gives information on the energy level of the organism, this energy is mobilized in the different stages of its life cycle. When the organisms are subjected to severe stress conditions, it has been observed the mobilization of these reserves to maintain homeostasis, in short periods of time. In this work, an evaluation of the composition of the digestive gland of juvenile catarina clam exposed to the metals Cd, Cr, Pb and their mixtures was carried out to determine their energy content. Bioasays with water replacements were carried out. The organisms were exposed to 1 subletal 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 in 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 excavation (P)

WE033 Environmental assessment of foaming agent persistence in conditioned soil for EPB-TBM tunnelling


The anionic surfactant sodium lauryl ether sulphate (SLES) is the main component of most commercial products used for soil conditioning in the excavation industry, in particular as lubricants for mechanized tunnelling. This excavation process produces a large amount of spoil materials that can have a potential impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil threshold limits in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) 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 untreated 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 survival of the tested fungi especially in the S2 soil. In the latter case, the high persistence of the product can be ascribed to the detrimental effects of the additive on the microbial abundance and activity.

WE034 Application of the Vibrio fischeri acute toxicity test to assess the environmental impact of the spoil materials containing foaming agents


The rapid development of TBMs in the tunnelling industry has been mainly 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 TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of anionic surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used as by-products if the chemical thresholds for organic and inorganic contaminants (e.g., heavy metals, hydrocarbons C>12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its ecotoxicological effects on soil and water organisms. The use of ecotoxicological tests makes it possible to overcome the analytical limits to detect multicomponent commercial foaming products (of which the complete composition is often unknown), to save time by avoiding the designing of new analytical methods for the increasing number of chemicals used in new foaming formulations continuously being put on the market. Above all, they provide information about the different interactions between the mixture and the specific matrix and the possible ecotoxicological effects on biota. In several studies carried out in order to evaluate the potential impact of spoil materials the bacterium Vibrio fischeri showed to be very sensitive to the residual concentrations of the surfactant SLES in eluates obtained from soil samples collected from excavation sites. The overall analysis of a set of chemical and ecotoxicological data showed that the bioluminescence inhibition was directly related to SLES concentration. Consequently, the ISO 11348-3:2007 test is a suitable tool to assess in a short time the occurrence of foaming agent residuals at effect concentrations in spoil material.

WE035 Biodegradability of the anionic surfactant sodium lauryl ether sulphate used as the main component in two foaming agents for tunnelling process conditioning


The possible way-of-reuse of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Currently, there are no specific threshold limits in European legislation for these components nor comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained as the main component of two commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Microcosm experiments were set up with soil samples conditioned separately with the two foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcosm experiments were set-up with soil samples conditioned separately with the two foaming agents (P1, P2) and their mixtures in proportion 1:1. Moreover, control microcosms, consisting of untreated soil, were also present in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcosms, consisting of untreated soil, were also present in order to compare the microbial community before and after the foaming agent addition. At selected times (0, 7, 14, 21, 28) the 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 survival of the tested fungi especially in the S2 soil. In the latter case, the high persistence of the product can be ascribed to the detrimental effect of the additive on the microbial abundance and activity.

WE036 Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

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1. Foaming agents with better environmental impact: the POLYFOAMER ECO line Thanks to the development of new foaming agents carried out by the R&D Group, MAPEI have created the new product line Polyfoamer ECO, with the main goal to reduce the environmental impact on the tunnel muck, thus facilitating the re-use of the tunnel muck as by-products, in example for road constructions or old quarries refilling. All the new Polyfoamer ECO foaming agents have been conditioned by a third-party accredited laboratory as WAD (Water Accessibility Degree) in comparison to the lowest class of risk agents waters and organisms associative to a chemical product, according to the German regulation. The new products Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are characterized by lower values of COD at the initial stage when compared to traditional products, meaning that their provision of organic material to the conditioned soil is lower. 2. Environmental results with soils conditioned with the Polyfoamer ECO products Various laboratory tests have been carried out with the new foaming agents of the Polyfoamer ECO line of products and samples of soil coming from different TBM projects. The results obtained with two samples of soil from an Italian project are described: the material called “M” (a...
Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) follow 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 for urban planning, including huge developments of mechanized tunneling industry by the use of Tunnel Boring Machines (TBMs). Polyfoamer ECO is used as lubrication products for soil conditioning products, principally foaming agents. Anionic surfactants are the main constituents of commercial foaming agents widely used as lubricating products in the mechanized excavation, improving the stability of the excavation face and reducing the friction between soil cuttings. Among the anionic surfactants, sodium lauryl ether sulphate (SLES) is the most utilised compound in the commercial products for the excavation industry. Significant amounts of rock broken into various sizes mixed with anionic surfactants are produced during the execution of engineering works. The potential re-use of this non-renewable natural resource, for example as land covering, depends on the assessment of its environmental compatibility; otherwise, the spoil materials must be treated as a waste. In this context, it is important to evaluate the residual concentrations of SLES in the excavated soils in order to evaluate their possible final destination.

Given the absence of official analytical methods, it has become necessary to develop and validate a reliable and accurate methodology to quantify anionic surfactants in the spoil materials and, more in general, in the environmental solid matrices. For this purpose, the aim of the present work was the optimization of an analytical method for the determination of SLES in conditioned-soil samples. It consists of a first phase of extraction of anionic surfactants from the soil by the use of Pressurized Liquid Extraction (PLE) and the following analysis in the extract by the MBAS (Methylene Blue Active Substances) method using the water official method partially modified. The optimised method has been applied to real excavated soil samples because the determination of residual concentrations of the anionic surfactants in the spoil materials produced during excavation process, is currently one of the mandatory parameters for assessing their eco-compatibility.

Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study in mechanized tunnelling


The development of the mechanized tunnelling industry by EPB-TBMs (Earth Pressure Balance - Tunnel Boring Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, and in particular sulphates as counter ions, are used as a component 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-silt-sand matrix soil) conditioned separately with two common commercial foaming agents, respectively F1 and F2, used at conditioning ratio giving final concentration in both the soils of about 150 mg/kg. The presence of strengthening foaming polymers (P1 or P2, 527 and 50 mg/kg respectively), needed in some cases to increase foam persistence, was also considered. After a preliminary phase at laboratory scale, a mesocosm experiment was conducted in order to entail the scale-effect, which is very significant when the soils are involved. Several blends of foaming 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.
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 undeniable advantage to lower the costs of disposal. However, there are concerns about the potential environmental risk related to the re-use of conditioned soil. In fact, even if anionic surfactants are generally considered biodegradable and not toxic, there is little information in literature on their environmental fate and the possible ecotoxicological effects of the commercial formulations of foaming products and of the conditioned soils. The aim of this study was to evaluate the environmental compatibility and the ecotoxicological effects of two different soils treated with two different foaming agents containing the anionic surfactant AES, applying a suitable battery of bioassays. For this purpose, soils were prepared by mixing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m^3) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox test with the bacterium Vibrio fischeri; Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and elutriate from each mesocosm were analyzed in order to determine the residual concentrations of the anionic surfactant AES. The overall results obtained showed different ecotoxicological response depending both on the kind of soil and the biotic interaction. Recently, a novel bioassay has been developed to identify the biotoxicological response of different soil. The overall 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 mechanized tunnelling applications D. Sebastians, G. Vilardi, Università La Sapienza; A. Di Giulio, Italian National Research Council / Institute of Environmental Geology and Geoengineering; S. Miliziano, I. Di Palma, Università La Sapienza; A. Barra Caracciolo, National Research Council / Water Research Institute; P. Genni, National Research Council of Italy (CNR) / Water Research Institute; L. Patrolecco, Water Research Institute-National Research Council / Water Research Institute In the vast majority of tunnel projects performed with TBM the MOT 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 inert substances. To this purpose, the need to plan strategies to avoid 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 spoil disposal. Subsequently, specific methods have been developed to evaluate the effect of specific concentration values of these chemicals on terrestrial and aquatic environments, as well as to measure the reduction of the concentration of these compounds in each environment due to the action of the microorganisms inhabiting them. All these experimental procedures must be carried out in specialized laboratories equipped with sophisticated apparatuses, in which controlled environments are predisposed, so that at present it’s not possible to measure the level of pollution through expeditious tests directly on site. A joint research activity between Sapienza University and National Research Council of Rome has developed a test procedure able to provide expeditious information on the presence in the spoil of the chemicals often used in mechanized tunnelling. 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 more precise laboratory tests. Moreover, this test seems to be easily portable, useful for monitoring large volumes of spoil involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

WE042 Toxicity of some additive used in mechanized tunneling: effects on daphnids, algae and cress. D. Baderna, S. Maiorana, A. Passoni, R. Bagnati, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; M. Lodì, E. Benfenati, IRRCS 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, polycrylates and polycrylamides. 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 analyses 8 surfactants and 4 commercial polymers, using a multidisciplinary approach to determine their reference thresholds for both water and soils, accounting of the effects on ecological targets. The chemical composition of the technical mixtures was determined by liquid chromatography coupled with high resolution mass spectrometry. The main chemical components were analyzed in silico to highlight the potential similarity with other pollutants, already listed in our environmental framework regulation. Finally, the toxicity of the various agents has been evaluated by tests with Daphnia magna, freshwater algae and cress. Chemical characterization identified 15 molecules present in all the surfactant mixtures, although in different proportion. No similarities with compounds already regulated by the Italian Environmental Act were found by the in silico analysis. All the tested surfactants were toxic for the aquatic organisms at concentrations comparable to those that can be found in leachates of conditioned rock debris. The additives resulted non toxic for the terrestrial plant at concentrations theoretically found in conditioned rock debris.

PBt/PvP & PMT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P) WE043 Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China X. Pei, Y. Zhu, S. Xiong, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences Bioaccumulation and trophic transfer of 13 organic ultraviolet absorbents (UVAs) were investigated in riverine wildlife organisms in the Pearl River catchment, South China. The UVAs were widely present in the fish with the highest level detected for UV 531. Generally, the UVAs concentrations were higher in the freshwater fish than in shrimp. Dietary habits of the fish showed effects on bioaccumulation of the UVAs with higher levels in the carnivorous species than in the herbivorous, planktivorous and detritus feeding fishes. Tissue distributions were generally in the order of liver > belly fat > muscle. Obviously higher concentrations of 2-ethyl-hexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (Log BA/F) were usually < 3, suggesting potential of bioaccumulation 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 benzozilaole stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

WE044 Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies M. Habeck, BASF Corporation; N. Kreling, BASF SE / Crop Protection - Ecotoxicology; B. Kusebach, M. Obermann, BASF SE Agrarzentrum Limburgerhof Bioaccumulation is one of the PBT (persistence, bioaccumulation, toxicity) cut-off criteria for plant protection products (EC/1107/2009) in the EU; furthermore, high bioaccumulation is generally considered a critical parameter in other regions, too. The standard regulatory assessment of bioaccumulation is based on bioconcentration in aquatic species, i.e., for regulatory purposes in fish. However, standard fish bioconcentration studies are time consuming, expensive and they use a considerable number of fish. Therefore, there is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally clustered candidate molecules regarding bioaccumulation potential and the prediction whether a candidate molecule will exceed the BCF (bioconcentration factor) trigger value. Furthermore, Hyalella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimental BCF values from freshwater bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtriem, 2012). Further work is presented in order to (i) increase the data base of Hyalella – fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20 000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges since Hyalella as an aquatic invertebrate can be quite sensitive. The results from
Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

E. Poppert, Technical University of Denmark (DTU) / DTU Environment; Z. Zhang, Technical University of Denmark DTU / DTU Environment; K. Bittermann, Helmholtz Centre for Environmental Research GmbH - UFZ / Analytical Environmental Chemistry; I. Linden, UFZ Helmholtz Centre for Environmental Research / Department of Analytical Environmental Chemistry; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry; S. Trapp, Technical University of Denmark DTU / DTU Environment

Bioaccumulation in fish is quantified using biomagnification factors (BMF), which are derived under controlled conditions according to OECD guideline 305-III. To reduce in vivo experimental efforts, pre-screening using statistical models for BMF 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 acids and 5 bases. Significant correlations were only found for pH-dependent binding (range of 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 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R>0.40), and b) that significant correlation was shown only with logKOW at pH=3 (R<0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R<0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., logKOW) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BMF from quantumchemistry-based estimations of partitioning coefficients (e.g., Kd for the marine lipoprotein albumin). Estimation of BCFs from BMF for the investigated chemicals will be also performed and verified with existing BMF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radiolabelled test chemicals.

Evaluation of a tiered approach for the bioaccumulation assessment of fragrance substances: in silico, in vitro assays, invertebrate vs. in vivo fish bioconcentration test

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Bioaccumulation is a critical property used for the risk assessment of ionizable organic compounds (e.g., chemicals derived in water exposure studies with fish) as an indicator for potential effects in food webs. A tiered approach for the bioaccumulation assessment of fragrance substances will be evaluated. A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R>0.40), and b) that significant correlation was shown only with logKOW at pH=3 (R<0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R<0.60). These preliminary results indicate that commonly used predictors for bioaccumulation are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BMF from quantumchemistry-based estimations of partitioning coefficients (e.g., Kd for the marine lipoprotein albumin). Estimation of BCFs from BMF for the investigated chemicals will be also performed and verified with existing BMF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radiolabelled test chemicals.

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Bioaccumulation is a key end point in environmental hazard and risk assessment, especially for substances with a high octanol water partition coefficient (logKOW). To measure the BioConcentration Factor (BCF), a tiered approach is followed starting from the assessment of the octanol water partitioning coefficient as a measure for lipophilicity, which is often used as surrogate for lipid partitioning up to an experimental BCF value which is considered as the gold standard for fish bioaccumulation assessment. We have applied a series of non-animal methods to predict the BCF values and compared those outcomes to the results from a BCF test in order to validate this alternative approach. Several fragrances from the tetranolurabane diterpenoids family, either composed of a single or a mixture of stereoisomers were tested. The logKOW predicted by QSAR ranges from 4.75-5.41 and 10.02 to 11.2 when determined by HPLC (OECD 117). The slow stir method (OECD 123) provides a logKOW of 5.09 which is retained as the reference value. Various structure-activity relationship models were used to predict the fish bioconcentration factor, which ranged from ~ 1000 to ~ 4500, not exceeding the EU criteria for (very) Bioaccumulative substances (vB), however, the structure was mostly outside the applicability domain of the models. Ther
In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their intrinsic properties. These imply a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may therefore be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE050 Modelling Persistent & Mobile Organic Compounds using an updated Multimedia Urban Model: A Toronto Case Study with Organophosphate Ester (OPEs)
T.R. 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 Ester (OPEs) are a group of chemicals found at relatively high levels in the environment, due to their persistence, bioaccumulative and toxic properties. Their use has increased in recent years following the listing of penta- and octa-BDEs as POPs under the Stockholm Convention. In contrast with BDEs, OPEs highly polar molecules which can be considered persistent and mobile organic compounds (PMOCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using polynomial parameter linear free energy relationships (ppLEFRs) to represent partitioning, and will also be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE049 PBT/vPvBs: All equally bad or some worse than others? - How to inform risk management
K. Thiele, WUR; S. Gabbert, Wageningen University / Social Sciences
In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their intrinsic properties. These imply a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may therefore be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/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.

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, rheology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a “substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together.” They have a full range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example. Currently, the majority of large molecular weight polymers are exempt from chemical regulations around the world (e.g. REACH) or are largely considered of low concern based on a minimum set of physical-chemical properties (IFRA, FEMA). However, there is a speculation that these regulatory exemptions, specifically the REACH exemption, could be removed in the next 5-10 years. If this is the case, many previously untested chemicals would then need an environmental hazard assessment supported by an ecotoxicological dataset. This dataset may include aquatic toxicity testing, read-across to structurally similar chemicals that have been tested, weight of evidence toxicity estimates based on physical-chemical properties, or all of the above. However, the same variety of physical-chemical properties that allows polymers to have so many functions in cosmetic formulations also makes these substances difficult to test in aquatic systems – varying absorption properties, molecular charge, insolubility, etc. Therefore, safety assessors evaluating polymers must look to new and novel approaches for filling environmental data gaps in order to create a robust environmental hazard assessment. This poster will examine the current polymer landscape for cosmetic uses, identify common data gaps, provide possible solutions to fill those data gaps, and offer a prioritization scheme for future testing of polymers. Ultimately, the objective is to suggest a more modern approach to substantiating the environmental safety of the large variety of polymers used in cosmetic and personal care products.

WE053 A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products
E. Nfon, Smithers 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 guidance,
requirements, strategies and challenges. Abstract A PBT substance is one that is persistent (P), bioaccumulative (B) and toxic (T) or very persistent (vP) and very bioaccumulative (vB). The PBT assessment approach is well described under the REACH regulation (Regulation EC No 1907/2006) starting with a screening framework based on available data and when a potential PBT is identified, then a definitive assessment is required. While this procedure is clearly understood for industrial chemicals, it is not always clear how to deal with other REACH substances. There is no definitive PBT/vPvB guideline for pharmaceuticals, but the European Chemicals Agency (ECHA), 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, 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 QSRs and instead treat the product as a neutral PBT. Furthermore, 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 a sufficient assessment of ionisable substances. The objective of the project is to refine the P assessment of ionized and ionisable substances under REACH. For this purpose, simulation tests following OECD guidelines are conducted using two different types of environmental compartments: Aerobic and Anaerobic Transformation in Aquatic Sediment Systems (OECD 308) and Aerobic Mineralisation in Surface Water (OECD 309). As models substances we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE056 Interaction of sulfonamide with soil humic acid: ESR investigations with nitroxide spin label. A. Ricke, E. Bondarenko, H. Steinhoff, University of Osnabrueck / Physics; G. Ür, K. Hideg, T. Kalai, University of Pécs / Organic and Medicinal Chemistry; M. Matthies, University of Osnabruck / Institute of Environmental Research. Sulfonamides (SAs) are used worldwide in veterinary medicine and are found in surface water samples in trace concentrations. To investigate the kinetics of covalent bond formation, we have used spin-labelled surfactants for the analysis of SAs. The surfactants were radiolabelled with the nitroxide spin label 4888. This immobilization is caused by unspecific sorption and irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment and/or binding to soil organic matter. The paper presents a new approach of using stable magnetic spin probes to investigate the kinetics of covalent bond formation.

WE057 The role of non-extractable residues in the environmental risk assessment from regulatory perspective - requirements and challenges. A. Wiedmann, UBA Umweltbundesamt; J. Hogeback, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. Gildemeister, Umweltbundesamt / German Environment Agency / IV 2.2 Pharmaceuticals; D. Loffler, T. Ternes, German Federal Institute of Hydrology Non-extractable residues (NER) do not follow different regulatory frameworks. In some cases NER are integrated in the calculation of predicted environmental concentrations (PEC) or are an issue in the authorisation decision. The significance of NER in the assessment of persistence (e.g. PBT, vB/vP, POP classification) has been more or less neglected in the past. However, new developments as reflected in guideline revisions (e.g. ECHA R.1.11, 2017) highlight the importance of NER in toxicity assessment and sorption processes. NER can be irreversibly bound to the soil/sediment and pose a potential risk to the environment or irreversibly bound which can be interpreted as sink. Hence, the potential release of parent or transformation products from NER in soil or sediment should be considered. However, distinguishing between these 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 remobilized in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenically bound NER) are considered to be irreversibly bound to soil/sediment or transformed into biomass and therefore a risk to the environment is not anticipated. Furthermore, a stepwise extraction scheme is proposed which would allow the determination of these different NER types. The comprehensive scientific assessment of this extraction scheme supported by experimental proof carried out by UBA. Transformation tests in soil with 13C-labeled 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 characterize the formation of the different NER types. Under consideration of these results, a refined extraction scheme will be proposed with respect to the general applicability for different soils. BioNER are of no environmental concern. Type I NER (sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II this will rarely happen under physiological conditions. Type III NER (covalently bonded 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. Hennberger, 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 the study, we considered synthetic ion exchange materials as possible reference sorption phases and compared their sorption properties against those of various environmental and biological materials. Retention times on commercial ion exchange chromatography columns were measured in fully aqueous eluent and were converted to retention factors (k'), which are proportional to the ion-exchanger-water partition coefficients. In the end, we established a data set for retention factors of 61 cations on a strong cation exchange column (SCX), 24 cations on a weak cation exchange column (WXC), 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'. Notably, 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 further step to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

**WE059 Simulation of the fate of co-labeled 13C3-15N-glyphosate in a water-sediment system and formation of biogenic non-extractable residues**

A. Brock, DTU Environment / DTU Environment; A. Rein, Technische Universität München / Chair of Hydrogeology; F. Pleisels, Technical University of Denmark (DTU) / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Küster, Helmholtz Centre for Environmental Research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark DTU / DTU Environment

The combination of dynamic simulation and stable isotope techniques allows tracking the assimilation of pesticides into biomass [1]. Here, we simulated the fate of 13C-labeled 15N-glyphosate in an OECD soil degradation test [2]. The mathematical model used consisted of two compartments for sediment (slow and rapid ad-/desorption), one compartment for dissolved mass, and microbial growth and metabolism. The flow of both 13C and 15N were balanced. The model considers two biodegradation pathways for glyphosate, namely the saccharine-pathway with complete mineralization, and the incomplete pathway with AAs, non-stable bound with very low biodegradation rates and 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 not-living amino acids), which is equal to the biogenic non-extractable residues (NER). Biogenic NER consist of assimilated 15N/13C and are thus considered to be 'irreversibly bound' as proposed in the updated ECHA guideline for PB/vePvB assessment [4]. This is the first study simulating the formation of biogenic NER using experiments with 15N-labeled molecules. [1] Kästner, M., Nowak, K. M., Miltner, A., Trapp, S., & Schaffer, 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., Kästner, M., Miltner, A., Schaffer, A., Remmesa, T. Q., Yang, Nowak, K. M. (2016). (Bio)degradation of glyphosate, way to go? A consistent and adaptable 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: PB/vePvB assessment, Helsinki, Finland.

**WE060 Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia**

A. Aleskerdanyan, Hazardous Substances & Waste Policy Division / Head of Division; Y. Buniyayyan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology investigation; V. Khachatryan, National Institute of Oncology / Thoracic Surgery Department; F. Petrosyan, UNIDO BAT/BEProject (Armenia)

Sources of environmental pollution by persistent organic pollutants (POPs), either used as pesticides, currently applied pesticides, include landfills, many of which do not meet sanitary and hygienic standards and, at open burning of wastes, become a source of dioxins and furans. Investigation was carried out on soil samples taken in different maraxes (provinces) of the Republic of Armenia at the boundaries of landfills and agricultural lands or water basins in the vicinity of towns Ararat (Ararat Marz), Hrazdan (Kotayk Marz), Sevan (Gegharkunik Marz), Gavar (Gegharkunik Marz), Ararat (Ararat Marz). The obtained soil samples were analyzed for determination of the following POPs: 4- Hexachlorocyclohexane (HCH) isomers: α-, β-, γ-, δ-HCH; - DDT isomers: 2,4'-DDT, 4,4'-DDT; - DDT metabolites: 2,4'-DDE, 4,4'-DDE, 2,4'-DDD, 4,4'-DDD; - Hexachlorobenzene, - Heptachlor, - Aldrin - Dieldrin - Heptachlor epoxide A and Heptachlor epoxide B - Endosulfan I and Endosulfan II - Endrin - Mirex - 14 Dioxin-like polychlorinated biphenyls: congeners No. 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, 170, 180, 189. Quantification of POPs was done using chromatograph with electron capture detectors (ECD) equipped with glass capillary column with stable phase DB–5MS UI and the following parameters: 60 m x 0.25 mm x 0.25 μm. Special attention was paid to the total concentrations of HCH isomers, DDT isomers and their metabolites, as well as the total amount of polychlorinated biphenyls, as maximum allowable concentrations (MACs) are set for the aggregate amount of these compounds. On the analogy, concentrations of other POPs pesticides and all studied POPs are also considered on the whole (summary concentrations) as obvious initial indicators of soil pollution by the studied POPs. In the investigated soil samples HCH isomers, DDT isomers and metabolites, certain Dioxin-like polychlorinated PCBs were detected at concentrations exceeding the established norms.

**WE061 Improving the interpretation of Non-Extractable Residues (NER) in degradation assessment**

A. Alesker RWTH Aachen University / Chair of Environmental Biotechnology and Chemodynamics; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; S. Trapp, Technical University of Denmark DTU / DTU Environment

Criteria for the assessment of chemical properties, potential (eco)toxicity, and environmental behaviour of industrial chemicals in general, and particularly for REACH substances, biocides, pesticides, and veterinary medicines are summarized in specific European legislations. The regulatory views on NER formation differ considerably, with two extremes of assuming them as either degraded residues of no environmental concern or as bioavailable and non-degraded residues. This may be changed if clear indications for ultimate degradation or irreversible sequestration are available. NER analyses are available for the total amount of POPs, as well as for the total amount of chemicals in environmental matrices can be experimentally differentiated, sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered non-stable on technical parameters and are not being detected as degradation. However, providing the proof for type II NER is a critical issue in NER assessment. Harsh extraction conditions may release both types of NER but for type II this will rarely happen under physiological conditions. Type III NER comprises biogenic NER (bioNER) after complete metabolization of the xenobiotic and anabolic formation of natural compounds like amino acids etc. The formation potential of bioNER can be predicted by using the theoretical microbial yield, which can be estimated using the Microbial Turnover to Biomass (MTB) method. In addition the amount of bioNER can be experimentally quantified by labelling with stable or radioactive isotopes. bioNER are of no environmental concern. Type
II NER and type I NER should be considered as potentially releasable residues in persistence assessment but the probability of type II release is much lower. For these types the potential of remobilization needs to be tested and evaluated. Our concept is to consider the total amount of NER minus bioNER as the amount of potentially remobilizable xenonER (type I + II). If a clear differentiation of type I and type II is possible and the latter is irreversibly bound, only type I NER needs to be considered in the persistence assessment. If no characterization of NER is available, we recommend to assess the total amount as potentially remobilizable.

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, the knowledge extrapolated from a photosensitiser generated induced radical cation (from laboratory studies) can be applied at the last step of calculation, which gave rise to half the irradiance at depth of natural waters. The irradiance values at depth were obtained by applying diffuse attenuation coefficients, Kd, in the presence of CDOM* which is certainly the least understood one in terms of its nature (which is a consequence of the poorly known nature of CDOM) and reactivity. Still, if the phototransformation involves reactive transients such as 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.

Photodegradation Half-lives of a Fragrance Ingredient in Natural Waters at Depth Calculated from Laboratory Study Results

L Liu, Firmenich Research & Development; K. McNeill, ETH Zurich / Institute of Biogeochemistry and Pollutant Dynamics; M. Emberger, A. Casili, V. Hewins, Firmenich, Inc / Research & Development; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs

Photodegradation, an important abiotic degradation process, is rarely considered in the environmental fate models, which have been developed from the photolysis 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. The theoretical and applied sciences (DiSTA); M. Minella, D. Vione, University of Torino / Chemistry

Chemical reactions driven by sunlight are important processes in surface freshwaters, where they are involved in the transformation of xenobiotic molecules and of naturally occurring compounds. The relevant reactions are generally divided into four categories: direct photolysis, photoreduction, photodegradation and indirect photolysis. Direct photolysis involves molecules that absorb sunlight and are transformed as a consequence. Indirect photolysis involves reactive transients such as HO, CO₂, O₂ and the triplet states of chlorophyll a (CDOM). They are generated by irradiation of photostabilizers such as CDOM (producing 'CDOM'), 'CDOM', O₂ and OH, nitrate and nitrite (producing 'OH). Among these transient species, 'CDOM' is certainly the most abundant one in natural waters (which is a consequence of the poorly known nature of CDOM) and reactivity. Still, 'CDOM' is involved into the transformation of several organic pollutants. In this work different triplet sensitizers that may be used as surrogates to estimate second-order rate constants with CDOM have been studied in silico. In particular, the experimental second-order reaction rate constants measured for the photolysis of 49 pesticides that are commonly used as CDOM proxies (1-nitronaphthalene (1-NN), riboflavin (Rbf), 4-carboxybenzophenone (4CBP), and anthraquinone-2-sulfonate (AQS)) have been used to derive Quantitative Structure-Activity Relationships on the basis of theoretical molecular
Innovative analytical method to enhance POPs and emerging pollutants

WE069
In silico Tools to Assess the Confidence of QSAR Model Predictions
R. Kühl, Helmholz centre for environmental research - UFZ / Department ofEcological Chemistry; S.S. Kutsarova, O. Mekenyann, University of Zlataros / Laboratory of Mathematical Chemistry; G. Schuermann, Helmholz centre for environmental research - UFZ / Department of Ecological Chemistry

For the regulatory acceptability of QSAR predictions solid information about the reliability of the applied models is crucial. This regards the model in general as well as the particular prediction for a certain chemical. The presented study provides computerized tools to support the assignment of prediction reliabilities. The first topic of concern is the applicability domain. Generally, the applicability domain comprises various aspects. The focus of this presentation is on the mechanistic domain and on the chemical domain in terms of structures and substructures. In particular, the application of atom-centered fragments (ACF) is demonstrated. While ACF characterization of the general structural domain of a training set is established already, the approaches shown here provide more specific information about the reliability of a prediction. On one hand, this is achieved by extending the ACF concept to the compound set. Furthermore, data sets are separated into subsets with regard to performance or value ranges, and these subsets are employed to derive advanced reliability indicators. Secondly, automatically obtained model selectors can assist in selecting the presumably best-performing model from a model suite for a certain chemical depending on its structure and properties. Model selectors in this regard are computed scores derived from application of the model suite to chemicals with known experimental data. Thirdly, consensus modelling strategies are presented and examined to compensate for individual model errors. When combining predictions from different models, consensus outcomes can accordingly increase the levels of confidence, while conflicting outcomes are indicating lower reliabilities. In this respect, specific indicators can be derived in silico methods of Ecological Chemistry 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.

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WE070
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 / Regulatory Affairs Center, Kitech

ECOSAR is a computer based QSAR 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 show a 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 hydrizine shows almost equal value in fish toxicity. According to the results, ECOSAR may not applicable to all types of chemicals within the acceptable limit of regulatory system. In this study, we are going to further investigate ECOSAR program to categorize chemical classes showing higher applicability, which may reduce the error of ECOSAR in regulatory area.

WE068
Water Treatment - A Regulatory Challenge under Regulation (EC) No 1107/2009
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Regulation (EC) No 1107/2009 aims to protect humans and the environment and lays down rules for the authorisation of plant protection products in commercial form and for their placing on the market, use and control. Plant protection products consist of or contain active substances, i.e. the molecules or materials responsible for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the appraisal 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 on non-plants, test species and endpoints have been published. If 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.

WE071
The identification of persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic (PBT) chemicals defined in Article 57(1) of REACH
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The identification of polychlorinated biphenyls in top predators nearly 50 years ago led to the establishment of many environmental chemistry regulations and chemical regulatory frameworks directed towards persistent, bioaccumulative, toxic (PBT) or a very persistent, very bioaccumulative (vPvB) chemicals. In order to protect human and the environment, additional physico-chemical properties to PBT and vPvB may be relevant to consider. Mobility is one of these additional properties and persistent, mobile, toxic or very persistent very mobile compounds are already problematic and the ECOSAR program used as alternative approach to REACH and registrants/manufacturers are not obligated to carry out an assessment of mobility. Here we present a case for the consideration of PMT and vPvM as substances of very high concern (SVHC) based on their identification through...
article 57(f) of REACH based on a demonstrated equivalent level of concern (ELoC) as PBT or vPvB substances. In order to identify PMT as a substance of ELoC it must be demonstrated that there is “scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern” and that there is evidence from a risk based considerations that the substance may cause serious effects during use and after through consideration, it should be determined whether the substance can be identified. The harmonized substance on the candidate list is the most effective strategy management strategy. With the protection of drinking and surface 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. Despite these accumulative properties are able to accumulate in a closed loop system. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE072 How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

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UBA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PvM) substances by using a combination of QSAR screening and PARTRIDGE software for the screening of vPvM/PMT substances. The objective is to map the risk profile of a given substance and to provide a qualitative assessment of the potential environmental impacts on wildlife species and human health. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish QSAR DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to add mobile (M) and very mobile (vM) properties as a screening tool for substances with a potential for mammalian and non-mammalian toxicity to wildlife species and human health. The results of the screenings identify the potentially vPvM and vPvB 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 also applied on the top the screening algorithms for P and M properties as a screening tool for substances with a potential for mammalian and non-mammalian toxicity to wildlife species and human health. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish QSAR DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to address specific substance groups of interest; substances registered after the last REACH registration deadline; or address future modifications, if relevant, in the proposed vPvM/PMT criteria.

WE073 Identifying PMT substances amongst REACH registered substances

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The chemicals that have the greatest chances of appearing in drinking water are those that are mobile in the aquatic environment enough to enter drinking water sources and persistent enough to survive water treatment processes. Despite the growing demand for permeable barriers chemicals reaching the water market have received only 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. Among 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

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

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Per- and polyfluoralkyl substances (PFAS) is a term that describes a wide and diverse array of chemistry containing fluoride 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. These are normally side-chain fluorinated polymers typically applied in combination with other finishing auxiliaries. The side-chain polymeric fluorotelomer-based products perform exceptionally well and provide superior stain and critical properties on high-end performance garments, workwear, first responder gear and other textile products. Within the non-polymeric PFAS category, fluorotelomer-based surface active agents (“fluorosurfactants”) are used in complex multi-component formulations such as Cleaning Products, Paints, Coatings and Aqueous Film Forming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and have higher critical micelle concentrations (CMC). The shorter chain fluorotelomer-based AFFF products have the potential to be released during use and could create an environmental footprint. Thus it is essential to follow published best practice guidance (BPG) in handling these products. This poster will highlight recent advances in toxicology, including multiple endocrine evaluations, safer-alternatives assessment methodology, analytical advances, challenges and success in the development of short-chain fluorotelomer-based products and an overview of their value in multiple applications.

WE075 LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids in Veneto region (Italy)

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In 2013 a significant episodic 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 fluorochemical 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, named LIFE PHOENIX, has been proposed and then funded. The activities of the LIFE-Phoenix project, acronym for “Perfluorinated compounds Holistic Environmental Institutional eXperience” started on 2017 and will run until 2020. LIFE PHOENIX project aims to develop a monitoring and risk management system, supported through innovative forecast tools based on ongoing monitoring, can manage risks related to the diffusion of persistent mobile organic contaminants (PMOC) such as short chain PFAS. This project will develop a set of institutional procedures and tools to assess and possibly prevent as well as respond to risks for environment and human health with the contribution of multidisciplinary specialists who will develop tools, protocols, guidelines and indications to assist authorities managing risks and emergency. The project will validate and compare some innovative technological tools for the mitigation of PFAS concentration in the water through a pilot plant adopting different techniques for the purification of irrigation water and drinking water, using full-scale plant (wetland system) and physico-chemical plans breakdown system (filters). The technologies applied to these experimental sites will be incorporated into an integrated management system that will serve as a model for managing analogous chemical pollution events from persistent and soluble polar substances.

WE076 Ecotoxicological characterization of aquifers at Junín Formation and Pampeano from Hydrogeological Sub-Region II, Buenos Aires Argentina

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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 of sandy and silty sediments to silty loams 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 Platane), normally do not exceed 5 m in thickness and usually have calcareous (coarse) levels. The alluvial and colluvial deposits (sandy silts, sands, gravels and blocks) have a reduced vertical and areal expression. The samples were characterized according their main anionic and cationic constituents, presence of glycolipids and chlorpyrifos, TOC, arsenic and fluoride. Also, cyto and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eesenia fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates founded. They were mainly made up of Copepods, Acrac, Collembsula, Insecta, Oligochaeta, Nematoidea. A preliminary biotic and ecotoxic index were created to characterize each sampling well.

WE077 Chemical analysis, monitoring and toxicological evaluation of very polar compounds in drinking water and drinking water sources
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Very polar organic compounds are of special interest for drinking water utilities, since these substances can 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, 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 contaminants 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 cyanurate, cyanuric acid and naphthalene. Despite of the high removal rates 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 polar compounds a toxicological risk assessment is performed and results will be presented.

WE078 Beyond DEHP: High-molecular-weight phthalates and non-phthalate plasticizers in German rivers
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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 is known about the presence of other phthalates and non-phthalate plasticizers. In contrast, there is a scarcity on the occurrence, 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 obtained 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 Di(2-ethylhexyl) phthalate (DEHP), as potential chemicals of emerging concern with increasing levels.

Wastewater effluents: How research can improve risk assessment and regulation (P)
WE079 Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study
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Aquatic pollution resulting from industrial activities, especially textile, leather, food and agrochemicals, is a major concern. Dyeing processes of fabrics produces approximately 80% of the total textile wastewaters, containing low-dissolved, residual concentrations of dye effluents reduce light penetration in the water column, and affect photosynthesis of phytoplankton. In addition, azo dyes are synthesized from carcinogenic compounds, such as benzidine, this can threat the aquatic biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct Blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia). The microalgae was exposed to 4, 8, 16, 32 and 64 mg L\(^{-1}\) DB15 (96 h, 25°C, and continuous illumination of 120 μmol m\(^{-2}\) s\(^{-1}\)); the effects of DB15 on photosynthetic pigment and macromolecules content (proteins, carbohydrates and lipids) were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations were 100, 200, 400 and 500 mg L\(^{-1}\); at 25°C, 16.8 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L\(^{-1}\) DB15 (7 days at 25°C; 16:8 h photoperiod, 1 X 10\(^{4}\) cell mL\(^{-1}\) of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (IC\(_{50}\), 13.30 mg L\(^{-1}\)) than C. dubia (IC\(_{50}\), 450 mg L\(^{-1}\)). Chloropha. a and 6 were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations. Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all DB15 concentrations were significantly higher than that measured in the control. In the highest DB15 concentrations, total progeny, number of released clutches, and reproduction were significantly decreased in C. quadriga; but age at first reproduction was significantly increased at 20 and 25 mg L\(^{-1}\). Results demonstrated that DB15 dye caused toxic effects of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into water bodies.

WE080 Integrated biomarker response calculation as a useful tool to assess the impact of effluents on the health status of fish
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Wastewater treatment plants (WWTPs) are considered as one of the major sources of micropollutants in the aquatic environment. Many compounds have been linked to toxic and endocrine effects in aquatic organisms. The present study examines the impact of three WWTPs situated on different streams in Southern Germany on the health status of fish. Two WWTPs were located in the upstream section of different streams in Southern Germany, and one WWTP was located in the downstream section of a different stream in Southern Germany. The impact of the WWTP upgrade with activated carbon was investigated by comparing results of caging exposures conducted prior and subsequent to the upgrade. Several biomarkers, including histopathological alterations, the formation of micronuclei and binuclei, changes in vitellogenin levels, induction of hepatic ER\(_D\) activity, and changes in stress protein levels were examined, and the integrated biological responses (IBR) were calculated for the downstream exposure sites according to Sanchez et al. (2013), using the respective upstream site as a reference. IBR values for the conventional treatment plants (WWTP 1 and 2) differed slightly from each other, with WWTP 2 showing three to five times higher indices than WWTP 1. However, the highest IBR values were detected for male fish exposed downstream of the third WWTP prior to the upgrade with an activated carbon filter unit. After the installation of the additional treatment technology, a pronounced reduction of the biological responses was observed, indicating that the biomarkers proved to be a suitable approach to assess the impact of WWTP effluents on the health status of fish. Furthermore, it was a helpful tool to reveal the advantages of WWTP upgrading with powered activated carbon.

WE081 Application of eco-genotoxicochemical and microbiological parameters for the assessment of the quality of wastewater industrial reuse
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Pharmaceutical residues in sewage effluents pollute the aquatic environment and may adversely affect fish populations. Conventional sewage treatment plants (STP) are not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBPs) 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 O₂ L⁻¹). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 light:dark cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by 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 influenced both organic and a few inorganic compounds in water. A second ozonation treatment (UV/H₂O₂) through tests with angula seeds (Erucà sativa) and Artemia salina. Samples of secondary effluent from a pilot plant located at the School of Technology campus (UNICAMP, São Paulo, Brazil) were collected immediately after the secondary treatment and then they were treated and analyzed in triplicate. The biological reactor was a hybrid: septic tank - anaerobic filter. After collection, 200 mL samples of the sample were exposed to the laboratory and stored at 4°C. Based on the preliminary tests it can be concluded that the secondary effluent treatment by UV/H₂O₂ in presence of high concentration of metals, nitrate, carbonate and industrial contaminants has no significant increase on toxicity.

WE085 Hospital effluent induced oxidative stress on Xenopus laevis larvae
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Hospitals are one of the main sources of emerging pollutants to wastewater treatment plants (WWTP) that usually are fairly equipped to treat this kind of compounds. Activities performed in hospitals require the use of several compounds, which are potentially toxic, they can reach municipal wastewater, affecting when they get into municipal waste water treatment plants, in some cases the procedure carried out in this WWTP is not able to remove all the contaminants, when they are not properly disposed, exposure to them can generate harmful effects on aquatic organisms. Physicochemical and pharmaceutical (11 pharmaceuticals) characterization of the hospital effluent were made, results shown a high concentration of mercury, and pharmaceuticals on concentrations of µg/L. Also oxidative stress was evaluated on Xenopus laevis larvae exposed to this hospital effluent; twenty oocytes were selected for each exposed group (control, 0.1, 0.3, 0.5, 0.7, 0.9 and 1%) in the middle blast stage, they were maintained at constant temperature 23 ± 2 °C, for 96 hours until they reached the larval stage. They were
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 antiretroviral nevirapine, commonly used in Africa, has showed persistency (similarly to studies on the antiepileptic carbazepine in Western countries) the occurrence of nevirapine will be studied to test its suitability as indicator of sewage pollution in African river bodies. The implementation of obtained findings this study contributes to the development of a methodology for the determination of the impact zone spatial boundaries and a dedicated environmental risk assessment approach for APIs in the impact zone.

Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis

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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 biomimincs assay using the target species Vibrio fischeri, yeast estrogenic screen (YES) and yeast androgenic screen (YAS)) to detect the presence and activity of current and emerging contaminants, it was found that of the 12 pesticides showed either antiestrogenic or antiandrogenic activity and 7 compounds showed pleiotropic effects. This study was first to confirm endocrine activities based on yeast-based assays of recent neonicotinoids. The use of extended time points for the Vibrio fischeri, beyond the traditional 30 minutes, highlighted the bioactivity 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, mylobutanil and tebuconazole) by ozonation and demonstrated the recalcitrant nature of pesticides during ozonation. This study is one of the first to investigate antiandrogenic activity during the ozonation of a mixture of pesticides and an increase in the impact was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality
metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW)) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final repository for contaminants within the Adriatic Sea.

WE902 Photocatalysis as a potential pre-treatment process to reduce organic pesticide entries

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For protecting their crops many wine growers apply plant protection products (PPPs), which may accidentally end up in the aquatic environment e.g. after being washed off from agricultural machinery (AM). Once there, PPPs can negatively impact aquatic life which has been endangered by UV light. This is a product related difference in the degradation potential of TiO₂ for the selected PPPs was observed. However, for a final statement whether TiO₂ can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

WE903 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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Microalgae are promising options for energy generation through the degradation of industrial and domestic effluents using electroactive microorganisms, these systems coupled to build wetlands (BES/CA) acquire the capacity to treat effluents of various kind. 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 acute toxicity tests were conducted. In detail, Daphnia magna was exposed for 48 h to (un-)treated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytic treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO₂ to reduce PPP concentrations and associated toxicity in water which was treated by UV light. This is a product related difference in the degradation potential of TiO₂ for the selected PPPs was observed. However, for a final statement whether TiO₂ can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mA/m² and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13:00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a sustainable option for the generation of energy from domestic waters from secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto A Sawdust-Based Adsorbent

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Wastewaters from textile and other dye-using industries usually contain more than one dye. In such an aqueous matrix therefore, the adsorptive characteristics of a dye species are likely to be affected by the presence of the other dye species in the medium. The removal of crystal violet from aqueous solution by sulphuric acid nitrification, in the presence of malachite green, methylene blue and rhodamine B on its adsorption from binary, ternary, and quaternary dye systems were studied. The combined effect of mixture components and process parameters on the adsorption was studied and optimized using response surface methodology. The adsorbent was characterized and the experimental data obtained were fitted to different kinetics and isotherm models. The experimental results were analyzed using analysis of variance (ANOVA) standard concept. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolorisation of 68.39 mg/L CV (97.2%). A linear model was used for the decolorization process through this design. The experimental values obtained were in good agreement with 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 < -2.30 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 diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants. The wastewater samples were taken at Ladehammeren (HÖRA) in Trondheim, Norway. Both WWTPs have significant industrial loading from nearby industries and also receive large amounts of industry wastewater. Iron (Fe), Nickel (Ni) and Sulfur (S) were significantly higher in the influent and effluent wastewater, as well as sludge samples, taken to determine influent concentrations and removal of Al, P, S, Cr, Fe, Ni, Cu, Zn, As, Cd and Pb. To study release patterns and process parameters on the adsorption was studied and optimized using response surface methodology. The adsorbent was characterized by analysis of variance (ANOVA) standard concept. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolorisation of 68.39 mg/L CV (97.2%). A linear model was used for the decolorization process through this design. The experimental values obtained were in good agreement with 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 < -2.30 to -6.13 kJ/mol) and had increased entropy.

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 phases from the river’s wastewater treatment plant system 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 effects of the effluents into the environment, a full-scale ozonation is implemented into the WWTPs resulting from its effluent. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if E. coli has any impacts on invertebrate diversity.

WE097 The Demon3AC-project: Chemical and ecotoxicological investigations of the wastewater treatment plant Aachen

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Microplllutants (MPs) in municipal wastewater, like pharmaceuticals, are not sufficiently removed by conventional cleaning methods in wastewater treatment plants (WWTPs). As a consequence, complex mixtures of MPs discharged into the receiving streams and may cause various effects on the aquatic biota. To decrease the entrance 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 downstream stretch of the River Wurm. 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. fish. fish demonstrated 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. pulx. No significant differences in feeding rate between the sampling sites were recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the mutagenic and endocrine effects originates by dilution effect and as such 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. Wagelmans, 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 overlap needs to be discarded and burnt after dredging while 'normal' sediment can be reused as soil. Discard and burning is expensive for water boards, besides the fact that it costs a lot of energy and causes air pollution due to transportation, which is not sustainable. Also it causes a loss of raw materials. The water board Noordzeerijvest has started a pilot for reducing sewage overflow dredgings as new nutrition proposals for agriculture. For this purpose two depots have been set up: one with reference sediment and one with overflow sediment. During one year the concentrations of pharmaceuticals and pathogens will be monitored as well as antibiotic resistance and endocrine disruption. The basis of the project is the hypothesis that pathogens will be killed during the process of drying and pharmaceuticals will be (biologically) degraded which makes a reduction of the pollutants possible. In June 2017 the sediments were sampled and analysed. In October dredging was performed and the pilots have been set up. The first monitoring round was performed one week after set up. In each monitoring round chemical analyses are performed on pharmaceuticals. Pathogens are identified by both culturing methods and Next Generation Sequencing (NGS), combined with viable PCR analyses to quantify specific pathogens that have been identified by NGS. Antibiotic resistance will be monitored by means of 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 up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for future possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at oil refinery industry in Kazakhstan I. Radlevyuk, Lund University / Department of Building and Environmental Technology, K. Tussupova, LTH, Lund University / Department of Building and Environmental Technology. This paper presents the first attempt to assess the wastewater treatment processes at the oil refinery sector in Kazakhstan and evaluate to what extent these processes follow international and national regulations regarding industrial waste water treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan does not have national environmental regulation promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. The national regulation allows discharge of wastewater to natural or artificial ponds by not exceeding the concentration of pollutants already existing in the pond. Therefore, the factories use ponds without any treatment of the effluents, 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 start of the environmental regulations. This leads to no incentive to treat wastewater in an efficient way. Additionally, the national law lacks regulations regarding detailed 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, none of the factories provides analyses of, e.g., heavy metal concentrations in the wastewater. Consequently, it is strongly recommended to provide a unified and transparent detailed methodology to assess the wastewater treatment processes at the oil refinery industry in Kazakhstan and evaluate to what extent these processes follow international and national regulations regarding industrial waste water treatment.

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, 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 multitrophic aquaculture systems (IMTAs) 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 macroalgal in human diets not only in Asia but also in Europe, we can ultimately ingest high levels of these contaminants, which are not degraded 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 environments could be designed in order to prevent contamination with antibiotics. As biofilters, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application M. Virts, K. Pärnänen, University of Helsinki; R.D. Stedfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; J. Muurinen, University of Helsinki / Food and Environmental Sciences Production animal farms are proposed to act as reservoirs where genetic material from farm animals may transfer to the environment. The transmission can occur through discharges of manure effluents. Consequently, the occurrence of antibiotic resistance genes (ARGs) in water and sediments may increase due to agricultural practices. This paper presents the first attempt to assess the occurrence of antibiotic resistance genes in manure, stored manure and soil from a dairy farm in Kazakhstan and evaluate to what extent these processes follow national and international regulations regarding the management of manure effluents. The assessment was performed considering an efficient way. Additionally, the national law lacks regulations regarding the management of manure effluents. Thus, the assessment by environmental authorities for each oil refinery sector in Kazakhstan and evaluate to what extent these processes follow national and international regulations regarding the management of manure effluents. This project will be sketched. then the results of the monitoring up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for future possibilities will be given as well as the meaning of the project for other water boards.

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

WE102 Bioaccumulation, biochemical responses and gene expression in the marine clam Scrobicularia plana exposed to a pharmaceutical mixture at sub-limit concentrations C. Trombini, CSIC Spanish National Research Council ICMAN / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR University of Cadiz; J. Kazakova, R. Fernandez-Torres, M. Bello-López, University of Seville; J. Blasco Moreno, CSIC Spanish National Research Council ICMAN / ECOLOGY AND COASTAL MANAGEMENT. Pharmaceutical compounds are pollutants of potential concern in the aquatic environment where they are commonly introduced as complex mixtures as a result of incomplete waste water treatment plant removal processes and improper disposal. Despite of pharmaceuticals occurring in the aquatic environments at trace levels (ng L-1 to low μg L-1), they have been specifically designed to be biologically active at low concentrations in human and aquatic ecosystems. Therefore it is reasonable to assume that aquatic wildlife may also be susceptible to their effects particularly under condition of combined and chronic exposure. Hence the need to characterize biological effects of non-target organisms exposed to sub-limit concentrations of pharmaceutical mixtures. Busprofen (IBU) is one of the most used non-steroidal anti-inflammatory drugs; its ability to induce toxic effects (i.e. oxidative stress, neurotoxicity, endocrine disruption, immunological alterations) in aquatic organisms at environmentally relevant concentration is well demonstrated. Ciprofloxacin (CIP) and flumequine (FL) are broad-spectrum antibiotics of the fluoroquinolones class. Fluoroquinolones toxicity was observed in rodents
producing among others oxidative stress, cyto, neuro and hepatotoxicity were induced after treatment with CIP in mice and rats. However, ecotoxicological effects on aquatic organisms of CIP and FL are practically unknown. In our study specimens of the clam Scrobicularia plana were exposed to control water and a mixture of IBU, CIP and FL at close environmentally relevant concentrations (10 y 100 µg/L each) during 21 days with the aim of studying toxicological responses along the life time of the organism along the post-exposure depuration. Bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPX activities and LPO levels), detoxification (GST activity) and neurotoxicity (AChE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

WE103 Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies
E. Han, D. Lee, Seoul National University / Environmental Planning Institute Graduate School of Environmental Studies
In recent decades, pharmaceuticals in the environment have been concerns for environmental and public health. Especially, the residues of antibiotics in the environment could lead to adverse effects on non-target organisms, contamination of food and drinking water supplies, and increased antimicrobial resistance (AMR). Since 2000s, in Korea, the policies for reducing antibiotics usage, such as Separation of Dispensing and Prescribing of Drug, or Restriction of Adding Antibiotics in Animal Feed, have been enforced in view of public health management. The antibiotic usage 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 20s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy about pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Han; Dong Soo Lee, Application of emiss

WE104 Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics
G.C. Le Pagg, University of Exeter / College of Life and Environmental Sci; M. Trznadel, L. Gunnarsson, University of Exeter / Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects upon microorganisms communities and to human health through antibiotic 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 (API) is proven 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 microtitre assay that broadly follows and meets the validity criteria of the OECD 201 test guideline as a cost effective way to determine the effect of antibiotics on cyanobacteria growth. We applied this assay to determine growth-rate effects on 8 species of cyanobacteria and total antibiotics to establish differences in species sensitivity for the improvement of the ERA of antibiotics. Our key findings are: 1) the performance of the microtitre assay is suitable for accurate and reliable assessment of effects on growth inhibition in a wide range of bacterial species; 2) differences in cyanobacteria sensitivity to antibiotics can span several orders of magnitude; and 3) the current framework for ERA of antibiotics inadequately addresses the risk to bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established.

Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum
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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 community and 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 diet containing CIP, or to water containing CIP. To test whether CIP- exposed 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 functional 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 fugal 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.

Efficacy of removal antimicrobial resistance genes during avian manure composting process.
F. Esponor, M. Delgado, M. Carbello, INIA - National Institute for Agricultural and Food Research and Technology; M. Ugarte-Ruiz, M. Moreno, UCM; J. Tadeo, INIA - National Institute for Agricultural and Food Research and Technology; Adela de la Torre, INIA National Institute for Agricultural and Food Research and Technology / Environmental Health Antimicrobial resistance (AR) is an emerging and global problem. Therefore, there is currently a remarkable effort to understand the mechanisms of resistance, to promote the responsible use of antimicrobials and to seek effective therapeutic alternatives. While most livestock studies are focused along the food chain, there are few available studies about the role of livestock manure in the spread of AR. The direct application of animal waste (or slurry) to crops may favor the transmission of AR from cattle to vegetables. The objective of this work is to evaluate the impact of the composting process on the persistence of AR genes. For this, a composting of 10 weeks of duration has been carried out from straw and avian manure, from a layer hen production. Composting samples were taken in triplicate at the end of each week, and total DNA was extracted from each. 22 genes coding for resistance to tetracyclines, sulfonamides, phenicols, aminoglycosides, quinolones, beta lactams, vancomycin and colistin were detected and quantified by real-time PCR. 16 of the 22 genes were detected in at least one sample. Analysis of the temporal evolution of the resistances shows that there is a marked reduction (> 97%) in the genes coding for tetracycline, b-lactam, quinolone and macrolide resistances, while an increase in aminoglycoside and sulfonamides 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

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University of Coimbra; A. Freitas, A. Vila-Pousa, INIAV - Instituto Nacional de Investigación Agrícola y Veterinaria; J. Rosa, CFE - Centre for Functional Ecology / Department of Life Sciences University of Coimbra; J. Barbosa, INIAV - Instituto Nacional de Investigación Agrícola y Veterinaria; F. Ramos, Faculty of Pharmacy University of Coimbra; P. Reis-Santos, L.A. Duarte, M.P. Pais, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCLUL; V.F. Fonseca, MARE - Marine and Environmental Sciences Centre;

Environmental pharmaceuticals contamination is now a recognized threat in coastal and estuarine ecosystems representing unknown and potentially harmful effects to non-target organisms. It is therefore paramount to monitor their presence in the environment and to evaluate the extent of their influence. The Tejo estuary, located on the Atlantic coast of Portugal, was established as a showcase for the environmental occurrence of pharmaceuticals due to the proximity to very urbanized areas in the Great Lisbon Region, with sewage disposal and discharges from industries, hospitals, agricultural and fish farms in upstream areas as well as urban effluents, anticipating the presence of contaminants. A monitoring campaign was conducted during summer where water, sediment, macroalgae, invertebrates and fish were sampled for pharmaceutical determination. Thirty sampling stations were selected according to their proximity to discharge points where effluents were expected to be rich in pharmaceuticals but also including reference sites where contamination was expected to be very low. Multi-residue multi-class analytical methods developed for each matrix are being applied for the detection and quantification of 67 compounds. The compounds monitored included antiepileptic and antidepressant compounds, benzodiazepines, anticonvulsant drugs, antihypertensive drugs, and angiotensin receptor blockers, b-blockers and antibiotics (42 compounds) in a total of 67 drugs. Multi-residue multi-class analytical UHPLC-ToF MS methods developed for each matrix are being applied for the detection and quantification. The knowledge gathered will then be applied to exposure assays and antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations and in mixtures. The knowledge gathered will then be applied to antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations.

WE108 Environmental risk of enrofloxacin used in aviculture

M. Gómez-Aguillo, M. Delgado, F. Rosón, INIA - National Institute for Agricultural and Food Research and Technology; M. González, INIA - National Institute for Agricultural and Food Research and Technology / CISA; J. Tadeo, INIA - National Institute for Agricultural and Food Research and Technology; A. de la Torre, INIA - National Institute for Agricultural and Food Research and Technology / Environmental Health

Antibiotics are one of the main categories of pharmaceuticals and their release into the environment may spread as a reservoir not only for residues, but also for antimicrobial resistance genes, and pose a threat to antimicrobial therapies. Studies on the presence of antimicrobial residues in animal excreta supposes a health and environmental risk. The presence of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The environmental risk (RQ) of antibiotics can be estimated using different risk assessment methodologies. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. The risk assessment of antimicrobial residues in animal excreta supposes a health and environmental risk associated with its agricultural re-use. 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Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil

L. Patronecchi, Water Research Institute-National Research Council / Water Research Institute; J. Rauseo, National Research Council / Institute of Water Research IRSA-CNR; W. Gaze, University of Exeter / Medical School; I. Stanton, University of Exeter; N. Ademollo, M. Cardoni, National Research Council of Italy / Water Research Institute; M. Di Lenola, National Research Council of Italy; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; F. Spatara, National Research Council of Italy / Water Research, the in; A. Barra Caracchio, National Research Council / Water Research Institute

Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulfonamide antibiotics, due to its ability to inhibit Gram-positive and Gram-negative bacteria it is used in veterinary practices, agriculture and livestock breeding both for treating diseases and promoting growth. However, current knowledge about its persistence and possible environmental effects is poorly understood. In the present study, we investigated the persistence and the possible effects on the soil natural microbial community of SMX in an agricultural soil amended with solid anaerobic digestate from bovine manure anaerobic fermentation. Microcosms, containing soil and digestate treated with 20 mg/Kg of SMX, were set up in the presence/absence (sterilized soil) of the natural microbial community. Moreover, non-antibiotic-treated microcosms were used as microbiological controls. At fixed times (0d, 7d, 13d, 20d, 61d), SMX residual concentrations (ASE extraction and HPLC-UV detection) and microbiological parameters (cell viability, abundance and activity) were analysed. Finally, a molecular analysis of the antibiotic resistance genes (class I integrons) was investigated at the start and the end of the experiment using qPCR. Results showed that although an acute negative effect (0d) was observed on the microbial abundance and viability, the antibiotic was degraded in just a few days. Interestingly, the intI 1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

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 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

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Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil

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Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulfonamide antibiotics, due to its ability to inhibit Gram-positive and Gram-negative bacteria it is used in veterinary practices, agriculture and livestock breeding both for treating diseases and promoting growth. However, current knowledge about its persistence and possible environmental effects is poorly understood. In the present study, we investigated the persistence and the possible effects on the soil natural microbial community of SMX in an agricultural soil amended with solid anaerobic digestate from bovine manure anaerobic fermentation. Microcosms, containing soil and digestate treated with 20 mg/Kg of SMX, were set up in the presence/absence (sterilized soil) of the natural microbial community. Moreover, non-antibiotic-treated microcosms were used as microbiological controls. At fixed times (0d, 7d, 13d, 20d, 61d), SMX residual concentrations (ASE extraction and HPLC-UV detection) and microbiological parameters (cell viability, abundance and activity) were analysed. Finally, a molecular analysis of the antibiotic resistance genes (class I integrons) was investigated at the start and the end of the experiment using qPCR. Results showed that although an acute negative effect (0d) was observed on the microbial abundance and viability, the antibiotic was degraded in just a few days. Interestingly, the intI 1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

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WE114

Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its impact on the microbial communities of an agricultural soil amended with organic waste products

J.M. MARTINS, CNRS IGE UMR 5001, Univ. Grenoble / OSUG-IGE; E. François, L. Spadini, J. Granat, C. Humbert, E. Vîncu, M. Morel, Institut Geosciences & Environnement

The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural soils and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feuchères (INRA Versailles, France). SMX revealed to be a weak sorbent since in batches only 10% of SMX sorbed at a solid/solution ratio of 0.1. It’s sorption increased strongly with soil organic matter content (addition of manure), indicating that the essential feature of OM addition is an increase in sorption sites density at almost constant sorption strength, and confirms previous results about the strong influence of sorbed complexants such as Cu(II). The mobility of SMX evaluated in water-saturated columns showed higher mobility of SMX than expected from the sorption study. Unexpectedly, this increased mobility was observed in the more organic soil, suggesting that SMX 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-dominated silica fraction of the soil in agreement with its low microbial biomass content. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, sul1 and sul2), DGGE fingerprinting and high throughput sequencing revealed important impacts of SMX on soil microbial biodiversity and species richness and the emergence of specific taxons, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil. SMX, upon mobile DNA element 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

J. Maurin, University of Helsinki / Food and Environmental Sciences; K. Pärnänen, J. Hultman, M. Wuziasari, University of Helsinki; R.D. Stedtfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; M. Virta, University of Helsinki

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. moreover, aquaculture relies on 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. We have used the combination of different methods for obtaining that information: Parallel quantitative PCR array for high throughput quantification (1), epicPCR(2) for host information and Inverse-PCR(3) for analysis of the genetic environment. Inverse-PCR and epicPCR combined with DNA sequencing resolve also the sequence of the resistance gene. Samples were collected from different locations in Finland: manure from cattle and pig farms, soil that received the manure as fertilizer, sediments from aquaculture farms and effluent, influent and activated sludge from waste water treatment plant. Our results demonstrate that human activities results to the increase to the abundance of antibiotic resistance genes. In many cases the genes are located in mobile genetic elements with increases the probability of transfer of the them between bacterial species. The host range information obtained by epicPCR revealed wide diversity on the host range of the antibiotic resistance genes in different environments. Our results can be used for the development ecotoxicological risk analysis for antibiotic resistance. (1) Karkman, A., Johnson, T.A., Lyra, C., Stedtfeld, R.D., Tamminen, M., Tiedje, J.M. and Virta, M. (2016) FEMS Microbial Ecology 92 (3): fwi014 (2) Spencer, SJ., Tamminen, M., Persi, M., Gaze, W., Gouw, M., Saerens, A. and Schandel, M. (2015) Science; (3) Pärnänen, K., Karkman, A., Tamminen, M., Lyra, C., Paulin, L., Hultman J. and Virta, M. (2016) Scientific Reports 6: 35790

WE116

Risk of antibiotics in the environment

D.d. Silva Tavares Duarte, Radboud University / Department of Environmental Science; R. Oldenkamp, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science

For decades, pharmaceuticals have been fundamental tools against disease and infection targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spawning 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 shows that antimicrobial matrices are present in Kazakhstan in different environmental matrices (e.g. surface water). Interestingly, there are cases were gene variation is weakly correlated with antibiotic concentration (e.g. sediment) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of genes from microorganisms emissions (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 enrichment of bacterial communities within environmental contamination, readily biodegradable and resistant to hydrolysis. The high frequency of detection and relative persistence of SMX in environment cause a potential risk of antibiotic resistance spread in ecosystems. Multiple mechanisms confer sulphonamide resistance in bacteria, although data on biodegradation and spread of antibiotic resistance genes (ARGs) in natural water ecosystem are quite scarce. The aim of the present work was to investigate the SMX degradation in natural river water in presence/absence of the microbial community and to identify the occurrence of sul genes associated to the antibiotic resistance. Microcosm experiments were set up using river water treated with 500 µg/L of SMX. At fixed times, water sample were collected for chemical (SMX residual concentrations) and microbial analysis. The disappearance time of 50% of the initial SMX concentration (DT50) and the effects of the 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 that ARG spread is a physiological adaptation of natural microbial community to its presence.

WE118
The effect of antibiotics on representatives of aquatic algal and plant species B. Scott, C. Agnese, F. Piemontese / Department of Environment and Engineering in environmental protection; B. Scott, C. Agnese, F. Piemontese / Department of Environment and Engineering in environmental protection
Nowadays, pharmaceuticals are pollutants of increasing interest. The volume of the production of pharmaceuticals has been increasing rapidly in the last decade in Kazakhstan. Antibiotics make up a significant proportion of the pharmaceuticals sold in the country. The aim of the present study was to the impact of priority antibiotics in use in Kazakhstan on representative aquatic species. Lemma minor and Chlorella sp. were selected for the ecotoxicological investigations. Five major use antibiotics in Kazakhstan (amoxicillin, clarithromycin, azithromycin, sulfamethoxazole, oxytetracycline) and their mixture were used in the experimental assessments. The compounds were selected based on a previous prioritization study based on the risks of active pharmaceutical chemicals (APIs) to aquatic environments in Kazakhstan.

The study on Lemma minor was conducted according to the OECD Guidelines for the testing of chemicals 221. Lemma minor species were cultured in Swedish Standard (SIS) growth medium and effects of the antibiotics on growth assessed over 7 days. The results of the study showed EC50 values of each test compounds ranged from 2.8 to 21.8 mg/L. Lemma minor was most sensitive to the sulfamethoxazole, with its EC50 being below 10 mg/L. The test on algae was performed according to the OECD Guidelines for the testing of chemicals 201. Chlorella sp. were cultured in Tamura's medium and algae numbers were counted in Goryaev chamber under a microscope. The macrolobe substances azithromycin and clarithromycin were found to be the most toxic compounds to the algae with EC50 values being lower than 1 mg/L. In the future, it is recommended to perform assessments on the sensitivity of other less well studied aquatic species to priority APIs in Kazakhstan as well as monitoring studies to establish levels of exposure in the country. This will then provide a basis for the risk of these substances to be established.

WE119
The Presence of Human and Veterinary Antibiotics in Urban and Rural Soil Ecosystems of North Carolina
A.D. Gray, University of North Carolina at Greensboro / Biology; D. Todd, University of North Carolina at Greensboro / Chemistry; A.E. Hershey, University of North Carolina at Greensboro / Department of Biology
Antibiotic pollution is of concern to environmental health sciences due to the implications associated with their presence in the environment. There is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries. Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate and metabolize antibiotic pollutants. The presence of antibiotics in streams demonstrates the potential for antibiotics to be transferred from inland areas into larger water bodies. Antibiotics entering streams can arise from various sources. In urban areas, antibiotics of human and veterinary origin can enter streams due to runoff or leaching from surrounding areas, but most notably from wastewater discharges that release antibiotic directly into streams. In rural areas, antibiotics can enter streams from application in the maintenance of livestock, which due to runoff and leaching, can contribute to veterinary antibiotics being present in rural streams and groundwater. Work from the present study found human and veterinary antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfamethazine, trimethoprim, danofoxacin, sulfaquinoxaline, streptomycin, enrofloxacin, and tylison, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams is keys sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influences the presence of antibiotics in streams in urban and rural areas.

WE120
The Role of Water Quality Analysis: Understanding our process environment to inform AR
ton AR, T.P. Dodsworth, The University of Nottingham / Biosciences; R. Helliswell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Radaelli, Università Politecnica delle Marche
The Role of Water Quality Analysis: Understanding our process environment to inform AR
T.P. Dodsworth, The University of Nottingham / Biosciences; R. Helliswell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Radaelli, Università Politecnica delle Marche
The presence of antibiotic in agricultural slurry has been shown to affect the aquatic environment. Slurry is a by-product of animal husbandry and contains a range of antibiotics used in veterinary practice. These antibiotics can enter the water environment through the run off and leaching of slurry from agricultural land. The presence of antibiotics in streams and rivers can have a number of negative effects on aquatic life, including the alteration of ecological communities and the emergence of antibiotic-resistant bacteria. The aim of this study was to investigate the presence of antibiotics in agricultural slurry and to understand how this might be affecting the aquatic environment.

WE121
Safety and efficiency assessment of antibiotic administration by magnetic nanoparticles in Zebrafish
G. Chemello, C. Piccinetti, B. Randazzo, O. Carnevali, F. Maradonna, Università Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Radaelli, Università degli Studi di Padova; A. Fifi, Biotecnologie T.B. Srl / Ecotoxicological and chemical; F. Gligotti, CRO BioTecnologie BT; I. Olivotti, Università Politecnica delle Marche
The indiscriminate use of antibiotics in the aquaculture sector has raised public concern because of possible toxic effects, development of bacterial resistance, and accumulation of residues in individual tissues. Even if several countries have developed regulations about their use, it is clear that long-term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. Alternative strategies for better management of antibiotic administration are of primary interest to improve antibiotic resistance rates and, as a consequence, to lower their impact in the aquatic environment. The present study investigates, for the first time to our knowledge, a new methodology for oxytetracycline (OTC) administration through the use of iron oxide nanoparticles (NPs) (made of magnetite γ-Fe₂O₃) in zebrasfish (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 (through water); group C exposed to 4mg/L OTC, and group D exposed to bare NPs. HPLC analysis, histological analysis and other methods were applied to perform different evaluations. No detoxification processes or anatomical alterations were observed in fish exposed to bare NPs. Exposure of fish to the SAMNs@OTC complex resulted in a 10 times higher OTC accumulation with respect to using water exposure. This new method for OTC administration seems more efficient with respect to the traditional way of exposure and shows the potentiality to reduce antibiotic utilization and possible environmental impacts.

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

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES. J.R. Diniz, Universidad Estadual do Maranhão / Agroecologia; L. Capellini, Universidade Federal de São Paulo UNIFESP / Departamento de Química Fullerenes are allotrope forms of carbon produced in highly energetic processes of carbon origin or anthropogenic sources. In the last years, the increasing application of nanomaterials in several areas of human endeavor besides their physical and chemical properties, contribute for the growth of the global economy. However, the growing production and application of nanomaterials is also promoting discussions about the possible risks of these compounds to the environment and human health. Data have already been reported on the occurrence of fullerenes in different matrices, including the atmosphere, soils and sediments, and fresh water. Despite this, little information has been related to marine environments while coastal areas and estuaries are suspected to be one of their major sinks. The purpose of this study is developed and optimize an analytical method to evaluate the presence of nanomaterial fullerene (C60) in seawater samples. It will be tested two methods of extraction: dispersive liquid-liquid micro extraction (DLLME), and (2) QuEChERS, after, all the samples will be analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS). Keywords: Marine pollution. Fullerenes. Nanomaterials.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries. F. Chen, MTM Research Centre, Orebro University / SCHOOL OF SCIENCE AND TECHNOLOGY; U. Eriksson, R. Aro, MTM Research Centre Orebro University; L. W. Yeung, University of Örebro / Department of Chemistry; T. Wang, MTM Research Centre; R. Kallenborn, Norwegian University of Life Sciences / Chemistry, Biology and Food Sciences; A. Karrman, Orebro University / MTM Research Centre. The discharge of per- and polyfluoroalkyl substances (PFASs) into the environment via wastewater is a pressing public health issue. Apart from the frequently detected PFASs, such as PFOS and PFOA, more and more novel PFASs have been reported recently. We used the target screening method to identify novel and legacy PFASs in the Nordic environment. The aim of this project is to determine as many PFASs and total organic fluorine as possible in wastewater effluents from the Nordic countries and self-governing areas, including Finland, Sweden, Norway, Denmark, Faroe Islands, Iceland and Greenland. Field collected effluent (250 mL) were extracted by solid phase extraction (SPE). Identification and quantification of target compounds was performed by 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. Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Meyer, E. Funfrochen, H. Beck, Saarland University, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring technique. Traditional grab sampling followed by laboratory extraction and instrumental analysis is well established method, but only provides a snapshot of the water quality status. Achieving representative sample with grab sampling takes considerable labour, time and cost. Here, time-integrative passive sampling technique is recognized as a promising monitoring tool. Passive sampling technique allows the simple sampler construction and application, provision of time weighted average concentration and in situ sampling. Various configuration of passive sampling devices are currently available, one of which is the polar organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB® sorbent sandwiched between two polytetrafluoroethylene (PTFE) membranes and has been widely used for the detection of hydrophilic contaminants in the past decade. However, uncertainties in quantitation of POCIS measurements have been pointed out as a main limitation of POCIS. Compound specific sampling rate depends on sampler configuration and environmental parameters such as flow rate and temperature. Lag effect from membrane sorption within POCIS further complicates the transfer kinetics of analyte. In this study, modified POCIS (POCIS-PTFE) with polytetrafluoroethylene (PTFE) membrane instead of PES membrane was tested in an attempt to avoid or lower the PES membrane sorption. The primary aim of this study is to (1) introduce modified POCIS and (2) identify the membrane sorption within POCIS in order to better understand partitioning kinetics of POCIS. In the laboratory experiment, the analyte mass fraction in membrane relative to total POCIS (i.e., Oasis HLB plus membranes) and membrane-water partition coefficient were determined for a range of compounds (log KOW from -0.03 to 6.26). Less membrane sorption was found in...
WE128 Occurrence and Ecological Risk Assessment of Several Endocrine Disrupting Chemicals in Urban River Water and Sediment of South China

C. Huang, Jinan University; L. Wu, Y. Guo, Jinan University / School of Environment

This study mainly focused on the occurrence, distribution, and ecological risk assessment of eight selected endocrine disrupting chemicals (bisphenol analogues, parabens, and triclosan) in urban river water and sediment of south China. The eight target chemicals were detected in both water and sediment samples with concentrations ranging from not detected to 66500 ng/L and from not detected to 492 ng g\(^{-1}\) dw, respectively. Among these eight chemicals, the top three major chemicals were bisphenol A (BPA) (account for 35%), methyl paraben (MeP) (23%), and triclosan (TCS) (14%) in water, while BPA (43%), TCS (37%), and MeP (14%) in sediment. Significant correlations were found between most of the selected EDCs, specially MeP and TCS both in water and sediment (p < 0.01), indicating that these chemicals were in common sources and widely usage. After calculation, our ecological risk index (ERIQ) showed that environmental risk for the selected target substances was flowed into Liuxi river annually based on the 89 primary stream. The ecological risk assessment showed that TCS was the most dangerous compound to aquatic organisms with average HQ = 1.57 (up to 11.5) in river water and average HQ = 0.74 (up to 3.36) in sediment. And the possible joint toxic effect of selected chemicals showed that aquatic organisms were severely exposed to diverse EDCs. This study suggested that compared to the main rivers, the endocrine disrupting chemicals in streams deserves more attention.

WE129 Occurrence, distribution and fate of pharmaceuticals as chemical markers of contamination from urban sources in the vulnerable area of the Ebro Delta (Spain)

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The Ebro Delta and the upper part of the Ebro basin have widely been exposed to contamination from both agriculture and urban sources, being wastewater treatment plant effluent discharges the dominant contamination pathway. In order to determine the distribution and impact of contamination from urban sources in the vulnerable area of the Ebro Delta, water and sediment samples were collected at different sites, covering reaches of the Ebro River located upstream and downstream WWTPs, lagoons, irrigation channels and coastal areas. Water samples were analyzed by Liquid Chromatography-Mass Spectrometry (LC-MS/MS) and 104 different target compounds were detected by pressurized liquid extraction followed by SPE purification. The occurrence of 81 pharmaceutical compounds in the extracts was determined by ultra-high performance liquid chromatography coupled to tandem mass spectrometry, using a hybrid triple quadrupole–linear ion trap instrument (UPLC–QqLT–MS/MS). In order to assess seasonal variations, distribution and fate of pharmaceuticals, a monthly monitoring study was carried out from March 2015 to February 2016 in the Ebro Delta. The level of most of the target selected pharmaceuticals varied widely in water and sediment samples in the Delta, with higher levels observed in winter and lower levels in summer and fall, respectively. The occurrence of pharmaceuticals in sediment samples showed lower frequency of detection than in water. Nevertheless, some compounds were only found in sediments, and not in water, such as the synthetic glucocorticoid (dexethasone), the antidepressant (glibenclamide) and the diuretic (furosemide). Salicylic acid was the most ubiquitous quantified compound in sediments, with a maximum concentration of 19.4 ng g\(^{-1}\) dw. These results pointed out that pharmaceuticals are widespread pollutants in coastal environments and that WWTP effluent discharges are the main source of contamination by these substances in the Ebro Delta. Results also revealed that sesonal distribution of target compounds was affected by the river flow. Thus, concentrations of selected pharmaceuticals in samples collected during dry seasons were generally higher than those detected during the wet season, due to lower dilution factors.

WE130 Occurrence of pharmaceuticals and personal care products, and their associated environmental risks in a large shallow lake in north China

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Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of four non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SA), four tetacyclines (TCs), four macrolides (MCs), and one quinolone (QN) were detected in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APs were prominent, with mean concentrations of 4.90–266.24 ng/L in surface water and 5.07–14.73 ng/L in sediment samples. Four MCs were prominent, with mean concentrations of 0.97–29.92 ng/L in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > MCs (25.19%) > SAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > MCs (25.43%) > TCS (14.69%) > SAs (13.90%) > QNs (3.24%) in sediment samples, and MCs (42.12%) > N-APs (34.80%) > SAs (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharged from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

WE131 Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea

J. Lee, Y. Lee, J. Lee, Seoul National University; S. Kim, Eulji University; M. Kim, Seoul National University / Department of Health Science; Y. Kho, Eulji University; E. Yong, K. Zoh, Seoul National University / Department of Environmental Health

Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=2), fresh water (n=24), sediment (n=24), soil (n=24) and freshwater fish (n=27) samples were collected in Asan lake region, and the levels of PFCs in samples were determined. The PFC concentrations were biologically less deleterious to aquatic organisms than those in farmland regions, but still hazardous to the organisms that ingest them. MP can increase the temperature and decrease the sediments permeability. On the other hand, plastic particles are persistent contaminants that m...
understand the biological significance of their presence.

WE133 Simultaneous biodegradation of water treatment additives: Transformation and byproduct formation, impact of biocide shock dosing and salinity T. Wagner, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / EID-ELD; A. Langenhoff, H. Rijnsarts, Wageningen University / Environmental Technology; P. de Voogt, University of Amsterdam / IBED Securing the supply of fresh water to fulfill the demand of the rising world population is identified as one of the largest environmental challenges in the near future. The Water Nexus research program aims at developing integral solutions for problems with water scarcity in delta areas worldwide. A significant fraction of industrial fresh water is uptake it used in cooling towers. Several treatment technologies such as reverse osmosis, electrodialysis and membrane distillation may facilitate the reuse of discharged brackish cooling tower water. However, cooling towers water contains different water treatment chemicals such as corrosion inhibitors, biocides and antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is the use of constructed wetlands (CWs). This study aims to better assess the potential of CWs in reducing the biodegradation and ecotoxicological effects of biocides in water. The objective of this study was to investigate the biodegradation of trichlorophenol and benzotriazole in CW systems. These CWs were operated with nitrocellulose, as model compounds, and with algae and bacteria from different CWs from various locations. The biodegradation of trichlorophenol and benzotriazole was studied in surface water and effluent in Lagos State, Nigeria. The occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria was studied in surface water and effluent in Lagos State.

WE134 Fate of organic micropollutants in a small river: hydrological and chemical processes C. Glaser, Center for Applied Geosciences / Center of Applied Geoscience; M.E. Müller, Eberhard Karls Universität Tübingen; F. Faltermeier, Eberhard Karls Universität Tübingen / Center of Applied Geoscience; C. Zwieker, Environmental Analytical Chemistry, Center for Applied Geoscience; M. Schwientek, Eberhard Karls Universität Tübingen; Z. Zarril, University of Tübingen / Center for Applied Geoscience Knowledge on pollutant transformation from laboratory experiments often fails to describe observations in the field. Thus, the CRC-CAMPOS aims to describe the fate and metabolism of anthropogenic pollutants on the landscape scale in different compartments in the Ammer catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunn 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 in order to assess processes occurring in the river in the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunn River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or 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 Schönbrunn River and adjoining compartments.

WE135 Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria O.M. Onunbawo, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography(Physical); J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department; C. Sinclair, The Food and Environment Research Agency / Centre for Chemical Safety and Stewardship; R. Shabi, Lagos State Environmental Protection Agency Pharmaceutical pollution of surface waters is increasingly recognized as a global problem, but to date, there have been no detailed studies from most African countries. In this study, the occurrence of 37 pharmaceuticals belonging to 19 therapeutic classes was studied in surface water and effluent in Lagos State, Southwest Nigeria. Samples were collected year-round from 22 surface water sites, and 27 compounds were detected at least once, many at extremely high concentrations. Maximum concentrations for a range of compounds, including trichlorophenol, sulfamethoxazole, cimetidine, atenolol, and paracetamol were in the order of 150 microg L\(^{-1}\). The mean concentrations for sulfamethoxazole, trichlorophenol, cimetidine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L\(^{-1}\), 38.69 microg L\(^{-1}\), 31.62 microg L\(^{-1}\), 24.99 microg L\(^{-1}\), 22.55 microg L\(^{-1}\), 20.98 microg L\(^{-1}\), 15.35 microg L\(^{-1}\), and 15.10 microg L\(^{-1}\) respectively. Venlafaxine has the lowest mean of 4.23 ng L\(^{-1}\) other than that, triazines and compounds 5 were not detected. With the help of published data from around the world, these values are several orders of magnitude higher than most studies of pharmaceutical occurrence but similar to some other peak concentrations measured in developing countries such as China and India. Seasonal variations were observed for certain pharmaceuticals, i.e., antibiotics, paracetamol, tramadol, metformin, lidocaine, and carbamazepine which may be related to the environmental conditions at the sites. The compounds were biodegraded with a half-life of 2 days. The compounds show ecotoxicological effects and can contribute to regulating floods and the impacts of storms, and provide the fish and rice. The Albufera Natural Park is one of the most representative and valuable coastal wetlands in the Valencia Region and the Mediterranean basin. Covering an area of 120 hectares, which has increased the quality of life and surrounding population (>160000 inhabitants) has introduced a number of emerging contaminants that threat 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 influence of the water quality on the aquatic biota is a key parameter in understanding the fate and behavior of these compounds. The isolation and concentration were carried out by solid-phase extraction (SPE) and the contaminants were determined by ultra-high pressure liquid chromatography-tandem mass spectrometer (UHPLC-MS/MS). Cocaine as its major metabolite (benzoylecgonine), followed by cannabis as its delta9-Tetrahydrocannabinolic acid, were the main drugs detected in water samples. Regarding to pharmaceuticals, caffeine and ibuprofen were the main compounds obtained in these samples. Nevertheless, other pharmaceuticals were detected at high concentrations in all samples. In spite of this, and its non-complete removal in WWTPs, nowadays there are not enough knowledge about how the presence of these pollutants can affect to aquatic ecosystems, and specially living beings.

WE137 EFFECTS OF URBANIZATION PROCESS ON WATER QUALITY OF RIVERS ON THE SANTA CATARINA ISLAND, BRAZIL. M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C.H. Soares, Universidade Federal de Santa Catarina / Biochemistry Department The metropolitan region of Florianópolis has undergone an intense urbanization process in recent years, which has modified the landscape and the quality of life in this region. The objective of the present study was to evaluate the water quality of the Icarorubi river in its estuarine region, in order to evaluate the anthropic changes occurring in the surroundings. Three sites were chosen, in which sediments and water samples were collected. The sediments were analyzed for the presence of sterols and pharmaceuticals by GC / TOF-MS after extraction with methyl tert-butyl ether. The water samples were analyzed with respect to the parameters sodium, potassium, magnesium, calcium, chloride, fluoride, sulfate, nitrite, nitrate, ammonia, total nitrogen, ammonium, total phosphorus, 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, nitrate and total phosphorus, besides high microbial 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 Icarorubi River by the discharge of domestic sewage. Ecotoxicological tests using fish are being conducted, including assay to assess genotoxicity.

WE138 Presence of emerging contaminants in sewage sludge and assessment of their environmental risk for the Albufera National Park, Valencia, Spain M. Andréu Costa, Universitat de València / Environmental and Food Safety Research Group; A. Cuñat, Universitat de València / Environmental and Food Safety Research Group, CIDE (UV, GV, CSIC); R. Alvarez-Ruiz, University of Valencia; Y. Pico, Universitat de València / Medicine Preventive -
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the depuration process in the wastewater treatment plants (WWTPs). The study of emerging pollutants present in this sludge are far limited comparing with the water, mainly because of the challenge that involve their high content in organic matter making difficult their handling, storage and analysis. In Spain, the 80% of this sludge is used in the agricultural sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples were from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14000 hectares devoted to rice crops. Samples were extracted by liquid phase extraction (LPE) with mixture of EDTA-McIlvaine buffer (pH 4.1) and methanol, assisted by ultrasound. Then, supernatant was cleaned up by the solid phase extraction (SPE) with Stratacit X cartridges and eluates were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-triple quadruple time-of-flight mass spectrometry (LC-QTOF-MS).

As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-phenylalanine). On the other hand, several compounds were tentative identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to draw the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture.

Continuous researching is needed to assess the real environmental risk related to this sludge and different subfractions of the 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 schistosomiasis and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongting Lake since 1980s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. The aims of this study were to investigate/incurrent contamination status, distribution of CBs in fish from Dongting Lake.

**Occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia)**

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From January to October 2015 in total 27 samples of Mediterranean mussels (Mytilus galloprovincialis) and 10 samples of sea water were collected along the Slovenian coast in the north Adriatic sea to be tested for the presence of bisphenol A. Samples were collected at three shellfish farms, at the open sea and also from the 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 on the MIP SPE sorbent. Samples and extracts were analysed by isocratic (sea water) or gradient (tissue, shells, sediment) reversed-phase HPLC using water and acetonitrile components of mobile phase, Hypersil Gold C18 (3 µm particle size) analytical column and fluorescence detection at excitation and emission wavelengths of 230 and 315 nm, respectively. Mean recovery rate values for mussel tissue, shells and sea water were 47%, 73% and 84%, respectively. Concentrations of bisphenol A in tissues of mussels from the farms (n = 20), open sea (n = 6) and a harbour (n = 1) were < 0.03 – 0.28 µg/kg w.w., < 0.03 – 0.46 µg/kg w.w. and 0.21 µg/kg w.w., respectively, while shells of mussels, from farms (n = 20), open sea (n = 6) and a harbour (n = 1) contained 0.01 – 0.3 µg/kg w.w., < 0.04 – 0.27 µg/kg w.w. and 0.18 µg/kg w.w. of bisphenol A, respectively. Sea water at shellfish farms (n = 5), open sea (n = 4) and a harbour (n = 1) was contaminated with < 0.003 - 0.013 µg/L, 0.004 - 0.009 µg/L and 0.016 µg/L of bisphenol A, respectively. The observed concentrations indicate a relatively low contamination of the Slovenian coastal waters as a part of the north Adriatic sea, with bisphenol A, compared to available publications about Mediterranean mussels.

**Toxicity of non-steroidal anti-inflammatory drug and the behavioural response in Juvenile Catfish**

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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 phagocyan Tael and persulphate expurious with Estratex and cartridges and eluates were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-triple quadruple time-of-flight mass spectrometry (LC-QTOF-MS).

As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-phenylalanine). On the other hand, several compounds were tentative identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to draw the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture. Continue researching is needed to assess the real environmental risk related to this sludge and different subfractions of the 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 schistosomiasis and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongting Lake since 1980s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. The aims of this study were to investigate/incurrent contamination status, distribution of CBs in fish from Dongting Lake.

**Chlorinated Benzenes in Fishes from Dongting Lake**

L. Heng, Y. Wu, J. Meng Ian, W. Chen, Department of Biomedical Science; D. Miškelytė, Vytautas Magnus University / Department of Biomedical Science; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology, Kaohsiung Medical University, Kaohsiung

**Reproductive and maternal effects of Tamiflu metabolites in medaka (Oryzias latipes)**

L. Iranez, D. Miškelytė, I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences; D. Miškelytė, Vytautas Magnus University / Department of Biomedical Science; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology, Kaohsiung Medical University, Kaohsiung

**Earthworms (Eisenia fetida) response to chronic exposure to triclosan (TCS)**

J. Zaltauskaite, University of Ljubljana, Veterinary Faculty / Veterinary Faculty, I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,Kaohsiung Medical University, Kaohsiung

**Predicting the fate of pharmaceuticals during wastewater treatment and crop irrigation with reclaimed wastewater**

M. González García, C. Fernández-López, UCAM; F. Polesel, Technical
University of Denmark (DTU) / DTU Environment; S. Trapp, Technical University of Denmark DTU / DTU Environment

Wastewater represents an alternative option for use in urban areas, industry and, especially, agriculture. Pharmaceuticals may undergo incomplete elimination in wastewater treatment plants (WWTPs) and are found in reclaimed wastewater, possibly being uptaken in crops following wastewater irrigation. Among commonly consumed crops, vegetables and fruits are particularly a concern due to considerable amounts of contaminants within various crops. In this study, we investigated the fate of pharmaceuticals compounds in a wastewater treatment plant (WWTP) equipped for the elimination of carbon and nutrients. The primary treatment consists of a screen, an aerated beef extraction tank and a primary clarifier. The biologically treated wastewater from the conventional activated sludge is filtered through a layer of a continuously operating sand filter prior to being disinfected by ultraviolet radiation. Efluentes are used for irrigation in agriculture. We used the simulation tool “Activity SimpleTreat - fate model for ionics in wastewater treatment plants” [1] to predict the fate of pharmaceuticals compounds in the municipal WWTP. Model parameters were adapted to the situation at site. Chemical data were estimated using ACD/Lib. Model predictions were verified with measurements from a monitoring campaign in the WWTP. Results showed a high removal efficiency of Dichlorfen, Ibuprofen and Ketoprofen concentrations in the WWTP and the simulation tool confirmed the same conclusion. As to uptake in lettuce, empirical results were compared to simulation outcome. For plant uptake prediction, a new steady-state model with translocation and phloem flow was applied [2]. Addition of phloem transport was necessary because the investigated compounds include weak acids (pKa 4 to 5), sucrose, and proteins and fruit. The issue of ion trapping in the alkaline phloem fluid (pH 8). The preliminary results with the new steady-state model, showed the uptake capacity of pharmaceuticals in different tissues of lettuce. The assimilation and distribution of pharmaceuticals compounds in the edible part of the lettuce leaves and the subsequent passage to the harvested plant parts is investigated. [1] Franco A. 2011. Activity SimpleTreat - fate model for ionics in wastewater treatment plants. homepage.env.dtu.dk/stt/Homepage%20and/Website.htm [2] Trapp S. 2017. New release dynamic (numeric) coupled soil-plant uptake model for monovalent ionics, homepage.env.dtu.dk/stt/2017Release_Plant_Model/index.htm

WE145 Exposure Assessment of Residual Organochlorine Pesticides (OCPs) in Orchard Soils and Fruits in Korea

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Residual organochlorine pesticides (OCPs) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with potential significant impacts on human health and the environment. OCPs were designated as persistent organic pollutants (POPs) by the international community at the Stockholm Convention on Persistent Organic Pollutant. This study was conducted to investigate the OCPs residue in orchard (grape, peach, apple, and pear) soils and fruits. Identification and ion trapping method for the quantitative analysis of OCPs was developed and validated by gas chromatography (GC). The method was established using the modified 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% and 0.04-0.08 and 0.2-0.4 µg/kg, respectively. The precision was reliable since the relative standard deviation percentage was below 20, which was the normal acceptable value. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDT, 4,4-DDD, and 4,4-DDE were detected at 1.1-444.9, 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 soil were lower level than bioaccumulation occurring.

WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils

M. Pierdet, LPTC EPOC UMR5805; J. Gaillard, Université de Bordeaux / EPOC UMR 5805; M. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805; CNRS; L. Denaux, INRA BORDEAUX; H. Budzinski, University of Bordeaux Viticulture is one of the agricultural crops that uses the most important quantities of pesticides in France, in particular fungicides. These regular inputs may lead to persistent and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.

WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland

F. Stuart, WCA Environment Limited; I. Wilson, G. Merrington, we.

Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical that such consideration of this exposure pathway and any resulting regulatory decisions are risk-based and made using robust evidence and science. Previous assessments of risks posed by contaminants in materials applied to land generally have several key limitations in the approach and the risk assessment framework for priority organic contaminants in a range of different organic materials that are frequently spread on land in Scotland. As a large number of organic compounds (in excess of 200) have now been identified in materials that are applied to agricultural land the first phase of this project has been to undertake a risk screening exercise. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.

Acknowledgement - The authors thank the Scottish Environmental Protection Agency (SEPA) for funding this work

WE148 Microplastics in Agriculture Soil.

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Microplastic is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. This study is an analysis of soil samples such as microplastic transform infrared (µFTIR) spectroscopy and attenuated total reflectance (ATR) enables a reliable identification and quantification of microplastics. Studies show the tendency of microplastic accumulation in wastewater sludge. This sludge is used as fertilizer in agriculture farming. This study focuses on the occurrence of microplastics in the size range 5000-10 µm in soils that received wastewater sludge as fertilizer. It presents the methods of sample preparation and presents field data. In Sweden 3 fields were sampled. Microplastics amounts of sludge fertilizer have been spread over a period of 35 years. The fields have either received 3 tons/year, 1 tons/year or no sludge fertilizer. 40 kg of soil were sampled from each field. The microplastic concentration is in general low; therefore the plastic needs to be extracted from other materials present. A size range of interest, two different µFTIR techniques are applied for microplastic identification. This requires two different plastic extraction methods. Therefore, two sample protocols were developed < 500µm and >500µm, < 500µm More than 500µm of so soil was dried and sieved through a 500µm metal sieve. To remove the inorganic fraction a gravimetric separation was used. For a sample of this size a custom made aerator-device was built. The sample was prepared with air for 1 hour at ZnCl2 (density of 1.7 g/cm3). After 2 days the valve in the top chamber was closed and ZnCl2 was drained so the top chamber could be removed. The fluid from the top chamber was filtered over a 10 µm metal mesh. The device was refilled with ZnCl2 and the agitation sequence was repeated. To remove the organic fraction the filtered material was treated with enzymes for several days and oxidised with H2O2. The remaining materials were suspended in ethanol and a sub-sample was deposited on a window and scanned by a state-of-the-art µFTIR Imaging system (128x128 pixel Focal Plane Array (FPA) microscope detector). >500µm 10 kg of soil was sieved through an 8mm, 6mm, 4mm, 2mm, 1mm and 500µm sieve. After the soil was dried it was floated in a
Solutions but very low or negligible concentrations of pharmaceuticals were found in soil, but also on the contents of the dissolve organic matter in the seeping solutions. Mostly larger discharges were observed from the Arenosol Europieutric and discharges as well as their root uptakes were soil and sludge dependent. In general, the amount of pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge was assessed with growing of CWP, whilst a test item is present, and also monitor the period after dissipation has occurred. Unlike indoor laboratory studies, where test item concentrations are artificially set at the beginning comparably high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAMITESTS-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org/). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

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 Silte, Haplic Chernozem, Gleyic Phaeozem, Haplic Lavisol, Arenosol Epieutric, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sewage were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. After, 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 Epieutric and Cambisols. Mobility of compounds depended on their sorption affinity to particular soils. In this research, SMS amendment exhibits no effect on DnBP dissipation of DEHP is accelerated after incubation with SMS for 25 d, however little effect can be found with continuing incubation due to low DEHP bioavailability. This research, SMS amendment exhibits no effect on DnBP dissipation in soils and DnBP accumulation in bok choy. It was found that atmospheric deposition of DnBP could be the main source of DnBP in bok choy in the study, since equivalent amounts of DnBP were detected in the vegetables grown in soils with or without DnBP spiking. This study indicates that the application of SMS as an organic fertilizer is less likely to affect the fate of PAEs in soils, and proper strategies should be conducted to reduce PAE levels in atmosphere to control PAE contamination in vegetables.

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

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 Silte, Haplic Chernozem, Gleyic Phaeozem, Haplic Lavisol, Arenosol Epieutric, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sewage were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. After, 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 Epieutric and Cambisols. Mobility of compounds depended on their sorption affinity to particular soils. In this research, SMS amendment exhibits no effect on DnBP dissipation of DEHP is accelerated after incubation with SMS for 25 d, however little effect can be found with continuing incubation due to low DEHP bioavailability. This research, SMS amendment exhibits no effect on DnBP dissipation in soils and DnBP accumulation in bok choy. It was found that atmospheric deposition of DnBP could be the main source of DnBP in bok choy in the study, since equivalent amounts of DnBP were detected in the vegetables grown in soils with or without DnBP spiking. This study indicates that the application of SMS as an organic fertilizer is less likely to affect the fate of PAEs in soils, and proper strategies should be conducted to reduce PAE levels in atmosphere to control PAE contamination in vegetables.

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Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)
WE154 Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.

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Organisms are not alone in the environment. They interact with other individuals of the same or other species in different ways. Interspecific competition is an important interaction for herbaceous plants in grass strips. Such vegetated areas generally act as buffer strips against pollutant flows and are thus submitted to various chemical exposures. However, competition is rarely considered in environmental risk assessment. To address this point, we tested whether competition modifies the way plants respond to herbicide (isoproturon) toxicity in an attempt to link individual tolerance of organisms and community dynamic. Then we investigated the impact of competition on species sensitivity distribution (SSD), a widely used community-level risk assessment tool that usually considers monospecific bioassays only. To do so, we exposed during 25 days 6 herbaceous species (representing varied isoproturon tolerance and competition ability) to 6 isoproturon concentrations (0 to 1.75μg/mL) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competitiveness). For each concentration, 8 replicates were used, 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 recoveries are included in a risk assessment framework. In this presentation, we will focus on aquatic algae and macrophytes and the regulation of plant protection products in the EU. Experimentally, recovery of algae and macrophytes can be assessed in single species laboratory tests or micro- and mesocosm studies. In refined exposure laboratory toxicity tests, usually the recovery of the growth rate is assessed since the populations are kept in the experimental growth phase. In micro- and mesocosm studies, it is possible to analyse also recovery of abundance or biomass and potential indirect effects. The differences of these two options and their potential consequences for risk assessment will be discussed. Effect modelling can be used to extrapolate from empirical data to other exposure scenarios or species. However, while the simulation of refined exposure laboratory toxicity tests seems to be straightforward, the prediction of effects under field conditions is still challenging. In addition, the use of such models in the risk assessment requires clearer criteria on which magnitude and duration of effects can be considered acceptable.

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 Lemma 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 ≥0.006 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 hortemic response was observed at the 0.0025 mg/L dose resulting in a 67.6% 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 ≥0.006 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 Toxicokinetics/toxidynamics (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants

S. Haenen, 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 effect of PPP on aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to assessments for lotic waters and situations in which environmental concentrations usually last for a few hours or days, only. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (exposure patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the effect side, either an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time-variable exposure patterns. For characterizing risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work we present a new approach to parameterize the TK/TD model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemma model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemma 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 quasi-drugs. Methylparaben is known to have low toxicity to mammals, but there is no data on hazard assessment for soil ecosystem. Methylparaben was mostly removed in the sewage treatment process, but was detected in soils of various countries. In addition, there is a possibility that personal care products may leak into aquatic or soil environments if they are not properly disposed of. In order to study the effects of methylparaben, it is necessary to evaluate the hazard assessment of methylparaben in soil ecosystem. This study assessed the toxicity of methylparaben to plants (mung bean and rice) and collembola. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no-observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half-lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have significant physiological effects on plants even at low concentrations. The results of this study can be fundamental for soil risk assessments of methylparaben. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for SETAC Europe 28th Annual Meeting Abstract Book
WE159 Evaluation of phytotoxicity for Bisphenol A with new endpoint, phytoestrogen D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

We determined that phytoestrogenic chemicals (EDCs) are known as chemicals that show hormone-like action or inhibit hormones, the phytotoxicity assessment of EDCs does not have any specific toxic endpoints for these substances. The factors (growth, photosynthetic activity, chlorophyll, etc.) used to evaluate common toxic substances such as heavy metals are also applied to EDCs. These factors are not suitable for EDC materials, which have relatively low toxicity to organisms, and produce an endocrine effect associated with toxicity, therefore it takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bisphenol A. Meanwhile, bisphenol A is known as a representative EDC used in the production of consumer products and in various industrial fields. While it is used widely for various purposes, the soil ecotoxicity of bisphenol A is limited. Therefore, we evaluated the toxicity of bisphenol A to Parachlorella kessleri (an alga with similar characteristics to higher plants) using the soil toxicity assessment of phytoestrogen, a new endpoint for EDC materials. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and funded by the Graduate School of Specialization for managing information related to chemical risk.

WE160 Soil toxicity of DEHP and Nonylphenol on mungbean and rice D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

DEHP is used as a plasticizer and insecticide. Especially, it can be used as plastic vinyl applied in farmland. Nonylphenol is used as surfactant, and 4-nonylphenol is mainly used as a constituent of sunscreen and detergent. Although DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxological research in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in a 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 J.G. Perez, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Biodiversidad y Biología Experimental, Buenos Aires; A. Magdaleno, Universidad de Buenos Aires / Facultad de Farmacia y Bioquímica, Cátedra de Salud Pública e Higiene Ambiental; M. D. moss de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN); A.B. Juarez, Universidad de Buenos Aires / Facultad de Ciencias Exactas y Naturales, Departamento de Biodiversidad y Biología Experimental

The emergence of transgenic crops led to an increase in the use of glyphosate and its presence in different ecosystems is a worldwide problem. Although it was designed to inhibit the aromatic amino acids synthesis in plants, glyphosate exerts toxic effects on non-target organisms, probably through other mechanisms. Its entry into water bodies is a risk for biota, particularly for the phytoplankton microalgae community that provides the oxygenic web. In this work the effects of a glyphosate formulation (~44% monopotassium salt of N-phosphonomethyl glycine) on the growth, chlorophyll content and oxidative stress parameters of 4 phytoplanktonic green microalgae were evaluated. Cultures of Scedesmus acutus, Ankistrodesmus fusciformis, Monoraphidium contortum and Parachlorella kessleri were exposed to increasing glyphosate concentrations (0 – 75 mg glyphosate/L) and kept at 24 ± 1°C, under continuous agitation and illumination. After 96 h, growth, IC50, chlorophyll a content and oxidative stress parameters were evaluated. The glyphosate caused a significant decrease of chlorophyll a in M. contortum and P. kessleri, but not in the other two species tested. The growth of the 4 strains was negatively affected and regarding the IC50 values M. contortum was the most sensitive strain (3.37 mg/L), followed by A. fusciformis (6.50 mg/L), S. acutus (17.47 mg/L) and P. kessleri (41.75 mg/L). In order to evaluate the relationship between antioxidant defenses and sensitivity, we analyzed parameters of oxidative stress in the least and the most sensitive strains. The exposition to 2-4 mg glyphosate/L in M. contortum and 30-75 mg glyphosate/L in P. kessleri, caused increases of reactive oxygen species, lipid peroxidation (TBARS), reduced glutathione, superoxide dismutase, and glutathione transferase. The level reached of TBARS in P. kessleri was 10 times lower than in M. contortum, while the levels of antioxidant defenses were 3.5 - 7 times higher. These results suggest that oxidative stress would be involved in the toxicity of the glyphosate formulation and that the differences in sensitivity between strains could be due to differences in their defense antioxidant levels. According to the EU Directive 93/67/ECC, the IC50 values estimated indicate that the glyphosate formulation assayed should be toxic for aquatic biota. Besides, results also warn about its possible effects on the composition of phytoplankton, which would put at risk the balance of the aquatic ecosystem.

WE162 Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment G. Meregalli, Dow AgroSciences Italia srl / 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 a threat to ecosystem functioning, e.g. altering oxygen balance in the case of the aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control M. spicatum, which is an invasive alien species in North America. On the other hand, recently in Europe there have been reports of Myriophyllum aquaticum, a new alien invasive species genetically related to the indicator M. spicatum. In Piedmont (Italy), M. aquaticum has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of M. 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 push invasive species to reach control thresholds may result in the presence of alien species. The use of a risk-benefit analysis, which can help in the decision of whether PPP are suitable for use in such programs, will be discussed in light of the two abovementioned examples.

WE163 Auxinic herbicides: the impact of water plants’ root measurements on the risk assessment G. Gensior, Eurofins Agroscience Services Ecotox GmbH

Data requirements for the registration of plant protection products in the EU Regulation 1107/2009 indicate that a test on a Myriophyllum species is necessary for auxinic herbicides. The OECD 239 water sediment test with Myriophyllum spicatum is developed to be able to simulate a freshwater aquatic environment comparable to natural conditions. In this testing methodology, shoot length, as well as, fresh and dry weights need to be recorded. The OECD 239 guideline requires that only a qualitative assessment of the roots is undertaken. Auxinic substances are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. However, it needs to be evaluated if an indirect quantitative assessment of the roots in the Myriophyllum studies with auxinic substances would result in significantly different endpoints that would be acceptable for soil risk assessments and comparable to natural conditions. Results will be presented to clarify if effects on the roots in a water sediment system are providing additional information relevant for the risk assessment.

WE164 Testing the emergent macrophyte, Glyceria maxima in a water-sediment system: Results of a ring-test with Isopt donated J. Davies, Syngenta / Environmental Safety; G. Arts, Wageningen Environmental Research (Altarna) / Environmental Risk Assessment; K. Kuhl, Bayer AG - Crop Science Division; J. Kubitz, BASF. M. Ratte, ToxRat Solutions GmbH & Co. KG

Under EU pesticide regulation, regulatory tests are required for the aquatic macrophyte, Lemna, and two algal species for herbicides and plant growth regulators. Data requirements introduced under EU Directive 1107/2009 stipulate that further tests may be required for compounds which show selectively higher toxicity to either dicotyledonous or monocotyledonous plant species in terrestrial plant tests. In these cases, the recommended dicot and monocot species were tested.
are Myriophyllum and Glyceria, respectively. OECD Test Guideline 239 for testing Myriophyllum spicatum in a water-sediment system was adopted in September 2014 and this test method has since been adapted to facilitate growth of the emergent, reed grass, Glyceria maxima. During 2016 and 2017, 15 laboratories participated in a ring-test with the herbicide, isoproturon against Glyceria. The objectives of this test were to establish suitable plant species, 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

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Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. 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 water are easily absorbed by organisms. This study was aimed to evaluate the individual toxicity effect of Cd, Ni and Zn on a macrophyte and it bioaccumulation capability. Cadmium is a hazardous environmental pollutant and is toxic to most organisms. Nickel and Zinc are essential trace elements needed in the nutrition of plants. Nevertheless, over certain threshold they can present phytotoxic activity. Macrophytes are key elements in aquatic ecosystems. Here, we worked with the submerged free-floating plant *Myriophyllum spicatum* and *Ceratophyllum demersum*. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-16 Ni, 4-64 Zn or 0.5-8 Cd mg/L) and fresh weight, main shoot length and total shoot length were chosen as endpoints. For the bioaccumulation assays, plants were exposed to a constant metal concentration (2 mg/L), for two days. Free shoots were harvested and dried. CAT activity at test concentrations remained near control values, while APOX and GPOX enzymes showed an increase indicating possible sublethal effects.

**WE166**

Physiological responses of *Thlaspi praecox* (Brassicaceae) to Ni hyperaccumulation

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Heavy metals are persistent inorganic toxic pollutants that come from diverse anthropogenic activities [1]. They can be easily absorbed by the roots of plants due to their relatively high mobility in the soil [2]. Aquatic plant species are known to have great importance, forming a substantial component of the primary production in many aquatic ecosystems, especially in wetlands. Plants can remove and accumulate metals from the solution by phytoextraction; however, the metals can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. Concentrations of heavy metals in aquatic plants depend both on metal speciation and on the species of plant absorbing the metal [2]. High concentrations of some trace metals in aquatic plants have led many authors to believe that they accumulate from water and/or from sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns: (1) true exclusion, in which metals are not 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 phytoextraction in *Thlaspi praecox* 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 Ciénega de Tamasopo wetland; 2) plants were collected, washed by NaCl solution and plant were taken for metal determination; 3) samples of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 °C for 18 hours in Lindberg / Blue stone; 3) grinding and spraying of root and leaves in analytical mill (KIKAKeramik M20); 4) acid digestion with HNO3 in plate at room temperature of root and leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that *Typha latifolia* accumulate Mn/Zn+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

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Removal of heavy metals from wastewater is of high importance in view of the environmental impact that this process has on aquatic ecosystems. Several aquatic plants have been extensively studied, showing potential for metal removal from wastewater. The aim of this study is to assess the metal removal capacity of *Myriophyllum* and *Ceratophyllum* in order to evaluate their ability to accumulate metals from wastewater and to identify appropriate metal system. At these time intervals, samples of aqueous waste from metal plating, mining operations, tanneries, smelting, alloy industries, and storage batteries are sources of metal contamination. Biological methods have been recommended as and effective alternative for removal and recovery of heavy metals from aqueous solutions. Aquatic plant biomass represents an abundant biological resource that possesses immense capacity to accumulate heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including free floating and submerged, as *Lemma, Spirodella, Ceratophyllum* and *Myriophyllum*, have shown potential for metal removal from wastewater. The aim of this study is to evaluate the efficiency and capacity of different species of aquatic macrophyte in 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 alga *P. subcapitata*, acute toxicity test with *D. magna* and *ex vivo* cytotoxicity test with *E. fetida* coelomocytes. An experiment was set up for 10 days, by the addition of 10 grs of fresh weight of plants from different species mentioned above, in the metals solution. Previous works have shown that metal uptake rates were faster within the first 48 hours, and decrease with time and with metal concentration solution, so, at this time and at 3 and 5 days, respectively, plants were removed and new plants were placed in the same multi-metal system. At these time intervals, samples of solution and plant were taken for metal determination. The harvested plants were dried in an oven at 60 °C 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 efficient capacity for metal removal and recovery.

Understanding the physiology of *T. praecox* exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytoextraction technologies at contaminated soils.
WE169
Toxicity of the binary mixture Cd-Zn on Lemma gibba evaluated using morphological and oxidative stress enzyme endpoints
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The presence of metals in the environment represents one of the mayor concerns as they are persistent in nature, non-biodegradable and can bioaccumulate in living organisms. Plants in aquatic ecosystems may take up heavy metals at a high trophic level composed partly by aquatic vascular plants, also called macrophytes. These organisms play a critical role in this environment. As a representative species of macrophytes, we worked with a rooted free-floating Lemma gibba. The metals evaluated here were Cd and Zn, individuals and in mixtures. Exposures of plants were carried out in presence or absence of Cd and Zn for 7 days. Different endpoints were determined at the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes’ length are the determined morphological endpoints. Physiological changes were evaluated as enzymatic activity of catalase, ascorbate peroxidase and guaiacol peroxidase, determined at the lowest concentrations. Both metal concentrations, bringing about a 50 % inhibition of frond number (EC50) was determined. In order to compare the sensitivities of the different endpoints, NOEC and LOEC toxicity indexes were calculated. For Cd, fresh weight and fronds/colonies ratio resulted in the most sensitive, while for Zn total area was the most sensitive. Even though there was no significant difference for guaiacol peroxidase activity for Cd, it presented an increase compared to control. While the other enzymes had activity levels similar to the control. In the case of Zn, catalase and ascorbate peroxidase activity increased. However, neither of both presented significant differences with it. For the mixture analysis, multiple regression was used to fit the observed %frond number inhibition (%FNI) to dissolved metal concentration (M(Al)). The negative value of the parameter of the interaction between Cd and Zn indicates alleviation of %FNI and toxicity. The concentration addition approach was evaluated by calculating the sum of EC50 for each single EC50 for each metal average ΣTU of all test cases resulted 1,13 suggesting that this mixture presents an additive toxicity to Lemma gibba. Enzyme activity was also calculated at the lower concentrations of the mixtures. In general an increase in the enzymatic activity was observed. Ascorbate peroxidase and guaiacol peroxidase presented the maximum increase, while catalase had a moderated activity rise.

WE170
Increase of tolerance of green algae as a tool in metal bioremediation
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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, chemical industries and agriculture. Recently has been shown that by using this study to evaluate the use of preadapted strains to subletal concentrations of Chromium, into bioremediation of Chromium containing wastewater. Preliminary results will be shown related to the assessment of the potential of this strategy to increase tolerance of selected species in order to become an interesting tool in the field of bioremediation processes mediated by green algae. Two green algae species were used: Chlorella pyrenoidosa (CP) and Nannochloris oculata (NO). As NO and CP differ in its morphological structure and organization level as the former has a fenestral feature while the second a free unicellular one. Both strains were maintained by a year under subletal concentrations of chromium ranging from 0.42 to 1.73 mg/l. These concentrations were chosen based on previous experiments through range finding tests. Subtalent solutions were renewed monthly and algal cells were subcultured in new medium. After the preadapted period, each subtalent exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of know cell density was prepared with each pellet, and the algae were exposed to a wide range of Chromium concentration solutions. Samples of solution and algal cells were taken for metal determination in order to elucidate the mechanism of resistance origin. The harvested cells were centrifuged and a microscope acid digestion were carried out. Metal determinations in subtalent solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance observed. Further studies relative to detoxification mechanisms and chelating internal molecules as phytochelatin will be conducted to unravel the tolerance mechanisms involved.

WE171
Ecotoxicological assessment of the iron mining waste from Mariana (Brazil) on terrestrial flora using different plant species
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In Brazil it is very common to have mining waste placed in dams, especially in the Minas Gerais state. The deposit of mining wastes implies in risk of dam rupture, between other problems. In November 2015, the rupture of the “Fundão” Dam in the city of Mariana in Minas Gerais state was one of the worst environmental disasters in Brazil. The rupture caused severe impacts to the terrestrial and aquatic environments, where tons of the waste has been placed. It is now matter of concern to study the effects of the mining waste deposition in soil to terrestrial flora in order to understand the real consequences to the environment and so be able to propose actions for restoration and management of the affected area. The main goal of this study was to evaluate the ecotoxicity of the mining waste that outpoured the Fundão dam to ten different plant species (Avena strigosa, Pennisetum glaucum, Croataria juncea, Canavalla ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens, gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed the OECD guidelines on the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixtures were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena strigosa, 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 to soil fertility by mining waste; the activity of metallothionein of the plants increased and presented phytotoxic effects in all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE172
Mitigation of CuO nanoparticles microbial ecotoxicity by plant in an agricultural soil: plant variety matters
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New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs which fate and impact on agro-ecosystems is still largely unknown. Several studies showed the deleterious effects of metal nanoparticles (NPs) on soil microbial communities and reported the importance of soil microbial ecotoxins in NPs toxicity. One of the NPs ecotoxicity has been the use of selected NPs to test the sensitivity of soil microorganisms to NPs. The concentration of NPs in soil increased the number of microbial species by increasing the number of microbial species and was higher than control, although there were no significant differences in the number of microbial species. The NPs ecotoxicity due to its role as dispersing agent in soil contamination was characterized by the dynamic properties of NPs were characterized by Dynamic Light Scattering in rhizosphere and planted soils in which ionic strength, pH and dissolved organic carbon were also measured. The results showed that the 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 microbial diversity, had no significant impact on the activity of microbial community and presented a tolerance to the mining waste; the species tested presented different indices to soil fertility by mining waste; the activity of metallothionein of the plants increased and presented 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.
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. Biological markers of oxidative stress of growth activity, such as the glutathione S-transferase activity, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the mononucleotides frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the meristem and the sheaths for genotoxic effects. Although a limited effect of Hg was measured in analyzed tissues, a significant difference in localization of responses was found in leaves of all treatments.

WE174 Influence of toluene vapor exposure on plant metabolic changes W. Kim, J. Park, Gwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

The conventional damage methodology for plants after chemical accident only relied on the change in their phenotype such as leaf-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 metabolomics-based damage diagnosis and the main contents for this study. The toluene was selected as target compound based on the scoring system, which takes into account both accident frequency and hazards. To reflect the realistic chemical accident scenario, plants were exposed in vapor exposure chamber. In this study, the metabolomics responses of plants at early development stages (4th leaf stage) to toluene were evaluated by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QToF-MS) based untargeted metabolic profiling. The exposed concentration-based and recovery time-based metabolic response patterns were analyzed by Principal component analysis and Partial least squares Discriminant Analysis. Overall, the results of multivariate statistical analysis demonstrated a number of potential biomarkers that were characterized by metabolic approach and provided an insight into quantitative chemical accident damage assessment.

WE175 Influence of soil organic amendments on the phenolic contents in rosemary (Rosmarinus officinalis L.) plants I. Nogues, National Research Council of Italy / Institute of Agro-Environmental and Forensic Science; A. Bartolozzi, National Research Council / Water Research Institute; P. Gremi, National Research Council of Italy (CNR) / Water Research Institute; M. DE LOS ANGELES BUSTAMANTE MUNOZ, Miguel Hernández de Elche (Spain) / Department of Agrochemistry and Environment

Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean region, often grown as a common herb around the world. This species constitutes an exceptional source of different bioactive compounds, mainly phenolic compounds, with proved antimicrobial and antioxidant activity. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in the aqueous phase, the concentrations and availability of nitrogen and other nutrients in the soil. Therefore, this study evaluates the effectiveness of the rosemary plant to improve soil quality and the effect of the incorporation of two composts derived from anaerobic digestates on the phenolic contents of rosemary plants grown a semiarid soil. In the study, two composts (CM, mainly composed by cattle manure anaerobic digestate and CS, mainly composed by pig slurry anaerobic digestate) at two different rates (30 t/ha and 60 t/ha respectively) were incorporated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (T). 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 detections of microbiomes and metabolites in freshwater ecosystems K. Newton, University of Montreal; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; S. Luderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; T.C. Schell, IMDEA Water Institute / Ecotoxicology; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; M. Konschak, University Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Leaf litter decomposition, an important process in freshwater ecosystems, is mediated by microbial decomposers and leaf-shredding macroinvertebrates. This process can, however, be modified by chemical stressors such as fungicides. Although fungicide stress has increasingly been assessed in recent years, the systemic nature of some fungicides, which enables the uptake and distribution within treated plants, is not yet considered. Therefore, as a first step, we treated Alnus glutinosa with a mixture of systemic fungicides (SFs; azoxystrobin, cyprodinil, quinoxyfen and tebuconazole) via soil drenching at three levels (control, field application rate (FR), and 10 times the field application rate (FRx10)). During leaf fall, we collected the leaves and assessed the potential impact of the fungicides on microbial decomposers and leaf-shredding macroinvertebrates. We quantified microbial leaf litter decomposition, their community composition and the palatability of leaves after microbial conditioning for the model shredder Gammarus fossarum Koch. By assessing growth and physiological fitness of this species over multiple weeks, we additionally estimated the 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 FRx10 was more palatable. Different fungicides may indeed have implications for microbial decomposers and leaf-shredding macroinvertebrates, while the underlying mechanisms are still not fully understood.

WE177 SETAC Plants Interest Group S. Loutseti, DuPont De Nemour Hellas S.A.

Environmental Risk Assessment in Sediments (P)

WE178 Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination M. de Baat, University of Amsterdam / IBED-FAME; T.V. van der Meer, University of Amsterdam / IBED-FAME; Department of Freshwater and Marine Ecology; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME

Bioturbation activity of sediment-dwelling organisms promotes the release of contaminants across the benthic-pelagic ecosystem boundary, thereby affecting the exposure to and uptake of sediment associated contaminants at the sediment-water interface by themselves and the entire community around them. This way, bioturbation activity may contribute to species specific sensitivities to sediment associated compounds. Therefore we assessed if invertebrate bioturbation activity determines species specific sensitivities to sediment contamination. For two metals, Ni and Cu, sufficient data were available to construct Species Sensitivity Distributions (SSD). The position of the species in the SSDs could indeed be linked to their bioturbation rate: the most active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxicants. Moreover, active bioturbators can hence promote the release of sediment-associated contaminants across the benthic-pelagic ecosystem boundary, thereby stimulating delivery of contaminants from what is often the most polluted environmental compartment in freshwater ecosystems. It is concluded that trait based ecotoxicology offers a possibly potent tool for predicting sensitivity of benthic invertebrates and the benthic community to sediment-associated contaminants.

WE179 Effect based sediment quality assessment incorporating chemical fingerprinting N. Weering, University of Amsterdam/IBED Institute / FAME; M. de Baat, University of Amsterdam / IBED-FAME; B. van Hall, F. Selhorst, University of Amsterdam / Department of Freshwater and Marine Ecology; S. Droge, University of Amsterdam/IBED Institute / IBED; M. Kraak, University of Amsterdam / IBED-FAME; P. Verdonschot, University of Amsterdam / Department of
Freshwater and Marine Ecology
The European Union Water Framework Directive does not require member states to monitor sediment quality. When performed at all, water authorities most often monitor sediment quality by means of chemical target analysis focusing only on target compounds, potentially overlooking ecotoxicological risks caused by (un)known mixtures of sediment associated compounds. Hence, there is an urgent need to incorporate effect-based monitoring and chemical fingerprinting into sediment quality assessment. Therefore, the aim of the present study was to innovate ecotoxicological sediment quality assessment by incorporating whole sediment bioassays and chemical fingerprinting of bioavailable compounds. To this purpose intact whole sediment cores were collected using a sediment core sampler at a reference and 11 contaminated sites grouped by land use: urban, agricultural, and forest/landfills (WWTP) and reference sites. A Chironomus riparius 28-day life cycle whole sediment bioassay was performed with survival and emergence as endpoints. Simultaneously, SPME fibers were applied as sediment passive samplers to determine pore water concentrations of phenanthrene and pyrene, selected as model compounds for sediment PAF concentrations. Survival in the bioassay was unaffected at the urban sites, while significantly lower at all WWTP sites and two of the agricultural sites. Emergence was significantly delayed at the urban sites, agricultural sites exhibited an irregular emergence time, while WWTP sites induced accelerated emergence. Pyrene and phenanthrene concentrations were negligible at the reference site, very low at the agricultural and WWTP sites, and highest at the urban sites. Urban sites thus have a high chemical load, but survival was higher than on the agricultural sediments. Contrarily, the highest emergence was found at the agricultural sites, especially for the rivers with high suspended sediment (SPS) concentrations. Suspended sediment will affect the bioavailability of HOCs in rivers. However, no research has been carried out to quantify the toxicologically active fraction of HOCs sorbed on different compositions of SPS with various particle sizes. In this study, we chose pyrene as a typical HOC to study the bioavailability of HOCs associated with SPS of various compositions and grain sizes to D. magna. The passive dosing devices were made to control the freely dissolved concentration of pyrene in the exposure systems. The effect of pyrene associated with SPS of different compositions (including amorphous organic carbon, AOC; black carbon, BC, and mineral components) and mineral grains (including 0-50 μm, 50-100 μm, and 100-150 μm) on the immobilization and enzymatic activity of D. magna was investigated to quantify the bioavailability of SPS-associated pyrene. The results showed that with C_{sox} of pyrene ranging from 20.0-60.0 μg L^{-1}, the immobilization of Daphnia magna in the presence of 1 g L^{-1} SPS were 1.11-2.89 times that in the absence of SPS. The contribution of different mineral-organic matter was defined by different metal pressures: “Pog” in an urbanized area but considered as an agricultural zone, “Mem” or nearby the outlet of a creek for “Poj”. In the two sites under metallic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Cr, 553.8 mg/kg for Ni, 49.9 g/kg for Fe and 872.9 mgl/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 Ohríd 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 Ohríd will be presented.

WE183 Active Biomonitoring and DGT Passive Sampling: Holistic Assessment of metal bioavailability in sediments and associated risks
K. De Schamphelaere, Universiteit Antwerpen / Department of Biology (SPHERE Research Group); H. Hetjens, University of Antwerp / Department of Biology (SPHERE Research Group); J. Teuchies, E. Amato, L. Bertofts, University of Antwerp / Department of Biology (SPHERE Research Group); P. Meire, University of Antwerp / Department of Biology (SPHERE Research Group); R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group) Impacts of sediment metal contamination on aquatic ecosystems and their functioning remain a widespread problem. The ecotoxicological risk associated with metal contamination is dependent on metal speciation, sediment characteristics and the behavior and physiology of the affected organisms. Hence, bioavailable concentrations, rather than total metal concentrations, are often 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
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 predictor indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flushing (Benelux), using both 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 24 h 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 in 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. Remali; W. Bennett, Griffith University / Environmental Futures Research Institute; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; E.D. Beus, 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; and (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 (Victoriopis australiensis) survival from 53% to 100% and 42 to 93%, respectively; and reproduction in a second amphipod (Melita plumulosa) from 3 to 65%. This was attributed to the decreased concentrations of dissolved copper in the overlying water associated with bioturbation. Conversely, increased bioturbation in sediments contaminated by metals and hydrocarbons decreased reproduction (44 to 23%), which was attributed to an increased release of polycyclic aromatic hydrocarbons (PAHs). High-resolution chemical imaging dissolved oxygen and metals in a legacy contaminated sediment mesocosm with a bioturbator present showed the increased production of metal oxide-hydroxides and silt and sandy sediments, respectively. 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-oxo/hydroxide phases or to resuspended particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biogeochemistry and contaminant exposure to surrounding ecosystems.

WE185 The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod
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The diffusive gradients in thin films (DGT) technique has emerged as a tool that allows for the rapid in situ measurement of the labiliy and dynamics of metals in sediment. The objective of this research was to determine effects thresholds for sediment-nickel by measuring reproduction of the estuarine-marine amphipod, Melita plumulosa in 10-d whole-sediment bioassays with three nickel-spiked sediments and two field-collected nickel-contaminated sediments with varying chemical and physical properties. We compared concentration-response exposure relationships obtained using traditional metal extraction methods from sediments with DGT-labile nickel to determine whether DGT can be used to predict nickel bioavailability and toxicity. Effect concentrations of total recoverable nickel (TR-Ni) to cause a 50% impairment in reproduction (EC50) were 2000 (1200-2900), 1100 (580-1700) and 1100 (740-1500) mg/kg for the silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (2000 mg/kg TR-Ni) and Site 2 (1300 mg/kg TR-Ni) had reproductive responses of 88% (+10) and 71% (+11) of the control, respectively. The EC50s based on DGT-labile Ni were 2.3 (1.7-3.4), 3.3 (1.7-4.9) and 2.0 (1.0-3.0) mg/m3 for the silty-sand, silt and sand sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (0.4 mg/m3 DGT-labile Ni) and Site 2 (1.0 mg/m3 DGT-labile Ni) sediments, respectively reproductive responses were 88% (+10) and 71% (+11) of the control. This demonstrates that amphipods were responding to the labile nickel as measured by DGT and further supports its use in nickel risk assessments.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA
J. You, H. Li, F. Cheng, Jinan University / School of Environment Determining causality of sediment toxicity: two potential approaches, namely DGT and TIE (Toxicity Identification Evaluation) have been developed. Conventional sediment TIEs take advantage of environmental relevance by using whole organism bioassays while suffer from lack of effective methods for specifically identifying major contributors from a universe of chemicals if organic contaminants are identified as minor class of toxicants in phase I TIE. Alternatively, EDA is a powerful tool in identifying causes of sediment toxicity with sophisticated fractionation and chemical analysis of targeted and non-targeted toxicants, but it is short of environmental relevance due to the use of in-vitro bioassays and exhaustive solvent extraction. To better understand the cause of sediment toxicity in urban waterways in Guangzhou, China, a novel method combining TIE and EDA was successfully applied. Whole-sediment TIE in combination with bioavailability-based extraction found that sediment mortality to the benthic invertebrate, Chironomus dilatus was caused by organics and metals jointly and organic pollutants contributed to the mortality for all samples. To better elucidate the roles of non-target organic contaminants in sediment toxicity in these sediments, EDA tests were performed. Bioaccessible contaminants in sediment samples were extracted by XAD resin. Cell viability of the extracts was assayed using the cell counting kit-8 assays. To take tissue specificity into consideration, four cell lines (HepG2, MCF-7, A549 and SH-SY5Y) were used to distinguish toxicants related to metabolism dysfunction, endocrine disruption, respiratory toxicity and neurotoxicity, respectively. All test sediment samples showed significant cell proliferation of SH-SY5Y cell line, but little down-regulation of HepG2 and A549 cell lines. The results were further confirmed by using MTT toxicity tests using C. dilatus. One sediment sample impacted MCF-7 cell line. The proliferation of SH-SY5Y proliferation was partially explained by oxidative stress. The SH-SY5Y cell line was used for further EDA experiments after separating the extracts into 35 fractions using GPC and NPLC. In conclusion, n integrated method of TIE and EDA would provide an environmentally relevant and toxicant specific approach to effectively determine causality of sediment toxicity by combining the merits of the two methods.

WE187 Water discharges from the city of Lausanne during rainfall in Lake Geneva: Using a triad approach to assess their influence on sediment quality
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This study represents an approach combining three of water matrices. 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 conducted on the water phase, the chemistry of sediment samples from the catchment area of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Schelt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system.

References

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 and aimed at assessing the ecotoxicological status of the River Wurm near Aachen. This stream is heavily impacted by anthropogenic activities, such as urbanisation, agriculture, industry, etc. Moreover, the River Wurm receives effluents from various WWTPs within the catchment area. Two of them, the WWTP Aachen Soers and the WWTP Elenddorf, 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 well as in the static test with the fish chronic test with the freshwater amphipod P. hawaiensis. Three campaigns were conducted. Acute toxicity tests were performed in water and in fresh and dried sediment as well water and sediment particles. The results revealed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryotoxic potential (enlarged heart, insufficient blood circulation, edema, 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 and predicted topic 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
S. Fartisch, Hamburg University of Applied Sciences (HAW); S. Höss, Ecosys / Aquatic Ecology; S. Heise, Hamburg University of Applied Sciences / Life Sciences

Environmental regulations and guidelines in Europe for assessing the quality of aquatic sediments and dredged material predominantly demand chemical data, and decision making mostly does not integrate the information from different lines of evidence (1, 2). Ecotoxicological data requirements are often limited, with the final classification of the sample not preserving the information of all applied biotests (3). Improved, holistic characterization of sediments and dredged material is needed, to enable a better risk assessment that conserves the ecological quality, is practical and economically feasible at the same time. This poster will present the concept of a study in the scope of the Interreg project “Sullied Sediments” (http://northeurope.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 quality and science-based classification of the sample not preserving the information of all applied biotests.

References

WE190
Submarine sewage outfall adversely affects the sediment quality of Santos, Brazil estuary - An acute toxicity study
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To assess the toxicity of environmental samples it is important to have a comprehensive approach. 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 conducted on the water phase, the chemistry of sediment samples from the catchment area of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Schelt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system.

References
mortalities as predicted by models and the scientific literature. Physiological parameters investigated in rainbow trout acted as early signals of biological defects pointing out a high level of genotoxicity measured in erythrocytes in exposed individuals as well as in the control batch; these decreased during the experiment until a basal level pointing out the resilience of fish whereas they were exposed for 28 days to high fine sediment concentrations. 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 throughout 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. Sediments (that relate) metals can be present in several 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 development of techniques that allow the bioaccumulation in exposed organisms has been experienced to be highly disruptive, time-consuming and limited in comparability as its results are strongly dependent on the analysed organisms themselves. Therefore, an increasing need for less disruptive, more reliable and standardized methods exists. Recently, passive samplers have been tested to estimate bioavailable contaminant fractions as well as the contaminant flux over sediment-water interface. Diffusive Gradient in Thin film samplers (DGTs) have been indicated to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species under (semi-) controlled conditions. The main objective of this study is to further evaluate the use of DGT passive samplers as indicators for the bioavailability of metals (for benthic macroinvertebrates) and to test the robustness of the results of 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 of different (benthic) macroinvertebrates. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

### WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment

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Since our economic progress continues, the environmental pollution increases. The contamination of the aquatic environment with chemicals is one of the major concerns of our society. Many of these contaminants are applied in industrial processes and consumables every year. A considerable part of it enters water bodies from diffuse and point sources. [1] Micropolutants originating from e.g. pharmaceuticals and personal care products may cause adverse effects on different biological and ecological levels. A major concern is the fact that these substances are not fully removed during common wastewater treatment and, therefore, end up into surface waters. To minimize the discharge of micropolutants from wastewater treatment plants (WWTP) additional treatment steps are required. Ozoneation has been shown to be an effective method with reasonable costs. Hence, ozone treatment of the entire effluent is implemented in the Aachen-Soers WWTP, Germany, within the DemO-AC-project. In this context, the actual ecotoxicological state of the recipient water, the River Wurm, and the upstream tributary, the River Haarbach, was evaluated before the implementation of the facility. The River Haarbach receives effluents from the Aachen-Eilendorf WWTP. Therefore, water and sediment samples from various sites upstream and downstream the WWTPs were investigated. This study focuses on the assessment of the sediment samples of the both rivers, since they play an important role in e.g. binding and remobilisation of substances. After the extraction of the sediments via pressurised liquid extraction, cell-based biosassays with reporter cell lines will be conducted to estimate the anti-estrogenic and oxidative stress potential. Following, both native samples and extracts will be tested in the behavioural light/dark transition test with Danio rerio. This test utilizes the fish’s scototaxis (aversion to bright areas and natural preference for the dark) to evaluated effects of neuroendocrine compounds within these matrices. [1] Schwarzenbach et al. (2006). Science.

### WE194 Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria

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Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decrete 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 Enviromorality index assumed by ecotoxicology (ifr), Bioaccumulation and bioavailability of sediments that considers the use of three species belonging to different trophic levels has to be applied both to solid phase and liquid phase (pore water or elutriate) of sediment. The results of ecotoxicological analyses are then assessed as a whole at the level of “battery” (not of single bioassays, weighting the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and then the relative contribution in the total bioavailability). The battery result is then used to provide sediment quality assessment, following the weight of evidence (WOE) criteria, this representing an innovative approach respect to previous regulation, where chemical classification was determined by at least one parameter exceeding the threshold level and ecotoxicological classification was determined by the worst bioassay result of the whole battery. In this work, a comparison between “old” and “new” sediment quality assessment was performed, applying the two classification methods to ecotoxicological data obtained on dredging sediments from different study sites. Results obtained underline the importance of using an integrated and weighted approach (WOE) respect to a “pass to fail” criteria.

### WE195 Toxicity of sediment-bound lufuron to aquatic arthropods in laboratory biosassays

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Lipophylic pesticides are frequently detected in sediments, potentially leading to toxic effects on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory biosassays 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 benzenylurea insecticide lufuron as one of the benchmark substances to evaluate the prospective sediment risk assessment was performed, applying the two classification methods to ecotoxicological data obtained on dredging sediments from different study sites. Results obtained underline the importance of using an integrated and weighted approach (WOE) respect to a “pass to fail” criteria.

**Parameter investigated in the study:**
- **LC50:** The concentration of lufuron that leads to a 50% reduction in growth or survival.
- **HC5:** The concentration of lufuron that leads to a 5% reduction in growth or survival.
- **95% confidence interval:** Provides a range of values within which the true LC50 or HC5 is likely to fall with 95% confidence.

**Results:**
- **Initiation of ecotoxicological and biological effects:** Measured using various test species and endpoints.
- **Comparative Toxicity:** Lufuron was found to be significantly toxic to certain test species, indicating potential risks to aquatic ecosystems.
- **Comparative Biological Relevance:** The results suggest the importance of considering the biological relevance of test species when assessing sediment toxicity.

**Implications:**
- The findings contribute to a more robust and scientifically grounded approach to sediment risk assessment.
- They highlight the need for further research to improve the predictability of synthetic organic matter effects on aquatic organisms.

**Conclusion:**
The study provides valuable insights into the potential ecological impacts of sediment-bound lufuron, demonstrating the importance of employing a more comprehensive approach to risk assessment in aquatic environments.

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**References:**
Improving the environmental risk assessment of the aquaculture 'Blue Revolution' (P)

WE198 Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal

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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 the marine 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 waters. 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 Montego estuaries in Portugal. Quantification of total protein, carbohydrate and fatty acid profiles were performed to assess differences between the organoleptic composition of organisms of the same species reared in four different aquacultures (two different species 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 HUFAs contents were also influenced by the rearing site. Eicosapentaenoic acid, docosahaexaenoic 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 Montego 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 the 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 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.

WE200 Effects of aquaculture antibiotics on marine biofilms and on the amphipodGammarus aequicaudatus


Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics may cause adverse effects on potentially sensitive organisms such as non-target microorganisms, primary producers or benthic invertebrates. The objective of this study was to evaluate the potential side effects of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the community composition of marine biofilms exposed to these substances and on the amphipod Gammarus aequicaudatus. Marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of oxytetracycline and flumequine for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicaudatus organisms for two weeks. The G. aequicaudatus aquaria set up was run with two treatments in parallel: (1) with input of antibiotics only from the biofilm and (2) with antibiotics administered via biofilm and also spiked into the water. This was done to test different bioaccumulation routes (i.e., ingestion only and water exposure combined with ingestion). All the treatments for biofilm and crustaceans test were run in triplicate. Preliminary results show a marginally enhanced biomass growth of the biofilm with increasing dose of both antibiotics,
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorous), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a higher biovolume up to 160 µL/L, while the highest tested concentrations contributed to a biofilm decrease. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicuada test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

**WE201**

**Shifts in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics used in aquaculture**

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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. Improved culture techniques, new antibiotic resistance, and 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 fluenceine) on the diatom assemblage structure and biological traits of marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Two experiments were performed under laboratory conditions, in which field-grown marine biofilms were exposed to 1, 10, 100 and 1000 µg/L each single antibiotic compound for one week and then changes on chemical and biological composition were analyzed. In the second experiment, biofilms exposed to the same antibiotic concentration range were transported to field conditions after two weeks of exposure in order to evaluate their recovery capacity. In both experiments, diatoms were determined to the lowest possible taxonomic level under the microscope (Nikon Eclipse TE2000-U). The taxon abundance of the sampled quadrats of each replicate was averaged and referred to the area sampled to obtain the taxon density per replicate. The fine structure of diatoms was analyzed under a scanning electron microscope (JEOL-6100). The diatom composition, the relative abundance of species (%), the Shannon-Wiener diversity index (H') and species richness were calculated for each sample and then summarized per treatment. The growth forms (biological traits) of species were analyzed before detachment and were grouped according to the literature. The biofilms were dominated by a reduced number of taxa, including the diatoms Brachysira apolinia and Cocconeis plaentula. High exposure concentrations of oxytetracycline and fluenceine (100 and 1000 µg/L) respectively, caused an increase of species richness and diversity, as well as an increase of community evenness. The global architecture and traits of the biofilms were also influenced by the high antibiotic exposure concentrations.

**WE202**

**Assessing the oxidizing effects of hydrogen peroxide using flow cytometry as a high throughput method**

A. Almeida, Norwegian Institute for Water Research NIVA; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment

Hydrogen peroxide (H₂O₂) is widely used in commercial, industrial, medical, environmental and hygiene applications. It is applied in aquaculture for controlling biological problems such as salmon lice. H₂O₂ produces highly oxidizing radicals that can cause paralysis, peroxidation in organelle membranes and inhibition of enzymes that replicate DNA in biological organisms. The release of H₂O₂ as an effluent into the marine environment is therefore a cause for concern particularly to primary producers such as algae. With the use of flow cytometry, single cells of algae with different features and physiological states, can be examined based on the quantum yield of probes and their fluorescence. Probes that enables fluorometric determinations of several parameters such as the ability of reactive oxygen species (ROS) to oxidize non-fluorescent probes to fluorescent products. In the present study, the effects of H₂O₂ on Skeletonema pseudocostatum were analysed. The method provided a rapid assessment of several endpoints in the same exposed samples. Effects on growth, photopigments and the detection of intracellular ROS production were assessed using 3 molecular probes, were measured over 72 hours. H₂O₂ was used for determining the oxidative burst, DHR 123 for mitochondrial oxidation, and BODIPY 581/591 to determine lipid peroxidation (LPO). Exposure concentrations were selected to cover the overall concentration response curve and a short-term exposure was also made to discern initial high reactivity of H₂O₂. Chemical analyses were performed to verify the stability of the concentrations during the exposure duration. The short-term exposures demonstrated rapid high toxicity of H₂O₂ to algae, where ROS production and the response to the photopigments were the observed endpoints. Over the 72 h, the response of the algae at the different test concentration clearly differed. The accessory photopigments actively responded when the main natural pigments declined. The ROS protective system seemed to be active at medium concentrations, whereas at higher concentrations damage on membranes lipids and mitochondria possibly instigated cell failure. This high throughput approach demonstrated a great potential to study the oxidizing effects of hazardous compounds in algae. While growth inhibition allowed to discriminate the overall toxicity, the high throughput methods, using flow cytometry, helped to screen and characterize the Mode of Action of H₂O₂.

**WE203**

**An updated version of the SEPA BathAuto tool for assessing anti-parasitic chemical treatments in marine fish farms**

I. Carrall, Cambridge Environmental Assessments; A. Berkeley, Scottish Environment Protection Agency; F. Ericher, CEA; G. Hughes, Cambridge Environmental Assessments

Marine fish farms operators in Scotland wishing to use anti-parasitic chemicals as bath treatments must first obtain a discharge licence from the Scottish Environment Protection Agency (SEPA). Discharge licences are granted by SEPA on a per-site basis, with the quantity of chemical that can be released from a particular fish farm determined by computer modelling. This computer modelling considers the location and composition of the fish farm, along with hydrographic data measured at the site and the toxicity and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. Of these, cypermethrin and deltamethrin are rapidly removed from the aqueous phase via binding to particles, and are therefore assessed using SEPA’s short-term model, which calculates projected concentrations in the chemical patch up to 6 hours after its release from the fish farm. Azamethiphos, however, remains in the aqueous phase for several days until it is broken down, and is therefore also assessed using a longer-term model, originally developed by Gilibrand and Turrell (1999; MLA Report No 99/05) and recently extended by Carrall, 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.

**WE204**

**State-of-the-art on the use of models for the ERA of chemicals used in aquaculture**


As aquaculture is expanding and becoming a more diverse industry in terms of species and production systems, there is an increasing demand to generate improved modelling tools to assess its environmental impacts. Although important developments have been made in disease prevention and treatment, the use of veterinary medicines and other potentially toxic substances (e.g. antifoulants, miscellaneous aquatic chemicals and non-target chemicals) are still raising environmental concerns, and these are used to assess environmental effects. This study presents an overview on the use veterinary medicines and other potentially toxic substances used in EU aquaculture, and the environmental standards and regulatory procedures available for their Ecological Risk Assessment (ERA). Furthermore, it describes the state-of-the-art on the development of models capable of assessing the fate, dispersal, exposure, ecological effects and associated ecological risks of veterinary medicines applied in aquaculture production. This study shows that a varied range of models has been developed during the last 30 years. Their effective implementation in regulatory ERA is, however, somewhat limited in many state members. Some recommendations are provided as to improve the chemical exposure assessments and the ecological realism of the modelling outcomes, paying a special attention to the protection goals set for the regulatory ERA of veterinary medicines.

**WE205**

**Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp**


Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp
formulations using benzobicyclon as the active ingredient were approved. Benzobicyclon is the active ingredient in the herbicide, BUTTE®. In 2001, various State University / Environmental Sciences School of the Coast and Environment Sciences; L.M. Basirico, Louisiana State University / AgCenter / Renewable Natural Resources.

The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ecotoxicological effects of benzobicyclon on crayfish (Procambarus clarkii) has gradually become a major problem. A commonly used pesticide against this crustacean is diflubenzuron (DFB), which acts as a chitin synthesis inhibitor and thereby interfere with the moultling 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 of Feq 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.

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 Infection Biology; A.J. Mmochi, Institute of Marine Sciences University of Dar es salaam; R.H. Mdega, Sokone University of Agriculture; E. Wimmer, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology.

Concentration of heavy metals Cu, Pb, Fe, Zn, Co, 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 histologically-dependent parameters were analysed by using different histological techniques. The degree of exposure to potential of Feq 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.

The studies of the isoflavones, genistein and daidzein, on juveniles (weight 1.23 ±0.41 g) of Solea senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20°C and pH 8.6. The concentration of LD50 (mg/l) of solea senegalensis was determined to be 1.47 (mg/l) and daidzein (0.625-10 mg/l), plus an untreated control and a solvent control (DMSO). Mortality was recorded and fish head acetylcholinesterase (AChE) was measured with acetylthiocholine as a substrate after inhibiting butyrylcholinesterase with iso-OMPA. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head AChE activity was not altered in fish exposed to genistein, but daidzein was found to enhance AChE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Aquaculture at University of Cadiz for providing the experimental fish used in this study. This work was supported by National R&D&I Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDI group: RNM-345).

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

Comparison between results of LumiMARA and Microtox tests. M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; P. Baldoni-Andrey, C. GELBER, M. Foumède, 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®. In its main advantage, LumiMARA® allows the detection of five non-mutagenic to very mutagenic 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). Using a set of narcotic substances with different hydrophobicities and two mixtures (one home-made formulation comprising equimolar concentrations of four of the narcotics tested and one petroleum based complex substance) a comparison of both tools was realised with the aim to determine which the most useful is the better tool to evaluate effects on bacterial species. While it was recognised that the substances tested would not be directly comparable to whole effluents, this method was felt to be appropriate to compare the two assays. The in-built EC50 calculation software were also verified. Some errors were detected with the LumiMARA® effects calculation software, and these were recalculated by hand using Regtot software, when possible. We observed that Microtox® is more sensitive than LumiMARA® and that in the latter test, freshwater bacteria toxicity is generally lower than that of marine bacteria. This suggests that there may be a small but real difference between freshwater and marine bacteria toxicity however this cannot be concluded on the basis of this research. Moreover, Vibrio fischeri is the bacterium that usually has the lowest EC50 compared to other bacteria. Thus, the marine bacterium Vibrio fischeri classically used to determine the biotic effect.
in a freshwater environment may be overestimating toxicity of effluents to the freshwater compartment.

WE210 Bioluminescent assays as tools for studying antioxidant activity and toxicity of bioactive compounds
A.S. Sachkova, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryashova, Institute of Biophysics SB SAS
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, C_{60}, C_{70}, C_{84}, C_{96}, C_{100}, C_{108} and fullerenol, C_{60}OH, and humic substances (HS) are used here as bioactive compounds. Fullerolens 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 (K_{2}[Fe(CN)]_{6}) oxidizers on bioluminescence tests. We found the effective concentrations (EC50) of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1.4-benzoquinone were 2.510^4 M and 10^4 M for bacterial and enzymatic assays, respectively, while the EC20 values of K_{2}[Fe(CN)]_{6} - 4·10^4 M and 2·10^4 M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations > 10^3 g/L and > 10^4 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 > the bacterial- and enzyme-based assays showed similar peculiarities of detoxification of oxidizer solutions by bioactive compounds. Results show, that low concentrations of bioactive compounds were active. Our work demonstrates a high potential of the bioluminescent assay systems, bacterial and enzymatic, to characterize and compare antioxidant activity of physiologically active compounds.

WE211 Effect of low-dose gamma-radiation on luminous marine bacteria Photobacterium phosphoreum
A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agroecological Technologies; D.V. Dementyev, Institute of Biophysics SB SAS / Radiobiology Lab; N. Kudryashova, Institute of Biophysics SB SAS
The address addresses biological effects of low-dose gamma-radiation. Radioactive 137Cs-containing particles were used as model sources of gamma-radiation. Luminous marine bacterium Photobacterium phosphoreum was used as a biosensor to test the bioluminescence intensity as the physiological parameter tested. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure (≤250 mGy), the irradiation conditions were varied as follows: bioluminescence intensity was measured at 5, 10, and 20° for 175, 100, and 47 h, respectively, at different dose rates (up to 4100 mGy/h). There was no noticeable effect of gamma-radiation on the bacterial DF emission, 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 bioluminescence activation (adaptive response). As with alpha- and beta-radiation, gamma-radiation did not demonstrate monotonic dose-effect dependencies. The bioluminescence inhibition efficiency was found to be related to the exposure time, while no dose rate dependence was found. The sequence analysis of 16S ribosomal RNA gene did not reveal a mutagenic effect of low-dose gamma-radiation. The exposure time that caused 50% bioluminescence inhibition was suggested as a test parameter for radiotoxicity evaluation under conditions of chronic low-dose gamma irradiation[1]. The reported study was funded by Krasnoyarsk Regional Fund of Science according to the participation in the event: «29th Annual Meeting of the European Society for Environmental Toxicology and Chemistry / SETAC Europe 28th Annual Meeting, International» References: [1] Kudryashova N.S., Petrova A.S., Dementyev D.V., Bondar A.A. 2017. Exposure of luminous marine bacteria to low-dose gamma-radiation. Journal of Environmental Radioactivity 169-170:64-69. in

WE212 Bioluminescent Assay for Toxicological Assessment of Nanomaterials
E. Esimbekeva, Institute of Biophysics SB SAS; E. Nemtsova, Siberian Federal University / Institute of Biotechnology; V. Kratasyuk, 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 bioluminescence 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 hydrazine fullerene C_{60}(CNHF). This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminous bacteria: NADP+/FDMN-oxidoreducatase + luciferase (Red + Luc). A protocol based on the optical properties of CNM for correcting the results of the bioluminescence assay was developed. If the effective concentration 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 > C_{60}(CNHF). The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L respectively. The immobilised enzyme system was more resistant to C_{60}(CNHF) than its soluble form, with an IC50 equal to 1.4 mg/L. According to EC Directive 93/67/EEC for aquatic organisms, chemicals are classified by their degree of toxicity based on EC50 values. We hypothesised that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescent method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).
as an indicator of the degree of dormancy. FTC was measured with the needles’ segments using fluorometer Junior-PAM (Walz, Germany). The needles were linearly heated from 25 to 70 °C at a rate of 2° C/min using a computer-controlled heating device. In climate conditions of Southern Siberia, disturbance of winter dormancy under air pollution stress represents a major threat to the health status of Pinus sylvestris and Picea obovata. Our data demonstrate that regardless the age of needles, the dormancy depth of both species clearly correlated with the ambient levels, and the trees growing in industrial areas were easier to release from dormancy and to be affected by late winter or spring frost. In urban environments the risk of frost injuries is even higher due to early spring warm spells associated with heat island effect. Scots pine is less susceptible to air pollution and temperature fluctuations than Siberian spruce, and therefore represents a better choice for urban forestry projects.

WE215
Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polycyclic aromatic hydrocarbons
M.N. Saksenov, A.E. Balayan, Irkutsk State University / Research Institute of Biology of Irkutsk State University; O.A. Barkhatova, Irkutsk State University / Faculty of Geography; A.D. Stom, Irkutsk State University / Research Institute of Biology of Irkutsk State University

Against the backdrop of the growing diversity of toxic substances that degrade the natural environment, the creation of new analytical systems for assessing the state of the environment is of paramount importance. Among such systems a luminescent microscope. It has been experimentally revealed that many pollutants of water bodies, it is necessary to isolate oil products and polycyclic aromatic compounds (PAHs), the flow of which in the valley is constantly increasing. On Lake Baikal, this is due to the development of tourism, the increase in the number of passenger ships and tourist bases, often not equipped with treatment facilities. The necessary system for monitoring the quality of the aquatic environment, including methods for 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. Euphausia pacifica Sars (Copepoda, Cucumariota) endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. pacifica accounts for up to 70% of the total biomass of zooplankton. Crustaceans Copepoda, having fat inclusions, accumulate in them oil products. This, 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 in these species make it possible to detect this pollutant in the water under investigation. It is noted that in the presence of unicellular algae that are absorbed by the crustaceans, this process is activated and the accumulation time of oil products and PAHs decreases. Another representative of the Copepoda Cucumariota also has chaotically scattered fatty inclusions in which the accumulation of oil products can be seen in a luminescent microscope. It has been experimentally revealed that E. baicalensis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colensis, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in Copepoda crustaceans in fat drops was proposed.

WE216
The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay
E. Nembtseva, O. Chmurina, Siberian Federal University / Laboratory of Bioluminescent Biotechnologies; M. Gerasimova, Siberian Federal University / School of Engineering Physics and Radio Electronics; V. K. Ratasyuk, Siberian Federal University / Biophysical The work is devoted to the development of the bioluminescent enzymatic bioassay of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of their contamination was under consideration. The aim of this work is to study the assessment of the luminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2-11.3% and detected arsenic 3.05–15.39 mg/kg) were studied by the method of excitation-emission matrix (EEm) fluorescence spectroscopy. The luminescence in the spectral range 290-600 nm under excitation at 340-580 nm was recorded for each extract as well as absorption spectra in the range 200-800 nm. The physico-chemical characteristics of the soils (particle size distributions, pH, humus content, etc.) were compared with the inhibitory effect of water soil extracts on enzymatic bioassay based on the coupled bioluminescent reaction of bacterial luciferase and NAD(P)H:FMN-oxidoreductase. It was revealed that the spectral-luminescent characteristics of water extracts are similar for all soils and featured by three types of fluorophores with excitation maxima at about 270, 330 and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The residual activity of the bioluminescent bioassay enzymes in the presence of soil extracts was found to correlate with intensity of two first bands that is the measure of the component content. Poor correlation was found between EEm characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of biosassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project no. 16-14-10115).

WE217
The comparison of enzyme systems for soil contamination bioassay
E. Kolosova, Siberian Federal University / Biophysical; D. Gulnov, Siberian Federal University; N. Rimatskaia, Siberian Federal University / Biophysical; A. Listisa, O. Sutormin, V. Krataysuk, Siberian Federal University

Detecting oils, in particular, highly sensitive biosassay systems are extremely necessary for ecological soil monitoring. Enzyme systems may be a perspective basis for the development of modern methods of bioassay. With sets of enzymes, it is possible to simulate the effect of toxic substances present in natural environments on living organisms. Moreover, coupling enzyme-target with bacterial luciferase provides advantages in the signal detection. The purpose of this study is to evaluate the possibility of using various enzymatic systems for the analysis of soil contamination. In this work NADH:FMN-oxidoreductase, alcohol dehydrogenase (ADH), NADH:FMN-oxidoreductase + bacterial luciferase (two-enzyme system), NADH:FMN-oxidoreductase + bacterial luciferase + alcohol dehydrogenase (three-enzyme system) were examined. The enzyme activities were measured by addition of the model soil pollutants such as a blue copperases, the insect powder “Dress Profi” (Bayer CropScience) and diesel fuel. The values of the toxicological parameters ? 20 and ? 50 (concentrations of the pollutants causing the system inhibition by 20% and 50% respectively) were determined. The sensitivity of each enzymatic test system to the aqueous extract of soil was also analysed. The blue copperases (II) –water solution shows an inhibitory effect on all enzymatic systems. The value of EC 50 is from 0.088 to 8.75 µM. The insect powder-water solution also shows an inhibitory effect on all enzymatic systems except ADH enzyme system. In contrast, the diesel fuel impacts only on enzyme systems coupled with bacterial luciferase. As the result the blue copperases (II) –water solution decreases catalytic activities all enzyme systems; the insect powder-water solution decreases only NADH:FMN-oxidoreductase catalytic activity; the diesel fuel decreases luciferase activity. The addition of aqueous extract of soil leads to activation of catalytic activity of NADH:FMN-oxidoreductase; for the two- and three-enzyme systems the addition of the aqueous extract of soil leads to inhibition of catalytic activities of the enzyme systems (more than 50%). The NADH:FMN-oxidoreductase + bacterial luciferase enzyme system showed the greater sensitivity to the soil pollutants than other systems. This fact is confirmed the promising use of this system for environmental monitoring. The study was supported by a grant from the Russian Science Foundation (project No. 16-14-10115).

WE218
Are changes in bioluminescence kinetics of Photobacterium phosphoreum responsible for bioassay to low-dose radiation connected with genetic mutations?
O. Guseynov, O. Guseynova, Siberian Federal University; T. Rozhko, Krasnoyarsk State Medical University, prof. VF Voyno-Yasentsky; A. Bondar, Institute of Chemical Biology and Fundamental Medicine SB RAS; N. Kudryashev, Institute of Biophysics SB RAS

Luminous bacteria of marine origin are widely employed as biological sensors for monitoring environmental conditions, in particular, radiation toxicity. Due to their capacity of use of radioactive elements and related concerns about the increase of background radiation, special attention is lately paid to the effects of low-dose radiation on the environment. The response of bioluminescence reaction to exposures of bacteria to low-dose alpha, beta and gamma radiation has been examined in previous research. The purpose of the current study was to determine whether bacterial genetic alteration is related to bioluminescence kinetics change under low-dose exposure with alpha-emitting (321Am) and beta-emitting (3H) radionuclides as sources of ionizing radiation. Bioluminescence kinetics of Photobacterium phosphoreum in solutions of 321Am(NO3)2, 7 kBq/L, and tritiated water, 100 MBq/L, were recorded and their stages were determined as follows – absence of effect, activation, and inhibition of the genetic alteration at different stages of the bioluminescent kinetics ensuring that the doses accumulated by the samples were close or a little higher than a tentative limit of a low-dose interval: 0.10 and 0.85 Gy for 321Am, or 0.11 and 0.18 Gy for 3H. The 16S ribosomal RNA gene was chosen as a target one for sequence analysis aimed to test whether low dose radiation triggers any alterations in this universal throughout bacterial world and can be a cause of toxicity at the genetic level. Radiation triggers any alterations in this universal throughout bacterial world and can be a cause of toxicity at the genetic level. Radiation triggers any alterations in this universal throughout bacterial world and can be a cause of toxicity at the genetic level. Radiation triggers any alterations in this universal throughout bacterial world and can be a cause of toxicity at the genetic level.
LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (P)

WE219 Meet the Framework Regulation and Supply Chain secondary standards in wheat cultivation for sustainable pasta production. An example of broadleaf weed control: halauaxifen-methyl (Arylex™ active) C. Vaj, S. Cavanna, Dow AgroSciences Italia srl; A. Haley, Dow AgroSciences Ltd; W. Jones, DuPont

The need and 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 auzinic herbicide, halauaxifen-methyl (Arylex™ active), for wheat weed control in the broadleaf stage, in spring and winter soft and durum wheat. This highly efficacious herbicide requires low use rates and its inherent properties (rapid degradation in the soil and plant) mean a low environmental and human health impact. Utilising halauaxifen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (e.g. pasta) and in the environment. Results will be presented and discussed. Therefore, the properties of halauaxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards.™ Trademark of Dow AgroSciences

WE220 Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs J. Koura, University of Balamand / Chemical engineering department; R. Mannhe, University of Balamand / Department of Chemical Engineering; R. Belarbi, University of La Rochelle / Laboratory of Engineering Science for Environment LiSIE, V. El Khoury, University of Balamand / Chemical engineering department; H. El Zakhem, University of Balamand / Department of Chemical Engineering; M. El Mir, University of Balamand / Chemical engineering department

The aims of this study are to (1) assess the environmental performance of an extensive green roof (EGR) mock-up installed on the rooftop of the Chemical Engineering Department at the University of Balamand, in the region of El Koura, North Lebanon (34°31'N, 35°50'E) from the raw material phase until the end-of-life phase through a Life Cycle Assessment (LCA); (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TGBR) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the Ecoinvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainwater through their growing medium and the vegetation could remove airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TGBR and EGR mock-ups within the use phase. Furthermore, the sensitivity and uncertainty analyses will be performed to check the robustness of the results.

WE221 Filling whole building life cycle assessment gaps for conceptual building design V. Hatton, University of Pittsburgh; J. Chhabra, G. Warn, Pennsylvania State University; M. Rile, University of Pittsburgh / Civil and Environmental Engineering

Resource consumption, harmful emissions, climate change, and hazard events have triggered increased interest in sustainable and resilient buildings over the past 20 years. The sustainability and resilience performance of buildings has been covered in numerous rating systems and building codes; however, these are typically prescriptive methods focused on setting minimum performance requirements rather than helping us understand and optimize buildings. Life cycle assessment (LCA) and performance-based methods (e.g., energy modeling, seismic loss assessment) can be more beneficial from this standpoint but can be complex and isolated from each other. Most building LCA studies to date have limited their scope to embodied and operational energy use, due to their overwhelming impacts in conventional buildings, while some aspects, such as repair from damages (e.g., seismic) and water use have been largely missing. This study uses LCA, energy modeling, water modeling, and seismic loss assessment simultaneously to obtain a comprehensive picture of the costs and benefits of life cycle analyses of high-performance building design alternatives. Preliminary analysis of a hypothetical building shows that in some metrics, such as cost and eutrophication, repair and water phases, respectively, can contribute more than 10% over the lifetime of the building. One design parameter expected to influence all of the mentioned performance aspects is the building form-factor, and its effect on the results will be presented. Based on the typical approach to building LCA and the shift in the sources of impacts away from operational energy as buildings transition to net-zero energy, this study investigates the potential contribution from missing phases in building LCA. This research brings together knowledge from multiple disciplines and links them through life cycle thinking, investigating the effects of building design decisions in multiple metrics. This approach can be crucial in identifying optimal solutions early on during the conceptual building design phase.

WE222 Prospects for multidimensional assessment of sustainability in urban environments F. García-Guallar, L. Liój, Universidad de Santiago de Compostela / Chemical Engineering; A. Núñez, L. González Louro, FEGAMP - Santiago de Compostela; E. Andrade, Universidad de Santiago de Compostela; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; S. González-García, University of Santiago de Compostela CIF Q1518001A / Chemical Engineering

Urban systems can be considered as living organisms driven by materials and energy flows (urban metabolism). Once these flows are computed, the environmental profile of the city can be analysed. However, when only assessing the environmental aspects of cities, a limited view of their performance is possible, as they are complex systems in which social and economic aspects are at least as important as environmental ones. This fact raises a dilemma, since today’s developed society bases its social and economic well-being on the consumption of resources and, therefore, on causing a large impact on the environment. The definition of sustainability includes three main pillars: society, economy and environment. However, considering the social and economic aspects of urban metabolism, two main gaps emerge. The first one is the lack of standardisation. Indicators are used to evaluate these aspects, but different specialized organisms propose different sets of indicators. The second gap is the difficulty of comparing indicators to each other in order to evaluate which city is the most sustainable in a sample. This study aims to fill both gaps by systematically assess the sustainability of several cities in Galicia (NW Spain). To select an appropriate set of indicators, including environmental, social and economic criteria, a Leopold matrix has been constructed considering: (i) the data available for the sample cities, (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 (Phillips et al., 2017). Finally, a composite indicator, i.e. a sustainability index, is obtained for each city based on the three composite sub-indicators of the sustainability dimensions (environmental, social and economic criteria). Acknowledgements This work was financially supported by the Spanish Ministry of Economy and Competitiveness (project ref. CTQ2016-75316-P) and by Xunta de Galicia (project ref. RCI2016/0101). S. González-García would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness for financial support (Grant reference RYC-2014-14984).

WE223 Life Cycle Analysis of remediation solutions in railways and surrounding areas M. Riera, Lietat Technological Center

An important environmental problem is the pollution associated with trains on external or underground railways. Despite is an issue less studied, a real contamination by heavy metals and hydrocarbons exists in railways, affecting also the surrounding areas. Following the strategic line of Horizonte 2020, RECOVER project aims to develop new technologies to reduce the environmental impact of transport systems. The project is executed by COMSA, CETIM and LEITAT, and is within the framework of the call "Challenges of Collaboration" in 2015, with partial funding from the Ministry of Economy and Competitiveness of Spain. The
main aim of the project is to develop systems for the collection and elimination of pollutants (hydrocarbons and heavy metals) present in the ballast and on the ground adjacent to the railway tracks through the use of different technologies: Ballast modified by sol-gel coating based on silicon oxide to capture heavy metals and titanium oxide for the degradation of hydrocarbons. Phytoremediation processes (use of plants to decontaminate soils) and bioremediation (bioaugmentation of the microbial population of the soil) for the uptake of heavy metals and hydrocarbons in the soil adjacent to the roads. The solutions are first performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, applicable technologies, and operation - 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 reductlon in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators are: Land Use Changes, Air Pollution, Water Pollution, Energy Depletion, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

WE224 Life Cycle Assessment of Asphalt Mixtures vs Road Pavements D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carzion, 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 research towards the implementation of sustainable techniques and operations, and decision-making tools are essential to help authorities to accept them. In this regard, LCA has become popular in pavement engineering but there is still a lack of detailing, consensus (especially in terms of system boundaries) and reliable data. Beyond ISO 14040/2006, ISO 14044:2006, ISO/TS 14067:2013, EN 15980:2012 and GHG Protocol 2013, there is no specific methodology for selecting the system and activities that should be included in either road or asphalt mixes. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixes. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixes. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The study presented here highlights the differences between the LCA of asphalt mixes and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE225 Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourist facilities: demEAUmed solution A. Claret, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vázquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division

The main objective of demEAUmed is to tackle water scarcity in the Mediterranean area, especially in places with high tourist activity. Also, the project wants to foster the incorporation of sustainability aspects in the tourism sector. To achieve both challenges, demEAUmed has demonstrated the integration of innovative wastewater/greywater treatment technologies to achieve an optimal and safe closed water cycle in Mediterranean tourist facilities. Water resources are limited and unequally distributed geographically and among the year seasons, with higher pressure during summer, in Mediterranean regions. For instance, water consumption per guest has been estimated at 222 L/day in hotels in Spain. So, it is of great importance to achieve a holistic water resource management. demEAUmed affords the reuse of greywater and wastewater generated in touristic facilities with an integrated approach bringing environmental benefits such as water savings and water management carbon footprint reduction. 8 different innovative technologies with an advanced monitoring, control and decision support system have been integrated and implemented on the demonstration site: Samba Hotel-Lloret de Mar, Catalunya, Spain. These technologies have been assessed through a comprehensive LCA, assessing the impacts for each individual technology and for the demo-site integration (7 different configurations). Besides the LCA, a Life Cycle Costing (LCC) is being performed in order to analyse the economic costs. A social LCA (S-LCA) is also conducted in order to assess the social impacts generated by demEAUmed. Life cycle stages of construction and operation of technologies and systems are assessed. Finally, results determined that the demEAUmed technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demEAUmed combined strategies, the carbon footprint is reduced up to 136% (greywater scenario) or up to 62% (wastewater scenario) thanks to water savings and focusing on the technologies, main environmental impacts are localized on the operation stage, due to electricity consumption. Concerning the LCC, the overall cost treating one cubic meter (1m³) of greywater or wastewater by the demEAUmed technologies along their life cycle are being determined. Finally, S-LCA has presented some indicators and the quantification of the socioeconomic impacts and benefits provided by demEAUmed solution.

WE226 Integrating Life Cycle Assessment and Risk Assessment to support decision making in the framework of Enhanced Landfill Mining G. Sarve, KU Leuven Research & Development / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering

The eco-toxicological impacts would be assessed by integrating the environmental impacts of product systems throughout their life cycle. However, when addressing waste management strategies, and in particular landfills, this tool could lead to some limitations. Landfills are in fact highly complex systems and their impacts are affected by several site- and time-dependent parameters. When assessing the potential for enhanced landfill mining (ELFM), the relative perspective of LCA and LCC is crucial - especially in terms of system boundaries and over- or underestimation of the impacts and to inaccurate results. The aim of the research is to support decision making by defining a consistent “Do Nothing” scenario for landfills for the evaluation of the environmental potential of ELFM. This can be achieved by understanding the processes underlying the emissions of different compounds and estimating the long term emission potential of landfills. In fact, landfill leachate emissions are, on the long term, the major environmental concern and the risks to human health and the environment (HHE) are dependent on environmental and time-dependent conditions. In this context, metal speciation is considered an important aspect to include in the estimation of the emission potential, as the emissions and eco-toxicological impacts of metals depend on the variation of site-specific conditions in time. In light of these considerations, a more consistent evaluation of impacts on a global and local scale and considering a long-term perspective could be achieved by integrating LCA with risk assessment (RA), which is a more site-specific tool. In fact, the evaluation of the long-term emission potential of landfills would include the definition of a fate, transport and exposure model for leachate emissions that would then be integrated in the impact assessment stage of LCA. The eco-toxicological impacts would be assessed by integrating the variation of pollutants’ concentrations in time and under specific conditions, and by including the variation of background concentrations in the receptor. Literature studies with focus on the integration of spatial differentiation (regionalization) and time-dependency (Dynamic LCA) will be used as references for the study.

WE227 Comparative environmental sustainability analysis of waste-to-energy techniques for municipal solid waste A.J. Ramos, INEGI / INEGI; A.J. Rouboa, University of Pennsylvania / Mechanical Engineering and Applied Mechanics

Progressively advancing societies generate increasingly complex mixtures of residues which led waste thermal treatment methods to evolve greatly in the last decades [1]. Incineration is among the most waste-to-energy (WtE) techniques used for solid residues treatment [2], still gasification is gaining notoriety due to its proven benefits namely concerning efficiency indicators and environmental outputs [3, 4]. Three waste-to-energy techniques for the treatment of municipal solid wastes were assessed through a life cycle analysis (LCA) per unit energy comparison so as to evaluate their environmental impacts: incineration, regular gasification and two-stage plasma gasification. The functional unit chosen was one tonne of residues which led waste thermal treatment methods to evolve greatly in the last decades. Comparing incineration and gasification techniques, adding an extra cleaning step to the raw syngas produced by gasification, where even higher temperatures are applied through the use of a plasma torch that literally “melts” the residues this technique grants environmental benefits such as lower levels of pollutant emissions, less landfilling.

**WE228 Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK**
S. Mohamed Yunus, University of York / Environment; A. Boxall, University of York / Environment Department; E. Igos, Luxembourg Institute of Science and Technology / Environmental Research and Innovation

Unused or expired medicines from the hospital and household waste can ultimately end up in landfills or be released to the wastewater system. Therefore, there is the potential for active pharmaceutical ingredients (APIs), from a range of medicinal products, to be present in landfill leachate and sewage effluents. Unused medicines may also be returned to the pharmacist and then be incinerated as hazardous waste. In this project, a household survey was performed to understand the typical waste generation patterns for medicines and the most disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method for the UK residents with highest estimated emission of APIs to the environment being estimated for paracetamol within the range 7.63 mg/person/day (sewage after sink and toilet disposal) to 76.52 mg/person/day (wastewater after excretion). Based on the survey data, a life cycle assessment study was performed to assess the broader environmental impacts of typical medicinal waste disposal management practices in the UK. The functional unit of this study was 1 tonne of pharmaceutical waste generated in the UK. Three scenarios and treatments were explored: incineration after returning back to the pharmacy; landfill treatment after rubbish disposal; and wastewater treatment after toilet and sink disposal. For the life cycle inventory (LCI) phase, two types of databases were used in the study: primary data from the survey data and secondary data from the ecoinvent database. Most of the datasets used in this study are from the whole of Europe (ER E) or the United Kingdom (GB). To carry out the life cycle impact assessment (LCIA) phase, the method that has been considered is LCID 1.8 2016 midpoint with APIs. Meanwhile, USEtox 2.0 was also used in this study to calculate characterisation factors for the APIs that were not commonly used in the previous study. Furthermore, the impact categories that were considered for this study are climate change, ecosystem quality, human health and resources. The study is still ongoing and the results will be presented at the event.

**WE230 Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool**

C. Tomasin-Montenegro KIT, Karlsruhe Institute for Technology; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Tomasini-Montenegro, C a, Weil, M a, b, c, HHU, Helmholtz-Institute Ulm, Helmholtztr 11, 89081 Ulm, Germany b ITAS, Institute for Technology Assessment and Systems Analysis, Karlsruhe, Germany c KIT, Karlsruhe Institute for Technology, P.O. Box 3640, 76021 Karlsruhe, Germany In our modern and globalized society, meeting energy needs in a sustainable way pose one the biggest challenges for the scientific, political and regulatory bodies around the world. Therefore, in the context of the United Nations Development Goals, affordable and clean energy access has been defined as a reachable goal for 2030. In addition to the social impacts associated with this action plan, both tackling climate change and defining regulatory and market frameworks are common elements to identify global solutions for a low carbon energy market. Although it is recognized that geopolitical factors will shape a tailored solution for each geographical region, a transformation of the energy system with a high share in renewable energy sources is necessary to reach a decarbonized energy supply. In particular, considering an energy system with a share of solar and wind power, energy storage technologies are required to level fluctuating energy production and demand. However, even though when it is recognized that the energy storage technologies exhibit different maturity stages, information about their associated environmental impacts is required to evaluate the sustainability trade-offs inherent to a technology decision-making process. In order to avoid environmental burdens shifting, a life cycle assessment approach is proposed to develop a model for the preliminary evaluation of emerging batteries or components of these batteries using CCaLC as an assessment tool. The outcome of this work is aimed at contributing to understanding the environmental impacts associated with batteries from a life cycle perspective, while evaluating the advantages and disadvantages of using CCaLC as an assessment tool.

**WE232 Development of Environment Hotspots of Analysis and the consideration of availability to 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 important ecological, environmental, ethical and social sustainability impacts”. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). Several API and services are evaluated 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 as well as the US. For TPP member countries, this phenomenon can be used as a lever to reduce the environmental burden of the countries that have high environmental standards. In this study, we have used the network centrality analysis, especially, the applied structural path betweennessness (Li et al., 2016; Hanaka et al., 2017) to EORA database (Lenzen et al., 2012, 2013) and analyzed the critical sectors for the cooperation policy in the current global supply chain network. From the centrality analysis, we identified the critical sectors and transmitters. In the case of TPP framework, the largest CO2 emitter are “JPN. Electricity, Gas and Water” and “CHN. Electricity, Gas and Water.” On the other hand, the largest CO2 transmitter are “RUS. Mining and Quarrying—JPN. Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN—JPN” in the country level. We can see the large CO2 emissions are related to the development of new projects in the critical sectors. In the case of other FTA framework, similarly, mining and qualifying sectors in Russia and China tend to be critical sectors. Replacement of the mining goods suppliers is not easy. Therefore, FTA member countries should make a guideline for acquisition of greener materials and parts produced in the critical sectors.

**WE234 Developing life cycle assessment to fight climate change**
P. Goglio, Canfield University / School of Water, Energy and Environment; A.G. Williams, N. Balta-Ozkaz, N. Harris, Cranfield University / School of Water, Energy and Environment; P. Williamson, University of East Anglia / School of Environmental Sciences; A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation (ERIN); P. Baustert, Luxembourg Institute of Science and Technology LIST / Resource Centre for Environmental Technologies (CRTE)

Climate change targets could only be achieved with the contribution of greenhouse gas reductions from several GGRT. However, the lack of a common approach to identify and assess the most significant environmental impacts 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 IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). Several API and services are evaluated 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 Japanes
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, the methodological design of the LCC was based on a comprehensive agreement with the IAM assumptions to be used and this constitutes a major limit. The choice among the approaches depends on the objectives of the LCA and should be as complete and comprehensive as possible when climate change claims are made. Future perspectives include a comparative testing of these approaches for selected GGRT and future research should develop and assess potential alternative approaches to those presented. Further research is necessary to develop the appropriate LCA methodology for GGRT.

**WE235 HYBRID FULFILMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT**

I. Espí Gallart, Fundació CMT, Centre Tecnologic; I. Berzosa, L. Vendrell, Fundació CMT Centre; F. Clares, Fundació CMT 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 all the socioeconomic impacts of a new process or project. This methodology is not only based in technical performance of the studied system, but also in the holistic approach offered by the LCA, LCC and sLCA methodologies. This semi-quantitative system is based on the scores of the relationship between indicators and impacts. In this way, this methodology allows calculating in which degree the objectives have been achieved, and how the impacts and indicators affect the system. One of the main strong points is its integrated approach which allows to consider the impacts of the project during different dimensions of the project. The indicators, placed in rows, are organized in four categories: technical indicators, environmental indicators, economic indicators, and social indicators. For technical indicators, data coming from performance of the system is implemented. The indicators for the environmental category are taken from LCA studied impact categories, which are supposed to be relevant for the project. In the case of the economic category, indicators studied in the LCC study are considered. Regarding the social indicators, those listed come from sLCA study. The distribution of the columns shows two parts: the fulfilment part, and the relevance part. In the fulfilment part, three columns are deployed: Baseline status, expected results set with the goals of the new project, and current or final results. On the importance part, the added columns represent the impacts of the project, which entail technical, sustainability, economic and social insights. When the impacts are selected, its importance in reference to the studied indicators must be defined based on expert know how and opinion. This importance is set by applying a value between 0 and 3.

The socio-economic scores are calculated combining the importance values with the fulfilment scores. As a case study, this methodology has been applied to LIFE RELEACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology has allowed to determine which socio-economic impacts have the higher contribution.

**WE236 SETAC Sustainability Interest Group**

D.L. Carr, Texas Tech University / Biological Sciences

**WE237 SETAC LCA Interest Group (Europe)**

H. Stichnoth, Thünen Institute / Agricultural Technology

**WE238 Life cycle assessment of a thermoplastic starch obtained from mango kernel**

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Agrifood industry generates large amounts of residues with potential to be used as feedstock. As a case study, this methodology was applied to Life cycle assessment of a thermoplastic starch produced from mango kernel (MK-TPS) and, compared to it, a starch-based biopolymer product. Mango fruit annual production in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can be used as feedstock. The production of MK-TPS started 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 economic allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial eutrophication and marine eutrophication, comparatively to LDEP. The most important contributor to impacts is starch extraction (due to hexane and methanol), except for marine eutrophication, for which the main contributor is glycerin used to produce the thermoplastic. The paper may contribute to the eco-design of a new biobased product using an agricultural residue from the fruit industry as its feedstock, through a Life cycle assessment based on laboratory scale data. Future studies shall take into consideration critical aspects and improvement opportunities identified through the study on a larger scale extraction process.

**Environmental monitoring of contaminants using terrestrial ecological biomonitor**

**WE239 Geostatistically estimating spatial structures for heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany and Iceland**

A. Schröder, W. Schröder, University of Vechta / 2. Dreyer, J.A. Silva, S. Ramos, LEPABE  University of Porto; H. Indriðason, I.A. UBA, Dessau. Text: 82 S, 4 Anh.: 212 S.

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 Surveye 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 l statistics and Variogram Analysis and mapped by use of Kringing interpolation. This is the precondition to spatially join the moss survey data with data collected at other locations within different environmental networks. The case study 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.


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**WE240 Semi-volatile organic contaminants (SVOCs) in pine needles from Iceland**

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Iceland is famous for a great number of things, but vegetation (particularly forestry) is not one of them. However, trees do exist in this country and pine stands and forest areas are reasonably widespread along the coastal areas of the island, allowing needles to collect upon availability in 24 sampling sites that included remote and rural areas as well as coastal forests adjacent to the main urban areas. In order to collect these needles, a study was conducted, during which needles were collected upon availability in 24 sampling sites that included remote and rural areas as well as coastal forests adjacent to the main urban areas. In Iceland is famous for a great number of things, but vegetation (particularly forestry) is not one of them. However, trees do exist in this country and pine stands and forest areas are reasonably widespread along the coastal areas of the island, allowing


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**WE241**

*Study of global diffuse pollution levels in remote high mountain areas and their impact on the organisms from these ecosystems*

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Global diffuse pollution results from the emission of multiple sources and long-range transport. Effects of this background contamination have been observed in the recent past in fish from remote high mountain lakes through mRNA measurements in which showed feminization effects and oxidative stress (S. Jarque *et al*. 2015). Although some of these effects were related to persistent organic pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they can bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the present work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1600m to 2500m asl. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (*Salmo trutta*) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutant found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. S. Jarque *et al*. (2015). Background fish feminization effects in European remote sites. *Sci. Rep.* 5, 11292.

**WE242**

*Spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada*

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Mercury is a persistent pollutant present in all ecosystems. The prevalence and spatial distribution of mercury will determine its movement in the atmosphere and potential to bioaccumulate and biomagnify through food webs leading to mercury contamination in top predator organisms. Monitoring of mercury and other trace metals can be costly, whereas the use of naturally occurring epiphytic lichens can be an effective tool for these types of studies. Nova Scotia, Canada is a hotspot for mercury and other trace metal accumulation in ecosystems, partially attributed to long-range transport of anthropogenic air pollution. The region also contains a number of historic gold mining sites that are known to have persistent high levels of mercury and arsenic in sediment. The relative contribution of local and national sources of mercury to local air is unknown. This work aimed to address which elements can be effectively biomonitored through lichens. Trace metals in lichens other than mercury may also help elucidate the potential sources of these elements: whether from geological, re-emission, or long-range transport. Over 300 lichen (*Usnea spp.*) samples were collected across Nova Scotia and analyzed for total mercury (THg); a subset of these samples were analyzed for other trace metals, whether from emission, or long-range transport. Effects of this background contamination have been observed in the recent past in fish from remote high mountain lakes through mRNA measurements in which showed feminization effects and oxidative stress (S. Jarque *et al*. 2015). Although some of these effects were related to persistent organic pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they can bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the present work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1600m to 2500m asl. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (*Salmo trutta*) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutant found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. S. Jarque *et al*. (2015). Background fish feminization effects in European remote sites. *Sci. Rep.* 5, 11292.

**WE243**

*Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania*

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Waste disposal has huge environmental impacts including toxins, leachate and greenhouse gases. Lichens (*Evernia prunastri* (L.) Ach. and *Ramalina (L.) Ach.*) were used for biomonitoring the health status of an area influenced by the largest solid waste landfill in central Lithuania. Lichen transplants were exposed for 3 months. Chlorophyll content increased in both transplanted lichens with increase in distance from the landfill. Chlorophyll content in lichens was significantly lower in the nearest study site in comparison with the control. Potential quantum yield expressed as Fv/Fm, in thalli was lower under the influence of solid waste incinerator in comparison with the reference. Higher chlorophyll degradation was characteristic to the transplanted lichens under the influence of landfill. The conductivity of leachate and content of thiobarbituric acid reactive substances (TBARS) increased in lichen material transplanted at sites facing the landfill. The results showed that biological monitoring can be useful tool for environmental quality assessment.

**WE244**

*What it means: Levels of PCDD/Fs in the surroundings of a hazardous waste incinerator* – M. Marques, Rovira i Virgili University / Chemical Engineering; M. Mari, Universitat Rovira i Virgili / Chemical Engineering; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IESPV; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química; J.L. Domingo, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health

Soil and vegetation were used as environmental monitors to assess the occurrence of dibenzo-p-dioxins and polychlorinated dibenzo[4,5]dioxin [PCDD/4,5-Fs] in the vicinity of a hazardous waste incinerator (HWI) located in Tarragona ( Catalonia, Spain). Results belonging to 2015 and 2016 were compared to a previous study conducted in 1998, before the plant started operating, to evaluate the potential impact of the facility after several years of regular operation. The median concentrations of PCDD/Fs in soil samples collected around the HWI were 0.46 pg I-TEQ/g (dw) (range: 0.14 to 1.96 pg I-TEQ/g (dw)) and 0.44 pg I-TEQ/g (dw) (range: 0.13 to 1.34 pg I-TEQ/g (dw)) in 2015 and 2016, respectively. No statistical differences were found between 2015 and 2016 campaigns. Comparing the study of 1998 (median: 0.75 pg I-TEQ/g (dw)) with these carried out in 2015 and 2016, the concentration of PCDD/Fs statistically decreased by 41 and 55%, respectively. Median concentrations of PCDD/Fs in samples of vegetation collected in the vicinity of the incinerator were 0.23 pg I-TEQ/g (dw) (range: 0.11 to 0.68 pg I-TEQ/g (dw)) in 2015 and 0.17 pg I-TEQ/g (dw) (range: 0.09 to 0.36 pg I-TEQ/g (dw)) in 2016. The temporal trend of PCDD/Fs in vegetation was very similar to that of soil, with overall reductions of 4%, 30% and 27% 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 samples 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 profile 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.

**WE245**

*The use of land snail Cornu aspersum as sentinel organism to monitor air pollution* – L. Sturbu, M. Vannuccini, G. Liberati, F. Nannoni, G. Protano, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Fattorini, University of Siena / Department of Life Sciences; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

The use of biomonitoring organisms for monitoring air pollution allow to assess real hazardous effects of airborne contamination over a geographical and temporal scale depending on selected species and scientific approach. The present study aimed to validate the use of the land snail *Cornu aspersum* as bioindicator of airborne pollutants effects by transplanting snails in plastic cages positioned in urban area strongly impacted by several industrial activities nearby. Ten sites were selected based on traffic density, prevailing wind directions and site characteristics was used to display and model these regional trends. While broad spatial resolution was the initial focus for these collections, a few target areas (biological mercury hotspot Keijmijkujik National Park and historic gold mining areas) were also sampled in more intensively to confirm spatial patterns. Lichens were also collected from one old growth forest site weekly for a one year period to investigate if there were detectable seasonal patterns in the mercury accumulation on lichens. We show that the association between mercury and lichens is stable over a one year period with minimal variability due to abiotic climate factors (solar radiation and temperature). The use of lichens as biomonitor of air quality is inexpensive and effective.
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 22.4 μg/dL and 24.8 μg/dL, respectively. There was no significant difference between BLLs before and after a week. GPS log data was averagely collected for 4.4 days and the means of distances of dog movements per day was 17.6 km. There was no significant relationship between distances of dog movements per day and the gap of BLLs in dogs between before and after a week. The distance between the mining area and dogs’ home was significantly negatively correlated with BLLs (p < 0.05). The previous study revealed the concentrations of Pb in soils were negatively correlated with distance from the mine. These trends suggest that the distance from the mine is a key factor of Pb exposure on dogs. In the present study, there was a significantly negative correlation between BLL before a week 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.

Monitoring and impact assessment of terrestrial ecosystem using Eisenia fetida affected by chemical incidents

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Many chemicals can be accidently spilled in the environment and it is important to know their presumable toxicities on the living organisms to determine risk assessments. There are no information on the terrestrial organisms of six chemicals possibly spilled into the environment, containing sulfuric acid, methanol, methylthylketone, nitric acid, formic acid, and toluene. In this study, we conducted acute toxicities of these six chemicals on Eisenia fetida in an artificial soil according to the OECD guideline 207. We used E. fetida adults grown in our laboratory for 10 generations in soil consisting of pig manure composts fortified with steamed sweet potatoes at 25°C. The earthworms used in this study were sexually well developed with an average body weight of 100 to 200 mg. The artificial soils were composed of industrial sand (70%, 50 to 100 micron particle), kaolin (20%, pH 4.5 to 7.0), and peat (10%). After mixing the components, pH was set in 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, methylthylketone, nitric acid, formic acid, and toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 g/kg soil, respectively. These results are very different from the acute toxicities using filter papers, which toluene exhibited 26-fold lower acute toxicity than sulfuric acid, the strongest toxic chemical among the tested chemicals. Using the filter papers, methanol and methylthylketone did not possess a negative effects on the earthworm. With these results, earthworms may act differently to the chemical incidents in relation to their residential condition when they expose to the chemicals.

Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.

A. Le Nyenayen, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, Ferafactologie de la Production Intégrée, Site Agrogene; Y. 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 insecticides. These compounds are toxic to non-target arthropods and increase the risk of resistance making apple orchards an interesting case to study the deleterious effects of OP insecticides on target species. In the face 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.

Capowiez, INRA Avignon; M. Rault, University of Avignon

The earthworm species Eisenia fetida is a common organism in the soil toxicity testing framework, however, recent studies have point out endogeic species are more sensitive to pesticide than E. fetida. Moreover, interspecific differences in the response of this ecological group of earthworms to agrochemicals should be investigated for a better understanding of pesticide impact at population level. Here, we compared two endogeic and abundant species in the agroecosystem (Allolobophora chlorotica and Aporrectodea caliginosa) were inoculated in Oeclabudán® (ethyl parathion)-contaminated soils. Behavioural (burrowing, casting and feeding, this latter assessed through earthworm mass changes) and biochemical (acetylcholinesterase [AChE] and carboxylesterase [CbE] activities) were measured after 7 days of pesticide exposure. Our results clearly showed specific interspecific differences, as the endogeic E. fetida evidenced a higher sensitivity of A. caliginosa AChE activity compared with that of A. chlorotica, which suggested that this toxicological endpoint may contribute to the interspecific differences of behavioural responses such as cast production rate. Our findings suggest the use of more than one endogeic earthworm species to assess toxicity from organophosphate insecticides, overall when these earthworms have a beneficial impact on soil fertility.

Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes

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Untreated waste water and solid waste generated by the tanning industry can cause serious environment damage, particularly to surface and groundwater. In order to avoid pollution, specific chemical, physical and biological treatments have been adopted to reduce waste toxicity, caused mainly by the presence of the chromium. Chromium exists in oxidation states of Cr (III) and Cr (VI). As it is well known, the trivalent oxidation state is the most stable form of chromium and it is essential to plants in trace concentrations. In other hand, the hexavalent is toxic and carcinogenic to mammals, even in small concentrations. Thus, the aim of this work was to investigate the Cr transport in sweet peppers cultivated with vermicompost to understand the behavior of this toxic metal and the leaching of Cr. The concentrations of Cr (III) and Cr (VI) were determined through graphite furnace atomic absorption spectroscopy (GF AAS). Values of Cr (VI) were below the detectable level (LOQ) in all the analysis. In general, all treatments showed a decrease on their (Cr III) content during the sweet pepper cultivation. The concentration of Cr (III) varied in leaves < stalks < roots < fruits. Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root accumulation was observed in all the treatments. Differences in the chromium contents were not observed between samples and treatments which received vermicomposted tannery wastes with others, without addition of chromium residues. Keywords: vermicomposting; tannery wastes; chromium; sweet pepper

Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.

A. Le Nyenayen, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, Ferafactologie de la Production Intégrée, Site Agrogene; Y. 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 insecticides. These compounds are toxic to non-target arthropods and increase the risk of resistance making apple orchards an interesting case to study the deleterious effects of OP insecticides on target species. In the face 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.

Biochemical and behavioural responses in two endogeic earthworm species exposed to parathion

F. JOUNI, UAPV/IMBE; J. Sanchez-Hernandez, University of Castilla La Mancha; C. Mazzia, University of Avignon / Biologie; M. Johnin, University of Avignon; Y.
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 earwig extracts. Acetylcholinesterase (AChE) activity, the molecular target of OP insecticides, was monitored as toxicological endpoint. We observed that the mortality rate of adult earwigs exposed to the authorized dose of chlorpyrifos depends on their age, and that earwigs sampled from 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 exposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations support the hypothesis of a molecular target modification in AChE decreasing to a degree 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 δ^{13}C values, indicating a C_{3}-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C_{4}-based diet preference characterized by lower δ^{13}C values. Moreover, enrichment of the heavy N isotope during metamorphosis is observed in the dragonfly and litchi stinkbug, but the other species (grasshopper, butterfly and moth) did not show significant increases in the values of δ^{15}N 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, a common multi-linear correlations between ln (adult/larvae concentration of PCB) and the compound was observed for the four taxonomic insects. The ratio of larva to adult decreased with increasing values of ln K_{OW} (log K_{OW} = 6-6.5), then increased (6 < log K_{OW} < 8) and decreased again (log K_{OW} > 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 recent years, the concern about the bioavailability of glyphosate-based herbicides (GHB), 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 lute it the meiotic arrangement, at high dose the abundance of oocytes increased spermatids are damaged. GBH accumulation is 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. Polesello, University of Bologna; J. Milionis; M. Mazzoni, University of Insubria, DISTA / Water Research Institute; B. De Felice, Universiti degli Studi di Milano; F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNIR; S. Polesello, 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 IPFAS; and PEB-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 long migration route. Seabirds and eggs of birds that are accumulated in birds can be transferred to the offspring via their eggs, which are considered as good bioindicators of environmental pollution for a plethora of contaminants. However, the information concerning the maternal transfer of PFAS in bird eggs and their variation in accordance 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, perfluorooctanoic, perfluorooctane sulfonate (PFOS) was the main compound detected in the egg yolk, followed by perfluorooctanoic acid (PFOA) and perfluorodecanoic acid (PFDoDA). Overall, the ΣPFAA decreased according to the position in the laying sequence, with first- and second-laid eggs showing higher concentrations compared to last-laid eggs. A similar decreasing trend was also noticed for single compounds, namely PFOS, perfluorohexanoic acid (PFHA), perfluorodecanoic acid (PFDoDA), perfluorooctanoic acid (PFOA), perfluorodecanoic acid (PFDoDA), with concentrations measured in the last-laid eggs that were significantly lower compared to those from the first- and second-laid eggs.

WE254
First assessment of metal concentration in the crab Goniopsis cruentata (Latreille, 1803) (Decapoda, Grapsoidea) from two brazilian mangroves areas with different levels of contamination
M. Vedolin, University of São Paulo USP; T.H. Trevizani, Universidade de Sao Paulo / Instituto Oceanográfico; M. Petti, University of São Paulo USP; R.C. Figueira, University of São Paulo USP / Institute of Oceanography The crab Goniopsis cruentata is a common semi-terrestrial species in Brazilian mangroves. Its geographical range includes the western Atlantic Ocean from Bermuda to Brazil, and the eastern Atlantic Ocean from Senegal to Angola. The species is an important fishery resource for traditional communities in the some regions of Brazilian coast. These ecosystems are located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of vector analysis (availability of metals) 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 non-contaminated areas. Samples were collected in two mangrove areas: São Paulo State (SP, Brazil). The sampling was carried out during the period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruentata to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills>hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.05). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (grain size, pH, salinity) that reduce the mobilization of these chemicals to the tissues and, consequently, their bioavailability to the local biota. Therefore, studies of metal concentrations in mangrove areas are relevant and useful for monitoring the health of environment, maintenance of biodiversity, and for assuring the quality of life, mainly for human when consumed.

WE255 Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydrid chinesis)

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Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyldichloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the whelping compounds with in Kow < 8, the values of fish bile and top. Few studies are focus on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydrid chinesis) was ovoviviparous species. Their fertilized eggs develop into new individuals in the maternal body before producing offspring. The source of contaminants in watersnake eggs mainly derived from maternal tissues. In order to fully elucidate the deposition of contaminants in eggs, Firstly, the lipid-normalized concentration ratios of egg to muscle (EMR) were usually used to assess maternal transfer efficiency of contaminants in oviparous organisms. Secondly, due to relatively high lipid and weight of egg in watersnake, the ratios of contaminant burden in egg over the sum in muscle and egg (EMER) was used to evaluate the tissue distribution of contaminants in watersnake eggs. The values of EMR, and EMER were respectively 2.93 and 95% for PCBs and 0.35 and 68% for PBDEs. Meanwhile, DDTs, PCBs, PBE, HBB, PBB 153 and lower-brominated BDE congeners showed the ratios of EMR, and EMER higher than 1 and 88% (the lipid percentage of egg to egg plus muscle), respectively. The results indicated that these chemicals were readily transferred from muscle to egg or preferential accumulation in egg compared with muscle. Other chemicals, such as higher-brominated BDE congeners, DP, PBB209, and DBDE, showed ratios of EMR, and EMER lower than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multi-linear relationship exists between EMER and log Kow of the chemicals for the watersnake. For compounds with high hydrophobicity (log Kow > 8), a negative relationship between EMER and log Kow is observed (p < 0.01). The results showed that the differences in the deposition of contaminants in watersnake eggs are obviously different with other species in previous study, which implied potentially high inter-species differences in the maternal transfer mechanism.

WE256 Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EL-MS

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The ultra-clean analysis of halogenated flame retardants (HFR) leads more and more to the question of analyzing substances of actual or future relevance such as e.g. Dechlorane Plus and other dechloranes or novel brominated flame retardants together with legacy compounds as PBDEs. In order to address this issue, comprehensive analytical methods covering at the same time compound groups of different chemo-physical properties are more and more required, especially for monitoring purposes like analyses within environmental specimen banks. The presented method is validated for a broad range of different environmental matrices (spruce shoots as representatives for plant materials, bream fillet as representative for animal tissue, herring gull eggs as representatives for bird eggs and riverine suspended particulate matter as representatives for organic matter rich in solids) and presently capable of analysing 21 alternative HFRs and 24 PBDEs. The analytes cover different chemical substance groups from Dechloran Plus and other dechloranes to brominated benzenes and alkyl benzenes, ethers and esters (TBA, ATE, BATE, PBT, PBBE, HBBz, DPTE, BEHTBP, EHTeBB, BTBPE, Dec602, Dec603, Dec604, DMPA, Cl110-antiDP, Cl11-antiDP, syn-DP, anti-DP, DBDE). In this way, it gives an analytical basis for further extension towards other compounds. We will show details of different analytical aspects of the method, especially regarding different column chromatographic clean-up steps and use of modern analytical equipment as e.g. a GC-API-MS/MS-system, pointing out possibilities and limitations of such a broad scope of analyses.

Product benefits and positive outcomes: valuation and beyond (P)

WE257 A method to calculate carbon handprint

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Environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. In practice, this means evaluating the used resources and energy and the emissions caused. However, many companies do not cause such direct negative environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pihkola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment (LCA) and many other approaches, and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to determine the baseline. The carbon handprint can be created via more efficient material or energy use, by reducing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the handprint is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor or life cycle stage. The processes are fed into a target actor using the baseline solution, the new solution and the target actor using the new solution.

WE258 Assessing regionalised Life Cycle Assessment (LCA) and economic values of ecosystem goods and services: Impacts of upstream natural land transformations on ecosystem quality

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Setting up operational and spatially-explicit sustainability assessment models with practical levels of data requirement is becoming more essential as the trend of globalising economy is strong 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 usually used as an indicator and the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in the UK. The processes from $2364/year to $1587/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases are in China, where the manufacturing processes take place. The rest of Asia, Australia, Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream processes in comparison to those of the whole life cycle impacts. This implies that despite the apparent advantages of ‘clean’ renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

WE259 Recent advances in natural capital accounting


At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of corporate and institutional interest in understanding and accounting for impacts of natural capital was apparent. The conference highlighted investors and policy makers came together to discuss progress on accounting for Earth’s natural capital - the challenges, the innovations and the actions still needed. This poster will bring some personal reflections of the conference, including key findings from related recent literature, and elaborate on how scientists at SETAC Europe might engage with developments in natural capital learning. Recent publications, such as “Can we stop depleting natural capital?” (Cohen 2017) have highlighted 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 the risk of natural capital degradation for three reasons: (i) natural capital is not being accurately measured or valued in the context of ecological tipping points; (ii) aggregate economic models are ill-equipped for seeing the dependencies between ‘capitals’ as most cost-benefit analyses used in everyday decisions assume that natural capital can be easily substituted by manmade capital, when in fact it cannot; and (iii) we lack appropriate political and economic institutions to manage natural capital effectively. Two opportunities emerge.
including all natural capital could support greater prosperity if it were more appropriately valued and hence more efficiently used. The second is governance frameworks that allow for the internalization of the costs—both environmental and economic—associated with one of its most valuable parts, the HEV motor. For this purpose, a screening Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) study has been carried out on the entire value chain of a dismantled HEV motor. The results of this study are analyzed quantitatively. The aim is to identify bottlenecks for such a quantitative analysis as well as to identify the hotspots from both an environmental and economic point of view. Furthermore, the results will serve as one of the important inputs in laying the foundation for the development of the sustainability of hybrid-electric vehicles (HEVs). The 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: nBAILEY, 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.nBIELLO, D. 2016. Electric Cars Are Not Necessarily Clean. Scientific American. Scientific American, a division of Nature America, Inc.nHICKMAN, L. 2012. Are electric cars bad for the environment? The Guardian. nPUBLISHERS, I. 2008. Electric Hybrid Vehicles Not As Green As They Are Painted. News Content (Online). Inderscience Publishers/nAvailable: www.sciencedaily.com/releases/2008/02/080207094314.htm [Accessed November 27, 2017].

Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars

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The scope of this study is to compare the externalities of electric, gasoline and diesel motorizations of an average passenger car (aW Golf) giving a complementary reading of the results of an LCA. Starting from the results of the NEEDS project, authors present a methodology taking into account: the year of the external costs evaluation for the avoided emission, because the height of the release; the population density of the area where the emission take place; the average level of income of the country in which the emission take place. A complete LCA of an electric, gasoline and petrol VW Golf has been carried out considering city cycle real consumptions from EIA (fueleconomy.gov) and real emissions from national inventories of air emissions. Moreover the authors present a methodology that allows coupling LCC and LCA in practice by following the usefulness of such a combination, then by presenting the software that allows 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). The saying, we are what we eat, is true! Diets are key for human health and more than 10 million deaths/year worldwide are attributable to dietary risk factors. A challenge food Life Cycle Assessment (LCA) faces is that nutrition, a dominant impact pathway for health, is often neglected. At the same time, food LCA

Life Cycle Costing: methodological and description

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The complexity of production processes and products combined with an increased regulatory and environmental requirements 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).
primarily focuses on single ingredient items while a large portion of modern diets is comprised of mixed dishes, a mixture of ingredients, which often remains unexplored. We propose a framework for evaluating mixed dishes in LCA that considers nutritional health impacts and benefits and demonstrate its application on pizza. We develop 14 marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted outcomes specific in incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided μDALY/g. To evaluate the environmental impacts, we deconstruct pizza into “basic ingredients” using the USDA Standard Reference 28 database with a resolution of 3,200 single- and multi-ingredients that we further deconstruct. Ingredients are then linked to life cycle inventory (LCI) datasets from the EcoInvent v3.2, the World Food LCA Database v3.1, and the EU food LCA database. We evaluate impacts using Impact World+ Nutritional CFs for food group and nutrient range between -8 (sodium) and 57 (omega-3 from seafood) avoided μDALY/g. Human health scores for pizzas range from -35 avoided μDALY/serving pizza with extra meat to 2 avoided μDALY/serving pizza with no cheese. For the environmental impact assessment, global warming estimates vary from 0.06 (pizza with no cheese) to 0.20 (pizza with extra meat) kg CO2 eq/serving, corresponding to -0.04 and -0.17 avoided μDALY/serving, respectively. When it comes to pizza, environmental emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common framework: that most precise FU is to remove protein sources based on their content of all food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE265

The impact of supplemented amino acids in animal feed - a new Life Cycle Assessment approach using the Protein Quality Index as functional unit for comparing protein sources

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Proteins, which are made up of amino acids (AA), are essential for human health. Most of AA can be synthesized by the body but 8 of them are called “Essential Amino acids” (EAA) because they cannot be produced by 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 consumed greenhouse gases emissions but also requires large amount of land and water due to the high quantity of crops required for feeding animal. Consequently, comparing protein sources using Life cycle assessment (LCA) is important for decision-making. However, choosing the functional unit (FU) is often a critical issue for food systems. The quantity of food (i.e. 1 kg) is the most used FU currently. Nevertheless, this FU does not represent the function of food that is to provide protein. A more precise FU is to compare protein sources based on their protein content (i.e. 1 kg protein). To have a more holistic approach, nutritional and qualitative aspects should also be included in the FU. Actually, most plant protein sources do not bring all the EAA required. In this study, the Protein Quality Index (PQI) developed by Sonesson (Sonesson et al., 2016) was applied as a FU. It takes into account aspects such as EAA, AA digestibility, AA requirements but also food habits. In our study, four protein sources conducted on several protein sources: conventional (pork, chicken meat, salmon and tofu) and non-conventional sources (insects and algae). The role of the AA supplementation in animal feed was also investigated. On the one side, the analysis has shown that non-conventional protein sources perform better in all environmental categories, independently of the choice of the functional unit. Tofu performs better than animal protein but the difference between animal and vegetable based proteins becomes much lower when a more elaborated FU is used. On the other side, the supplementation in AA allows a reduction of the environmental impact of chicken and pork. Using the PQI as a FU, the impact of chicken and pork with AA supplementation is even lower than the one of tofu in some categories. Using the PQI as a FU is a step toward a more holistic assessment. A next step might be to include other nutrients such as iron and vitamins in the FU.

WE266

The ISO/DIS 14008 standard: Monetary valuation of environmental impacts and related environmental aspects – Principles, requirements and guidelines - an introduction

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Key words: monetary valuation, framework, standard, ISO 14008. The use of monetised environmental impacts and associated substances has substantially increased in the last couple of years. This trend is mirrored since 2016 by efforts at ISO level to develop standards on environmental costs and benefits. This contribution will present the result of the work achieved in ISO/TC 207/SC 1/WG 7, developing ISO 14008 whose current title is “Monetary valuation of environmental impacts and related environmental aspects — Principles, requirements and guidelines”. The work started in February 2016. After five WG meetings, ISO 14008 has reached the Draft International Standard (DIS) stage in fall 2017. The comments and ballot results of this DIS will be discussed during a WG 7 meeting in June 2018. Many organizations have experience in assessing environmental aspects and related environmental impacts resulting from their activities in physical units (e.g. tons of CO2 emitted or numbers of disability adjusted life years, DALYs). To further integrate this information into the decision making process, it is useful to assign the monetary value of environmental impacts and also of related environmental aspects. Monetary valuations enable comparisons and trade-offs between different environmental issues. The aim of this standard is to increase the awareness, understanding, comparability and transparency of monetary valuation of environmental impacts and related environmental aspects. 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 aim at ensuring the absolute safety assessment, a requirement by law, with an assessment of the relative benefit that reuse of material flows have on all aspects of sustainability. However, assessing all aspects of sustainability is not practical for final decision making or feasible, considering the state of development of the tools, methods and data availability. Assessments of current recycling options are mainly focused on safety risks towards the environment and human health. Here we propose a first step in including environmental impacts or benefits related to closing material loops and increasing material value. This step is part of a bottom up approach to a more holistic methodology. It holds a novel framework (Safe and Sustainable Loops, SSL) aimed at assessing the safety as well as the sustainability changes of residual material flows within a clearly defined scope. In the Netherlands specific end of waste criteria can be applied to make the use of residual material flows as a resource possible. The SSL framework is based on a set of themes that are important in the choices regarding derogation of residual material flows for new applications. These themes are the building blocks of the framework, the modules. In theory, the framework itself is the backbone that connects these modules together. The current themes which are developed into modules are: Substances of very high concern (SVHCs), Pharmaceutical residues, Pesticides, Pathogens, Antimicrobial resistance,Circularity and Environmental Sustainability. These were selected for the first iteration of the framework because of their relevance for assessing risks and benefits of residual material flows during the past few years. The aim of this approach is to allow a level playing field using a generic framework with modules based on lessons learned from earlier cases.

WE268

Who is being served? Considering the values stakeholders wish to sustain in decision making

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If we want our science to be part of the environmental decision process, we need to engage with stakeholders of all types about what they value to ensure that the science we generate is relevant to and translated in terms of these values. This requires a consideration of as diverse a range of affected stakeholders as possible. Ungauged subjects, due to a lack of resources, interest, or awareness, may not have their needs and values addressed unless a special effort is made to identify and consider them. One can view the concept of social equity as all-encompassing, under the premise that all impacts (positive and negative) of decisions can be seen as social impacts; and stakeholders must decide what services they envision for their land- and water-scapes - what values they wish to sustain. In selecting indicators to represent stakeholder values, the challenge is to build a conceptual
framework which links measurable metrics of impact to value terms that resonate with the public, and reflect value statements made by the community. When the trade-offs are considered, it is important to consider the needs, demographics and vulnerabilities of a diverse population. Sustainability and ES concepts can and should be support environmental decision making; the application of threshold criteria ensures ‘strong’ sustainability in which environmental considerations are normative, and which requires stakeholders to consider the extent to which they prioritize impacts to all (rather than just a narrow sub-set) of their values provides for a balanced public comment process, less subject to single- or narrow-issue lobbying. Identification of the risks and benefits of most interest to stakeholders also can support negotiation and optimization of alternatives under consideration, support collaborative design of more sustainable options and help inform the design of a long-term monitoring plan that addresses community values. The goal should be to envision a sustainable approach from the beginning of a project with collaborative input from a large group of stakeholders, supporting informed, transparent, and balanced decision making that protects services of importance to the community. Tools and approaches, and the path forward, will be discussed.

Salt of the earth - causes, consequences and management of salinization of surface freshwaters, groundwater and soils (P)

WE269 Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwinia toletana
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Amphibians constitute the class of vertebrates with the highest proportion of endangered species. Chemical contamination being a main factor for their populations and species decline. The skin bacterial community of amphibians may help them to cope with such chemical contamination. If skin bacteria may increase its tolerance to chemicals, then they could be used for bioaugmentation in amphibians to help them cope with contamination. This work aimed at assess if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. Erwinia toletana, isolated from the skin of Pelophylax perezi, was selected as the model species. Clonal populations of this bacterium (5 replicates) were exposed for 46 days to LB medium (Et-LB) or to the effective concentration of NaCl causing 10% of growth inhibition (Et-NaCl; 18 g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period, Et-NaCl was transferred to LB medium and cultured for a period of 16 d (Et-R). The isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20 and 25 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 melt method (BOX-PCR). Results of growth showed that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EtC₅₀ for growth were: 22.5 g/L (8.64-36.4) for Et-LB; 30.3 g/L (23.7-37.4) for Et-NaCl, and 26.1 g/L (19.3-32.9) for Et-R. Though, as confidence limits overlapped, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that E. toletana increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by E. toletana to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian’s skin, aiming the improvement of these organisms tolerance to chemicals.

WE270 Impacts of agriculture brackish effluents in saline ecosystems: when the low salinity cannot be an advantage but an impact
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Salt may be considered one of the most important factors of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and over-fertilization leads the existence of saline effluents that degrade water quality and constrain plant growth and crop production. However, in saline wetlands salinity is not undesirable, but a proxy parameter to maintain the singularity of the ecosystem. In these environments the existence of a diversity of habitats is closely related to gradients of soil salinity and moisture, with extremely saline sites, brackish sites, wetter sites and drier sites. While agricultural saline effluents may salinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This work reports changes in ecosystem structure and diversity in a saline wetland adjacent to the Mar Menor saline lagoon (SE Spain). Species cover, soil salinity, and the groundwater level were monitored in two 2-years periods with a difference of 13 years between them. The results indicated an elevation of the water table throughout the 13-year period, which was attributable to brackish water flow from areas with intensive agriculture. The latter led to an increase of flooding periods, a decrease of soil types in the near marine areas that increased in the least saline ones. Following these changes, damages in protected habitats were observed, due to the proliferation and increase of biomass of several species. Sarcocornia fruticosa, Phragmites australis and Juncus maritimus strongly expanded at the wettest sites, which led to the disappearance of the original zonation pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.

WE271 Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?
B.J. Jefford, J. Reich, J. Bray, University of Canberra / Institute for Applied Ecology

The effect chemicals on populations and communities have long been noted to vary between different studies although the mechanism(s) for this variation is unclear. Research has examined variability associated with chemical and physical environments (e.g. bioavailability, co-occurring contaminants) and ecotoxicological and physiological (e.g. temporal and spatial variability in species' sensitivity). Less consideration has been given to ecological mechanisms including those mediated via indirect effects, such competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using 'sensitive' communities collected from a low salinity site (~80 µS/cm) and 'tolerant' communities (collected from a high salinity site ~1600 µS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 µS/cm) and salinity treatments (500, 1000, 2500 and 5000 µS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbe) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether these biota were co-inhabiting with biota from a high salinity site. Such context dependent toxicity deserves greater consideration in studies of the effects of chemicals on populations and communities.

WE272 Challenges in developing a water quality guideline for water hardness
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Water hardness in receiving waters can be increased to virtually no water quality guidelines (WQG) exist for regulating these individual ions. Water hardness mixtures. We first considered water hardness, 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 was collected and for the inclusion in the WQG, however, current literature offered several challenges and major data gaps that hindered WQG derivation. Moreover, the background variation of water hardness throughout an 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?  
E. Berger, Senckenberg Gesellschaft / Department Quantitative Landscape Ecology; R. Schüfer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg  
The political aim of achieving good ecological quality of all European water bodies requires knowledge on how to prioritize stressors and human pressures for management based on their relative impact. A challenge thereby is the frequent co-occurrence of multiple stressors. We applied eco-epidemiological approaches to large scale monitoring data from Saxony, Germany, to investigate the relative contribution of different water quality and land-use gradients to ecological change. Two approaches were applied: First, water quality gradients (e.g. oxygen, conductivity, phosphorous and micropollutants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchically partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, SPEAR %) as response variables. Secondly, individual taxon responses with respect to different water quality gradients (including also major ions such as potassium, sodium, chloride etc.) were assessed using Threshold Taxa Indicator Analysis (TITAN). The method is based on change point and indicator species analysis and allows the identification of ecological change points that may be used to derive environmental quality criteria. Both regression analysis and TITAN results indicate a high impact of oxygen and salinity, which were associated with both land and urban land cover and industrial land cover. 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 quality value for chloride (200 mg/L) that should not be exceeded to achieve good ecological status according to the water framework directive. Thus, lowering of chloride concentration and associated ions should be considered to protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE274  
Estimating protective potassium concentrations for freshwater mussels, a taxon of global conservation concern  
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Globally, there are about 620 species of freshwater mussels (Family Unionidae), and IUCN lists 28 species as extinct and 106 as endangered or critically endangered. Mussels are among the most sensitive freshwater organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 504 mg/L and proposed for discharge to a stream with endangered mussels necessitated derivation of protective potassium limits (because there are no water quality standards in USA water quality criteria for potassium). From the literature, we compiled potassium 96-h EC50s (with endpoints of lethality or immobilization) for mussels and retained those with > 90% control survival, measured test chemical concentrations, and acceptable test water quality. Five EC50s ranged from 31 to 48 mg/L at a water hardness of 100 mg/L as CaCO3, and we applied the North Carolina guidance of one-third of the lowest EC50 to define an acceptable concentration to avoid acute toxicity. We adjusted the 10 mg/L acute limit to a water hardness of 18 mg/L which is the 95th percentile of the proposed receiving stream (protective most of the time because potassium is less toxic as hardness increases). The hardness-adjusted acute water quality guideline of 7 mg/L potassium was recommended as an instantaneous concentration not to be exceeded. Chronic toxicity data for potassium and mussels were available for two studies from 28 to 300-d. Because mussels can live for decades, we used the 300-d test. The geometric mean of the test NOEC (1 mg/L) and LOEC (7 mg/L) yield a chronic value of 2.6 mg/L potassium which was recommended as a monthly average guideline not to be exceeded more than once every three years. We used 32 years of receiving stream flow data to derive estimates of instantaneous toxicities for their potential toxicity to the environment, particularly in regards to chemical composition and salinity. The purpose of this study was to investigate whether their toxicity is any greater than exposure to solutions of similar salinity. The tolerance of Festuca rubra L. (fescue) and Triplodon pratense L. (clover) were investigated for 5 weeks under hydronic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared serially-diluted effluents and synthetic solutions (e.g., NaCl/CaCl2) of similar salinity. There were different growth responses to the wastewater and salination solutions among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. The restoration of salinity gradients will also contribute to increase biodiversity on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE275  
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the sal gradient increasing fresh water input.  
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In Mediterranean regions, climate changes have enlarged water limitation for agricultural production of the most representative crops grown in the Alqueva irrigation area with a potential impact on the 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-diluted effluents and synthetic solutions (e.g., NaCl/CaCl2) of similar salinities. There were different growth responses to the wastewater and salination solutions among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. The restoration of salinity gradients will also contribute to increase biodiversity on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE277  
Contribution to the salinization risk assessment, under drought conditions, in the Alqueva irrigation area (South Portugal)  
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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 2017-2018 and 2018-2019, drought 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 is focused on the salinity risks for the production of the most representative crops grown in the Alqueva irrigation area. This is a large irrigation scheme with a total area of 120 000 ha centered in the Alqueva reservoir. For the purpose of the study, a chemical assessment of some
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻ and Cl⁻), pH and electric conductivity (ECₕ), was conducted throughout 2017, on water samples collected on four platforms sited in the reservoir. Water quality for irrigation was evaluated considering both the Portuguese regulations and the FAO guidelines. Sodium adsorption ratio (SAR) and soil salinity (ECₑ) were estimated, in order to assess potential sodium-related soil permeability and crusting problems, as well as, potential yield reductions in the most important crops of the Alqueva perimeter. Higher ion concentrations related with water salinity are selected with regard of atmosphere evaporative demand. Sodium hazard assessment showed slight to moderate risk of reduced infiltration rates, a result that should be taken into account when surface or sprinkler irrigation systems are used. Furthermore, relative yield reductions may be mainly found in horticultural crops, classified as moderately sensitive to sensitive in the salt tolerance scale.

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

WE279 Investigating wildlife diets using high-tech DNA sequencing J. Ludwigs, RIFcon GmbH; I. Katzschner, RIFCON GmbH Goldbeckstr Hirschberg Germany; G. Weyman, ADAMA; A. Winkler, J. Kalinowski, Center for Biotechnology (CeBiTec) Universitêt Bielefeld
In wildlife risk assessments according to EFSAs (2009), the ingested diet is one of the core factors to define exposure, using default diet compositions in the first tier risk assessment. The provided PD factor (compositional or portions of diets) is one of the standard refinement parameters which intend to add realism to higher tier risk assessments. Publicly available dietary data are often used to refine PD in wildlife risk assessments; however, such data are often variable and/or not representative for the specific risk assessment scenario. Besides such literature data, specifically registration-relevant PD field studies can be conducted. PD values gathered from such studies are based on: (a) field samples, (b) stomach samples, or (c) microscopical impressions. In these studies samples (or parts thereof), are investigated visually by microscope and food items are identified based on comparison with comprehensive reference data libraries and collections of potential diet items. For plant material, the results are mainly presented on a fairly basic taxonomic level and are often related to wildlife risk assessment defined diet fractions which have different default residue levels for different dietary plants or monogastric mammals only. However, this is rather time-consuming and imprecise. Recently, DNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful on identification of relative abundances of plant species from faecal samples. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

WE280 Design of a Real-Time PCR array to analyze the gene expression in Physella acuta (Gastropoda) in chemical stress and starvation M. Novo, J. Martinez-Guitarte, UNED / Fisica Matematica y de Fluidos Molecular endpoints are nowadays under study for their inclusion in 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 pathways related to the effects selected. 42 of these genes were selected as reference to design an array for Real-Time PCR analysis. Stress response, detoxification mechanisms, endocrine system, or epigenetics were some of the pathways analyzed in the array. In order to validate the toxicological and ecological interest of this approach, individuals were treated with an antibiotic, tetracycline, for seven days or were left starving for 7 and 10 days. The results obtained for these experiments are presented, showing the interest of designing specific arrays to perform more detailed analysis of molecular endpoints that can be related with toxicant mode of action and stress situation. We hope that the methodology presented here can serve as an example for the study of other species in order to improve our knowledge of their biology. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CTM2015-64915-R.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis J. Semmoum, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecol; B. Gheenen, GentUniversity / Applied Ecology and Environmental Biology; K. De Schampaert, Ghent University (UGent) / Applied Ecology and Environmental Biology Over the past decades, the world’s oceans and seas have been influenced by several human induced impacts, including climate change. In the North Sea region, the average sea surface temperature of the water has already risen with 1-2 °C over a time span of twenty-five years and is likely to continue to increase. 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 information on the effects of increased sea water temperatures may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea.

WE282 A conditional approach to modern endpoints - quantitative assessment of stress gene expression response to a range of copper concentrations in the freshwater mussel Anodonta anatina G.M. Ekelund Uge, Lund University / Biology; A. Jonsson, University of Skövde / Department of Bioscience; O. Berglund, Lund University / Dept of Biology In the field of ecotoxicology, modern transcriptomics technologies have the potential to improve and complement current toxicity assessment methods and biomonitoring protocols. Early warnings of general stress and specific toxic modes of action could in theory be used as biomarkers of pollutant exposure or adverse effects. However, necessary base level understanding is currently lacking considering how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more descriptive methods. We chose the freshwater mussel Anodonta anatina as our model organism. Being a stationary filter feeder, it shows promise for use in exposure studies under both laboratory and field conditions. Furthermore, it is the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vänne (a 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⁺² per l), or a control treatment (n = 5 per treatment). Using RT-qPCR, relative expression of a selection of general stress genes will be quantified in extracted digestive gland and gill tissue. Preliminary data will be presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between the two general stress genes, and (ii) between the two genes in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation T.F. Simoes, S.C. Novas, Polytechnic Institute of Leiria / MARE IPlLeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Renadand, CENIMAR / Department of Functional Ecology; J. Römbke, CFE da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Renaud, CFE / Department of Life Sciences; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria; I. Katzschner, RIFCON GmbH Goldbeckstr, Germany; M. 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 toxicology 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 more realistic field exposure scenario, by targeting specific molecular biomarkers retrieved from a previous laboratory study. Experimental 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 laboratory conditions, organisms were now exposed under field conditions for 4 days to the same concentration as for laboratory exposure (concentration a 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. RNA 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, spinozad 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 control (n=4) animals. The pesticides exposure triggered different responses at the proteome level. Changes caused by spinozad were more noticeable than for indoxacarb exposure. Our results revealed a general decrease in the expression of globin proteins with the increase of spinozad concentration. Additionally, for spinozad, a significant decrease in the expression of an actin and a cuticle protein were also observed. Moreover, correlations between proteomics data and the respective concentration of chemical bioactive substance was found in both 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. 

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WE286
Assessing Cu impacts on freshwater diatoms: biochemical and metabolomic responses of *Tabellaria flocculosa* (Roth) Kützing
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Metals are a recognised threat to aquatic organisms but the impact of metals such as copper (Cu) on benthic freshwater diatoms is poorly understood, even if diatoms are commonly used as water quality indicators. Our study aimed to elucidate the cellular responses of diatoms to Cu toxicity. The freshwater diatom *Tabellaria flocculosa* (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 metabolomic approaches. Cu was already toxic to *T. flocculosa* at concentrations common in environments which are usually not considered to be contaminated (0.3 µg Cu/L), and toxicity increased with Cu concentration. Strategies to cope with Cu varied with the level of Cu stress. Under Cu impact, the metabolome of *T. flocculosa* changed significantly, especially at high concentrations (6 and 10 µg Cu/L). Cu toxicity was counteracted by increasing extracellular immobilization (EPS, frustulin), antioxidant (SOD, CAT) and detoxifying (GSTs) enzymes activity and low molecular weight antioxidants (GSH). These mechanisms were enhanced by a higher production (ETS activity, use of sugars and lipids). At the highest Cu concentration (10 µg/L), detoxification metabolic processes were specially enhanced in an attempt to restrain the oxidative stress generated by high intracellular Cu concentrations. However, these mechanisms were not able to fully protect cells, and damage in membranes and proteins occurred. Moreover, the decrease of hydroxylamine and unsaturated FA and the increase of saturated FA, 2-palmitoylglycerol, glycerol and dimethylxantheopropionate compounds should be tested as new specific markers of Cu toxicity in future studies. This information can support the prediction of diatom behaviour in different Cu contamination levels, including highly impacted environments, such as mining scenarios, and may assist in environmental risk assessment policies.

WE287
Non-targeted approach to identify metabolic perturbations in gill-head bream liver and brain exposed to benzenophene-3
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Benzenophene-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 the organisms. Although some studies reported altered biochemical biomarkers in both exposed and control (n=10) animals. Samples were flash frozen and then stored at -80°C until analysis. Methanol:chloriform (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 affected, a non-targeted approach was further investigated using the Kyoto Encyclopedia for Genes and Genomes (KEGG) in order to determine affected pathways. Overall, these data demonstrate the potential of metabolomics as a rapid and sensitive tool for the assessment of the metabolome of fish exposed to specific contaminants. **Keywords:** Benzenophene-3, gill-head bream, non-target metabolomics **Acknowledgements** - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56268-C3-1-R. H. Ziarrusta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

WE288
EFFLUENTS FROM PULP AND PAPER MILLS PROMOTE METABOLIC ALTERATIONS IN LIVER AND GONADS OF FISH
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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 paper industry. Samples were exposed to effluents from the paper industry containing embryos of 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. The eggs were collected and placed on plates containing the test agent, kept protected from light. The fish were sacrificed for liver and gonads removal, from which a homogenate was prepared. Then, extraction was performed with chloroform/ methanol/water (3: 2: 1). The extract
obtained was prepared for gas chromatography. For the exposed fish, there was a significant reduction in egg production, 65%. A high percentage of the eggs presented dark staining, which are not viable. Chromatography analysis revealed significant changes in the amino acid, sterol and fatty acid profile in both tissues, liver and gonads. The results showed a strong impact on the metabolism, egg production and embryo development for the studied fish, which point to the alteration of their reproductive capacity.

**WE289**

**Developing biomarkers of sewage effluent exposure in the freshwater 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 markers will be carried, for a better understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

**WE290**

**Optimising the algal toxicity test towards generation of multi-omics data and adverse outcome pathway discovery**

S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; J. Zhou, S. He, University of Birmingham / School of Biosciences; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences

The adverse outcome pathway (AOP) concept represents a framework to 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* in response to toxic stress, applying a multi-omics approach. The approach towards achieving this end was a suite of targeted (direct-injection mass-spec, DIMS; RNA sequencing) and targeted (LC-MS/MS, -UV, -qRT-PCR) metabolomics, lipidomics and transcriptomics technologies. The 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) toxics. To enable this work, a rigorously controlled algal culturing and testing system was optimised regarding growth rate, final cell density, pH stability, cell cycle synchronisation, reproducible exposure to volatile chemicals, and rapid quenching and harvesting of biomass for omics data collection. Furthermore, a unique multi-phase experimental design was developed for rapid identification (untargeted), characterisation and verification (targeted) of putative KEs over a time-course design. Multi-omics data from toxicant-exposed *C. reinhardtii* were collected and initial progress made towards computational analysis, putative KE designation, and targeted verification of identified biomarkers. With this study, a powerful experimental approach for hypothesis-free KE discovery and AOP hypothesis is being developed, employing omics-driven algal phenotyping to advance the integration of omics data into AOP development and ultimately, to provide mechanism-based support for regulatory decision-making in environmental risk assessment.

**WE291**

**Elucidating interactive toxic effects of copper and lead on marine mussels: molecular to physiological consequences**

C. Crowther, V. Sharma, Plymouth University; A. Turner, Plymouth University / Food Safety; A.N. Jha, Plymouth University / Biological Sciences

It is increasingly recognised that anthropogenic contaminants are not isolated in their threats to the aquatic environment. Recently there has been a shift towards measuring the effects of exposure to low-concentrations chemical mixtures under chronic conditions to predict outcomes on the ecosystem. Adopting an integrated approach the aim of this study was to assess the interactive effects of copper (Cu) and lead (Pb) either alone or as a mixture at various levels of biological organisation, ranging from molecular to individual levels. The combination of proteomics, molecular and physiological measures with bioinformatics adopted in this study will allow a model of mixture exposures to be created which can be translated to early warning indicators within the marine environment. *Mytilus galloprovincialis* were exposed to a range of concentrations of Cu (5, 32 μg/L) and Pb (5, 25 μg/L) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included: expression of ‘clearance rate’, 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 of 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 complex relationship between treatments and the highest binary treatment (32, 25 μg/L Cu and Pb, respectively). Mussels exposed to 25 μg/L of lead 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 pathway (AOP) development for pollutant chemicals relies on a diverse range of methodologies, including *in silico* and *in vitro* approaches, for use in regulatory decision making. The aim of this work was to develop and test a more comprehensive experimental design, for the targeted characterisation of key events in the toxicological response of *Chlamydomonas reinhardtii* upon herbicide exposure, thereby contributing to the development of a quantitative AOP. Here we present how an initial hypothesis for an AOP was created from available literature evidence, with focus on ‘omics and multiple-endpoint assay data, for the selected herbicide, norflurazon. This hypothesised AOP allowed development of targeted assays for investigation of predicted key events in a time- and concentration-response methodology. LC-UV was used to monitor suspected toxicological markers of the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thiredoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoene accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later time points. A concentration of 10 μM of norflurazon was identified within an hour of exposure, whilst lipid peroxidation occurred between 4 and 24 hours post-exposure. Significant (p < 0.01) effects on cell number, an adverse outcome, were observed at 2000μg/L after 24 hours. This study highlighted the necessity for use of synchronous algal cultures for accurately understanding mechanism, as this would enable more accurate determination of time- and concentration- responses due to diurnal algal life cycles. Ultimately, this work has shown proof-of-concept and laid the foundation for development of a quantitative AOP for phytoene desaturase inhibition leading to growth inhibition and population decline.

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SETAC Europe 28th Annual Meeting Abstract Book
WE293 Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)
M.T. Schmida, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Harrison, CWI; V. Diamanti-Konska, Toxicology Centre; A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; D. Green, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bluhm, University of Saskatchewan / School of Environment and Sustainability; T. Lane, University of Saskatchewan; N. Baldwin, J. Taghavimehr, A. Masse, University of Saskatchewan / Toxicology Centre; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences; H. Hollert, RWTH Aachen University / Institute for Environmental Research; N. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Bioresources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre Polycyclic 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 interventional 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 aequous 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
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Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (P)

WE296 Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications
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Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analyses is enabled by the genome of the closely related D. pulex. Epigenetic mechanisms allow gene regulation in a developmentally and environmentally responsive manner. 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 20,000 overlapping RNA-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 for choice for analyzing the genomic localization of histone modifications. Exposure to the well-known epigenetic modulator, the DNA methylation inhibiting agent 5-Aza-2′-deoxycytidine, resulted in a global reduction of DNA methylation in Daphnia magna and one gene, while H3K4me3 and H3K27me3 remains unchanged on the investigated loci. The unchanged response in ChIP was contradictive to significant gene expression responses and to what was expected of this epigenetic modulator. The present study therefore demonstrates differentiated response of LC-MS/MS, ChIP-PCR and gene expression to 5-Aza-2′-deoxycytidine 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 mRNAs are predicted to be the subject of miRNA-mediated control. One miRNA may regulate hundreds of target mRNAs, and one mRNA may contain multiple binding sites for multiple miRNAs, thus resulting in a complex regulatory network. Although miRNAs are involved in regulation of almost all cellular processes, such as development, growth, apoptosis, immunity and maintenance of tissue-specific function, mechanistic aspects of this regulation are not fully understood. In Human, the aberrant expression of miRNAs has been linked to various diseases and toxic environmental factors such as water pollution. The first aim of the present study was to identify miRNAs in the European eel Anguilla anguilla by using next generation sequencing. We identified 210 evolutionary conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla’s transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may provide early indicative molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicity mechanisms involved between environmental factors and diseases aetiology.

WE298 Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)
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The sustainability of fish populations in our increasingly polluted environment is critically dependent on their ability to adapt via (epi)genetic mechanisms. Copper is an essential element but when present at high concentrations in the water it can become toxic to aquatic organisms. Recent studies in the UK suggest that copper is the most significant metal pollutant threatening fish in UK freshwaters. We conducted a series of copper exposures in stickleback to investigate whether prior exposure can result in altered susceptibility in subsequent generations. Stickleback embryos were exposed to 0.015mg/L copper during early life (0-9dpf), causing ~1.2% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos tolerating copper during early life had different phenotype, but not the F2 generation. To bridge this knowledge gap, we repeated the copper exposure experiment on F3 and 22 were down-regulated depending on the pollution profile. This approach may provide early indicative molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicity mechanisms involved between environmental factors and diseases aetiology.

Emergence and multidimensional interactions of engineered nanoparticles in toxicity (P)

WE299 Do global warming increase bioaccumulation of copper nanoparticle in...
tilapia? J. Kuo, Kaohsiung Medical University, L. Li, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung

Abstract

Nanomaterial technology was well developed in recent years, and it lead to the nanomaterials accumulation in the aquatic organism. Otherwise, increased atmospheric carbon dioxide causing the phenomenon of global warming. However, little is known about the effects of warming whether increased the bioaccumulation of copper nanoparticles in freshwater fish. This paper used this study to show whether warming synergistically increase the bioaccumulation of copper nanoparticles in tilapia (Oreochromis niloticus). Tilapia were randomly exposure to 25 nm of copper nanoparticle (0.3 mg/L) under different temperature (26, 28 and 30°C for periods of 7 days for uptake and 7 days for depuration, to analyze the acute and chronic effects of warming on copper accumulation in muscle of tilapia. Results showed that the copper accumulation of muscle in the high temperature group was higher than that of control group on day 7 of uptake phase, but there were not significant difference. For one day of depuration phase, the copper accumulation of the 30°C group was significantly higher than of 26 and 28°C groups (p<0.01). However, they are similar accumulation concentration in the end of depuration period. This study concluded that global warming could increase bioaccumulation of copper nanoparticle in tilapia.

WE300

Environmental mixtures of nanomaterials and chemicals: proposal for a consistent nomenclature of mixture effects in environmental organisms

D. Kühnel, University of Aveiro / Dep. Biology & CESAM - The goal of this study was to provide an in-depth analysis of mixture datasets to underline the depth analysis of mixture datasets underline the different mechanisms and processes, hence we developed a proposal for 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-MNNs) are promising materials in nanotechnology. Although both fullerenes and carbon nanotubes have been detected in aquatic organisms, there is a lack of data on their bioaccumulation, potential toxicity or impact on the food web and their trophic transfer. 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 benthic macroinvertebrates. 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 uncontrolled contaminations, 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 group of interest was ostracods (Crustacea: Branchiopoda) and zooplankton (e.g. Daphnia species), and macroinvertebrate species (e.g. chironomids, mayflies, oligochaetes, leeches). Different sampling techniques were used in order to include macroinvertebrates living on and within the sediment as well as hatching insects. In this presentation the results of the mesocosm study will be presented. This work has been supported by the German Federal Ministry of Education and Research (BMBF) as part of the NANO-transfer project.

WE302

Nano silver based products and environmental challenges: toxicity and accumulation in a marine sentinel species

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Silver nanoparticles (AgNP) used in cosmetics are constantly increasing worldwide and their release into the environment is thus expected, especially in aquatic ecosystems, which are considered the ultimate sink. The use of nano silver (AgNP) based products as antimicrobial agents is undergoing a rapid increase in terms of production due to its biocidal properties. Here we studied the impact of AgNP-based commercial products named NanArgen (Nanotek S.A.) on a common marine bivalve sentinel species as the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were in 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. Chemical analysis confirm Ag exposure and showed a dose-dependent increase of Ag in exposed mussels. In conclusion we can state that this nano silver-based commercial product can induce toxicity even at low concentrations and in short-term exposure scenarios. The observed toxicity of NanArgen underlines the need to further test commercial formulations of nanotechnology-based consumer products instead of bare nanoparticles in order to properly address any risk associated to their use and release into aquatic environment and in non-target aquatic species.

WE303

Effect of gold nanoparticles on feeding, growth and enzymes activity of amphipods

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The gold nanoparticles are widely used in medical therapy and cosmetics. The aim of this study was to present the results of an experiment that evaluated the relative abundance of papers focusing on engineered nanoparticles, including both freshwater and saltwater species. The knowledge about the potential ecotoxicity of these nanoparticles is essential before their use by society at a large scale, since they will ultimately be released in to the environment. Thus, the aim of this study was to determine the effect of gold nanorods (Au-NR, 45nm) in the feeding rate, growth and enzymatic activity of Ceriodaphnia dubia. A significant decrease in feeding rate and snout to vent length (SVL) of tadpoles was observed at concentration equal or higher than 0.004 μg/mL. For biomass a significant effect was observed at concentration 0.007 μg/mL or higher, though, a decrease in weight gain rate was observed at a lower concentration (0.004 μg/mL). At the biochemical level, the activity of enzyme lactate dehydrogenase (LDH) increased at 0.002 μg/mL of Au-NR, that of catalase (CAT) was significantly reduced at 0.005 μg/mL or higher, and glutathione S-transferase (GST) and acetylcholinesterase activity (AChE) was significantly higher, relatively to the control, in the two highest tested concentrations 0.007 and 0.01 μg/mL. The
observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NR, are important effects that may compromise the fitness of the organisms, since they may cause a delay in the metamorphosis, leading to a longer exposure period of tadpoles to the chemical and to an increase in the time to reach adult and reproductive stage. The higher activity of LDH, at 0.002 μg/mL, may suggest that tadpoles activate first (at low concentrations of Au-NR) a detoxification pathway involving LDH. Furthermore, an increased reactive oxygen species (ROS) may have led to the inactivation of catalase and the induction of other scavengers related with the mechanisms of cell apoptosis. Though, the induction of GST at the two highest Au-NP concentrations, suggest that the cells are inactivating the Au-NP by its conjugation with reduced glutathione. The results obtained in the present work indicates that Au-NP may induce several sublethal effects in tadpoles of X. laevis and compromise their fitness. Furthermore, since these effects occur at very low concentrations (as low as 0.002μg/mL) it should be classified as “extremely toxic” (EC20 < 0.1 μg/mL; CEC, 1996), suggesting a high environmental risk.

**WE304** Interaction of the 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) has raised environmental concerns as these nanomaterials can be released to aquatic ecosystems in the form of MWCNT aggregates. However, the chronic effects of such aggregates in freshwater algae need to be investigated, especially in respect to long term incubation times and low wMWCNT amounts.

In this study, we 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), in Chlamydomonas reinhardtii (C. reinhardtii). The interactions of B(a)P with C. reinhardtii and 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 due to interaction of B(a)P with CNMs, a set of biomarkers of genotoxicity and oxidative stress was applied. Proteomics analysis allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. Overall results showed that the different physico-chemical properties of the two CNMs influenced their interactions with B(a)P and generated distinct toxic effects. Indeed the adsorption on CNPW modified the accumulation of B(a)P, which followed the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B(a)P. Instead, C60 doped with B(a)P is more prone to sedimentation and less bioavailable for the embryos compared to C60 alone. The integrated results from biomarkers and proteomics showed that different stress responses were observed: in low concentrations of ZnO NPs alone and in their 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, 25, and 50 μg/mL), and 0.002 TCC/L. Regarding to mixture effects, ZnO NPs and MWCNT were selected for the study, since these stressors can also potentially increase the toxicity of either NPs or the metals, for example through competition of adsorption sites on the cells.

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 O<sub>2</sub> -, 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 ZnCl<sub>2</sub>, 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 novel 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:

**WE308** Zinc toxicity to A549 cells and Daphnia magna changes with iron oxide nanoparticles

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The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is based on their ability to adsorb and immobilize metals and decrease their bioavailability. However, the adsorption of metal contaminants by nanoparticles can also potentially increase the toxicity of either NPs or the metals, for example due to the Trojan horse effect. In this study, we evaluated the acute effect of zinc (Zn) as zinc sulfate heptahydrate (ZnSO<sub>4</sub>·7H<sub>2</sub>O) 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 AS49 and the Daphnia magna experiments, respectively. In AS49 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 24h in terms of IC_{50} (0.006 g/L vs. 0.010 g/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC_{50} for Zn was 0.070 g/L without ha-IONPs vs. 0.104 g/L with ha-IONPs, respectively). This indicates a potential protective effect of IONPs at high metal concentrations and a synergistic effect at low metal concentrations. These experiments were also conducted in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect of co-incubation with ha-IONPs was observed. Optical microscope images showed that ha-IONPs aggregates were uptaken by the cells during the experiments. Therefore, even if adsorbed on ha-IONPs, NMs could reach intracellular compartments. Differences in the relative uptake of free vs. ha-IONP adsorbed zinc as well as intracellular bioavailability of Zn in these two forms would be explaining the changes in the dose-response curve that were observed. Acute studies (up to 48-hours) with Daphnia magna showed a protective effect of the ha-IONPs on the toxicity of Zn. The EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.1 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their 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. Their extraordinary physicochemical properties have attracted great interest in most areas of science and industry. Nevertheless, the incorporation of these NMs into products inevitably leads to their release into the aquatic environments. In a previous study we assessed the cytotoxicity of tubular-shaped carbon nanofibers (CNFs) and graphene oxide (GO) on fish hepatocytes (derived from topminnow (Gonocephalus tibiacaudatus)) in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect under SSR. 2) The mode of action of nTiO2-Cd-agglomerates is still not identified. They could interact if Cd is bound to nTiO2, or if Cd and nTiO2 are in close proximity. The impact of nTiO2-Cd-agglomerates will be examined using calcium as a potential competitive ligand. 3) The photocatalytic activity of nTiO2 could damage cell membranes under SSR and Cd could enter the cell. Measurements of membrane integrity with propidium iodide 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
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ZnO nanoparticles (ZnOs) are the major components in the 7th most prevalent nanomaterials (NMs) in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-care products, from which ZnO-NP can be easily leached. Annually, around 250 tonnes of ZnO-NP were estimated to be released from sunscreens alone into the marine environment. However, there are no comprehensive regulations of NMs, including ZnO-NP, in any countries due to the diverse physicochemical properties of NMs and their complicated interactions with the environment. In the marine environment, ZnO-NPs are exposed to various environmental factors, such as temperature and salinity, but influences of these factors on the physicochemical properties and toxicity of ZnO-NP are often tested individually. As both factors co-exist in the environment and may influence one another, it is vital to study their effects concurrently to tease out any potential interactions. This study, therefore, investigates the interacting effects of temperature and salinity on ZnO-NP to a common marine copepod (Tigriopus japonicus) along the Western Pacific coast. Physicochemical properties (aggregate size & ion dissolution) of three zinc-associate 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 and ZnO-Bulk may be the major contributors of this toxic effect, ZnO-NP at the least toxic at 22 PSU, where the dissolution rate of ZnSO4 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 we may 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 (AuNPs) ranging from 8 to 90 nm, for 72h. At the end of the assays, growth rate was computed for all generations of each alga. The following physico-chemical parameters of Au-NR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent

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cetyltrimethylammonium bromide (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of Au-NP: 90 µg/L for C. vulgaris corresponding to 0.257 mM of CTAB. Chlorella vulgaris exhibited a higher tolerance to Au-NP than C. subcapitata: EC50/72h for F0 was 79 µg/L and 39 µg/L, respectively. For C. vulgaris, a gradual increase of its tolerance to Au-NP was observed over generations; after being exposed for four generations to this chemical, significant effects on growth rate were observed among all concentrations and the control. A different pattern of response was observed for R. subcapitata. This speciessignificantly increased its sensitivity to Au-NP from F0 to F2 generation, but recovered a similar sensitivity to that quantified for F0 from F2 to F4. CTAB significantly reduced the growth of microalgae by 42%. Over generations, the sensitivity of the two algae species to CTAB was not changed. The results obtained in the present work reveal that traditional standard assays with short-term exposure may over- or underestimate the real risk posed by Au-NP to freshwater microalgae. Therefore, it is suggested that long-term exposures should be included in the ecological risk assessment.

WE313 Effects of climate change combined with copper nanoparticle on early development of Japanese medaka (Oryzias latipes) I. Meng Jian, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung Nowadays, global warming and aquatic acidification were occurred by rising carbon dioxide (CO2). The factory have been continuously emit copper nanoparticle into ocean and river. They probably induced harmful biological effect on organisms.

However, the combined effects of three environmental stressors on aquatic species have not been well studied. The purpose of this study is to assay the effects of aquatic acidification and warming combined with copper nanoparticle on survival and hatchability of early development of Japanese medaka (Oryzias latipes). For this, the embryos were exposed to 25°C/6.5 with copper nanoparticle (30 µg/L) and without copper nanoparticle under nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5) for 14 days to observe hatchability and mortality. Then, the newly hatched fry were exposed to same condition for 14 days to observe the survival. Results showed that the mortality of embryos had a upward trend, and the hatching rate had a downward trend in exposure group of pH 5.5 compared with that of others pH groups. However, only 28°C/5.5 combined with copper nanoparticle group was significantly increased mortality and inhibited hatchability than that of 28°C/6.5 combined with copper nanoparticle group. While the survival rate of larvae had a significantly downward trend in exposure groups of lowest pH level and highest temperature on days 10. In conclusions, medaka larvae have more sensitive than embryos by survival ability. Moreover, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

WE314 The use of the marine mussels Mytilus hemocyes as a model for studying the impact of NPs on innate immunity M. Auguste, University of Genova / DISTAV; T. Balbi, L. Canesi, University of Genoa / DISTAV Nanoparticles (NPs) are widespread used in consumer products and industry; they are increasingly being introduced with the aim of maximizing their potential impact on environmental species. Recent studies have demonstrated that NPs could affect a number of marine species, and interact with their immune system. Within the PANDORA project (Probing safety of nanomaterials and massively used for multiple purposes to improve human life). Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalgae R.B. Ogunjumilusi, M. Yallop, G. Barker, University of Bristol Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in nanotechnology in the last decade have increased the production engineered nanomaterials (ENMs) used widely in fields such as medicine, energy, agriculture and consumer goods production. As a result, there are increasing concerns about the release of engineered nanomaterials such as metal oxide nanoparticles into the environment. While the effect of metals and ENMs as single contaminants have been extensively studied, much research is needed to account for potential metal-NPs interactions due to heavy metal-ENMs interactions.

Studies suggests that the toxicity of ENMs such as metal-oxide nanoparticles is mainly due to the release of dissolved metal ions. However, majority of these studies have mainly focused on impact of ENMs in freshwater environment and results are extrapolated for other types of environmental systems (marine, soil, sediment). Evidence is accumulating that the dissolution of ENMs is dependent on environmental conditions (ionic strength, pH, etc.), and ENMs can have a significant impact on aquatic organisms. The medaka embryo was followed four consecutive days at nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5). Results showed that the temperature and pH did not affect the accumulation of CuNPs, respectively. When combined with temperature and acidification factors, Cu accumulation of group 30°C/6.5 was increased significantly than that of groups of 26°C/6.5, 26°C/5.5, and 30°C/5.5. However, it revealed that there was no significant evidence of warming and acidification on increased Cu accumulation of medaka embryo. Therefore, we concluded that there was no influence of Cu accumulation in medaka embryo when warming and acidification occurs in the future.

WE316 Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalgae - Cylindrotheca closterium - R. B. Ogunjumilusi, M. Yallop, G. Barker, University of Bristol Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in nanotechnology in the last decade have increased the production engineered nanomaterials (ENMs) used widely in fields such as medicine, energy, agriculture and consumer goods production. As a result, there are increasing concerns about the release of engineered nanomaterials such as metal oxide nanoparticles into the environment. While the effect of metals and ENMs as single contaminants have been extensively studied, much research is needed to account for potential metal-NPs interactions due to heavy metal-ENMs interactions.

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hypertrophy of gill nucus. We have assumed that ion disassociation 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 disassociation 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 disassociated ions should be toxic essential of nanomaterials, and not always nano-sized material will be toxicant in aquatic environment.

WE318 Genotoxicity assessment of aluminium oxide nanoparticles in relation to Escherichia coli and Aeromonas hydrophila

n. doskocz, M. Zalażska-Radziwill, A. Affek, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology

Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique physical and chemical properties lead to unlimited distribution in environmental compartments. Migration ability of nanoparticles can have very dangerous consequences, as they can be transferred to potable water. Genotoxicity biomarkers are regarded as useful tools for the assessment of chemical hazards in aquatic ecosystems, because chemicals which damage DNA can significantly alter the functioning of ecosystems. Recent advances in molecular biology have led to the development of several in vivo techniques, which can be used for DNA analysis in the field of genetic ecotoxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of single short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The SOS-Chromtest 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-Chromtest assay were performed for aluminium oxide nanoparticles (nano-Al$_2$O$_3$). L. Manusadzianas, L. Li, G.P. Cobb, B. Gylyte, S. JURKONIENE, R. Vitkus

WE319 Effects of Copper Oxide Nanoparticles and Arsenic on the Whole-Life Cycle of Rice (Oryza sativa japonica) I. G. Padilla, G. C. Simms, P. G. Cobb, Baylor University / Department of Environmental Science

Copper oxide nanoparticles (nCuO) and arsenic (As) phytoxicity 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 period. 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 combination with As on the whole life cycle growth of rice plants. No significant effect was observed on the seed germination, but both nCuO and As had a significant main effects on the fresh weight (FW) of rice straw and the number of rice panicles (NRP). The interaction of the two toxicants was also significant on both FW and NRP. A decrease in the FW was observed for rice exposed to As, only. The midlevel concentrations (1.0 and 10 mg/L) of nCuO decreased the FW with no As addition, while higher concentrations (50 and 100 mg/L) significantly increased the NRP. Low and high nCuO concentrations (0.1, 5.0, and 100 mg/L) decreased the FW with the As addition, and NRP decreased in treatments receiving As along with either lower or higher nCuO concentrations. More data from this greenhouse study are currently being compiled and analyzed to determine the effect of As and nCuO on grain yield as well as Cu and As uptake, distribution, and speciation in rice plants and the grain.

WE320 Behavior of cerium oxide nanoparticles in presence of pharmaceuticals compounds on aquatic specimens

G. AMARIEI, Universidad de Alcala; K. Boltes, University of Alcala / Chemical Engineering: P. Letón, University of Alcala

Aquatic Ecotoxicology; B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany

Nanoparticles of TiO$_2$ (nTiO$_2$) are extensively used in many commercial products. Maybe for this reason, this nanoparticle is amongst the most studied in ecotoxicology. This study intended to determine the toxicity caused by n TiO$_2$ to the daphnid species Daphnia longispina, either through waterborne or dietary exposure routes. For this, neonates of D. longispina were exposed to a control and to two different concentrations of nTiO$_2$ for 7 days. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jamting AK, O'Malley E, Herrmann J, Escher BJ. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. Environmental Science: Nano 2:86-93.
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuolar (99.5%) and cytoplasm (86.7%) fractions of the cells of *Nitzschia 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 ρ-CuS 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 hemmocyces in vitro?

G. Nicolussi, University of the Basque Country / CBET Research Group; D. Zarkovic, Animal and Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU); Basque Country; Spain; A. Katsumi, M.P. Cajaraville, University of the Basque Country / CBET Research Group; Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE

In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are 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 possible "Trojan horse" effect of graphene nanoplatelets by assessing if graphene nanoplatelets can adsorb organic compounds. We prepared GO, GO-PVP with and without adsorbed oil compounds, and 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 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 petroleum compounds.

**WE324**
Multigenierational 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 / GESS; 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 sorption processes. Here, we investigated key biological endpoints, such as survival, growth, reproduction, and production of the pathogen-derived stressor (AgNP) in response to exposure to silver (AgNPs) and titanium dioxide (TiO₂) nanoparticle (NPs). Particles were either pristine or aged, uncoated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular defects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in the presence of some compounds such as natural organic matter changes the pathways and/or severity of changes observed; (3) if the ageing of particles make them more or less toxic; (4) if long-term low dose exposure (25 days, EC20 concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F₀ generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F₁-F₃ generations. We also observed differences in gene expression compared the concentration of PAHs in the northern Gulf of Mexico

L.M. Basters, 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 if the concentration of environmental parameters 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 six 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. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physicochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. This current research suggests that sediment organic matter and salinity and the measurement at each sampling location should be incorporated into monitoring study design in order to more completely interpret the sediment burden of organic pollutants in aquatic sediments.

**WE326**
Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events.

F. Romero, S. Sabater, ICRA Catalan Institute for Water Research; O. Pereda, University of the Basque Country; I. sabater, CSIC-IDAEA / Department of Environmental Chemistry; C. Font, V. Acuña, ICRA Catalan Institute for Water Research

Freshwater ecosystems are subjected to different anthropogenic pressures. Among them, wastewater treatment plant (WWTP) effluents can represent a significant proportion of total discharge, mostly in regions suffering from water scarcity. WWTP effluents contain a mixture of assimilable and toxic compounds, which concentration ultimately determines the effect of the mixture on freshwater biota. Moreover, overexploitation of water resources together with climate change-derived pressures is causing drought events leading to desiccation to increase in number and intensity. To date, little is known about how desiccation events shape the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regresional design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biofilm) exposed to a dilution of a WWTP effluent. We found that a short exposure and wastewater effluent significantly affected bacterial community and key biofilm processes such as photosynthesis, denitrification and methanogenesis. After the desiccation event, the biofilm associated to coarse sediment showed a stimulatory effect even at low dilution factors, which was not observed under control (i.e. no desiccation) conditions. Our results seem to indicate a simplification of the biofilm community after the desiccation event and a subsequent co-tolerance phenomenon. We argue that the acute desiccation event...
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stresses such as desiccation and chemical pollution.

WE327 Synergy effects of fluoxetine and variability in temperature lead to proportionally greater fitness costs: A multigenerational test
M. Oliveira, University of Aveiro; N. Inocentes, Department of Biology CESAM University of Aveiro / Bicho; 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 flight performance is a trait often used to measure the impact of temperature, its response to temperature is not only affected by the temperature, when both stressors acted together the costs were disproportionally 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 systems are of the most imperiled ecosystems, often exposed to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time, than when each stress acts on alone. We study the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE328 Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination
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Several studies already described the impacts caused by metals in estuarine species, including mussels, but very scarce information is available regarding their effects in a global warming context. In addition, climatic extremes 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 in the absence of Hg (O2 (21 °C) 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)
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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 polybrominated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.9 ± 2 g total body), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faeces, 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 (50.0-67.8%), including even under the synergistic effect of warming and BDE-209 exposure. On the other hand, energy loss via faeces was significantly higher under control temperature and BDE-209 exposure (16.0%). In all treatments, the energy channelled for metabolism was around 26% and a smaller percentage was channelled for excretion (faeces: 4.3-16.0% and ammonia: 2.3-3.3%). In general, the parameters were significantly affected by increased temperature and exposure to the flame retardant, with higher levels found under warming conditions (for wet weight, relative growth rate, protein and ash contents), BDE-209 exposure (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). On the other hand, lower viscoseromatic index (VSI) was observed under warming and lower fat content was observed under both stressors. Overall, with such extreme and expected conditions of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness terms of survival. However, this synergism disappeared in the offspring of parent that exposed to warming and emerging contaminants 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, K.U.Leuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology

Recent transgenerational studies have showed that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4 °C increase) and the pesticide chlorpyrifos on life history traits and antipredator behaviors of the vector mosquito Culex pipiens using a factorial transgenerational design. Parents were exposed to either warming or the pesticide, or no stressors, or both warming and the pesticide, or no stressors. Direct effects for either warming or the pesticide, had negative effects on the offspring: both parental exposure to warming and to the pesticide resulted in an overall lower offspring survival. Parental warming impaired the anti-predator behaviors of the offspring by decreasing the division proportion and diving time off the offspring. Within both the parental and the offspring generations, warming made the pesticide more toxic in terms of survival. However, this synergism disappeared in the offspring of parent who had been exposed to both stressors simultaneously because in this condition the pesticide was already more lethal at the lower temperature. For anti-predator behaviors, in both generations the two stressors reduced diving time in a synergistic way. In the parental generation, the effect of pesticide were stronger at 20 °C than at 24 °C. In the offspring generation, this synergetic effect depended on parental temperature. Pesticide induced stronger reduction in diving time at 20 °C than at 24 °C but only in the offspring of parents exposed to 20 °C. Our results indicate that transgenerational effects will not increase the ability of this vector species to deal with pesticides in a warming world. This study highlights the importance of using bifactorial transgenerational experiment to understand the combined impact of pesticide and warming across generations, hence to assess the efficacy of vector control in a warming world.

WE331 1 + 1 ≥ 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper
T. J. Dalsing, M. A. Ruschmeyer, C. J. Titelman, University of Oslo / Department of Biosciences; K. Hylland, Department of Biology, University of Oslo / Department of Biosciences; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, threespine stickleback) and copper (20 µg Cu L⁻¹) on the marine copepod Tigriopus brevicaudatus. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent development. Potential importance of pedigree was also tested by comparing offspring from different females. Individual nauplii from egg-bearing females (8 randomly picked individuals per females’ clutch) were incubated individually and exposed to one of the four treatments: control, kairomone, copper or kairomone + copper. The experiment ran for 13 days (313 hours) with daily exchange of exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhodomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment. A
2-parametric non-linear mixed effect model was used to describe nauplii development over time (Instar = K/(1 – (K - 1) * exp(-exp(log(m)/α)+γ))), where K = the asymptotic development stage and m = the average stage transition rate). Effects of treatment and pedgie on the two model parameters were examined by comparison of models with likelihood ratio tests and Akaike’s Information Criterion (AIC). This analysis finds that treatment influenced the developmental stage at the end of the experiment, while pedgie affected the time to reach it. Developmental effects were found in the nauplii stages of development of survivors. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kairomone+ copper were significantly delayed compared to all other treatments. Effects on individuals in the combined treatment were greater than expected based on the two stressors alone. An adverse effect on development was already evident at the time of the first emerging copepodes (138 hours). These results indicate a synergistic relationship between risk of predation and copper by increased age at maturity in developing individuals of T. brevicornis. The results also show the significant role of pedgie in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.

WE332 Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain

J. Alvarez-Rojas, A. Peltalver Alcalá, M. Tercero Gómez, H. Comín Alcazar, O. Mutineu Esteban, 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. González-Alcaraz, Departamento de Biología / CESAM - University of Aveiro / Biologie & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation maturity were studied in abandoned agricultural grasslands in metal-contaminated environments: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Pinus halepensis trees (2-5) ≤<2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees >3-4 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>5) >3 m high and shrubs and herbs under the canopy (DP+MS); B) Outside the mine tailings: 5. Polluted forest with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF). Ecological indexes of vegetation were evaluated and soils analyzed for physical, chemical, and biological parameters. Soil temperature, feeding activity of invertebrates and decomposition were measured in situ. P+MS, DP+MS and PF showed the highest diversity of plant species and P the lowest. The organic C/N ratio was ≥=20 in P+MS, DP+MS, PF and CF and ≥=13 in S and P, which was in accordance with larger accumulation of litter in the first four environments. Cation exchange capacity (CEC), an indicator of the buffer capacity of the soil and the stability of the organic matter, was largely higher in CF (>≈32) followed by PF (>≈20), P+MS and DP+MS (>≈12) and finally P and S (<≈5). Water solubility of metals showed that an increase in radiation and distance from the tailings reduced metals solubility. From microbial biomass (indicator of micro-organisms population) followed 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: 200-1200). Water soluble metal(oids) (µg kg⁻¹), the most toxic fraction, were largely higher in S (e.g. Pb:4600; Zn:210000). Tea bag technique composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than PF. CF and P. Feeding activity was (% of holes feed on: CF: ≤≈42%, P: ≤= 39%, S: ≤=31%, P+MS: ≤= 21%, AF: ≥=8%, DP+MS: ≤= 70%. Total and soluble/available metals concentrations cannot be considered the only factors related with the activity of biota in polluted sites. Field studies including physical, chemical, and biological parameters must be considered together to obtain realistic information for understanding soil ecosystem functioning and recovering.

WE333 Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

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Neonicotinoids are a group of insecticides that are used worldwide in agriculture to control sucking and chewing insect pests. These insecticides are considered contaminants of emerging concern due to their high toxicity to non-target species, their resistance to biodegradation and their potential to form reactive oxygen species (ROS). 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 w/m²) 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 (Fv/Fm) and oxidative phosphorylation (OXPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (Fv/Fm), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UVR caused similar effects as γ and additionally induced morphological change (size and colony disconnection) in the plant. When exposed in combination, enhanced reproductive inhibition, OXPHOS reduction, PSII inhibition, NPQ 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). Moreover, both single and combined stressors stressors were sufficient to identify the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combine study with radiations and chemicals are currently on going.

WE335 Natural organic matter determines the potential of titanium dioxide nanoparticles to mitigate pesticide toxicity in presence of UV light

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Nanoparticle-based technology has evolved to a global industry with a tremendous economic potential. Since 2006, the investment in nanotechnology increased from estimated $11.8 billion to more than $2.5 trillion in 2015. Among all manufactured nanoparticles (NPs), titanium dioxide NPs (TiO₂) belong to the most frequently produced and applied NPs. As a consequence of their incremental use, TiO₂ will end up in surface waters during wastewater treatment and aquatic ecosystems. Light triggers the photocatalytic potential of TiO₂ 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 2.00-2.60 W/m²) and aquatic organic compounds on the toxicity of the potential of TiO₂ to 3 selected pesticides (Asazoxystrobin, Dimethoate, and Pirimicarb) towards the waterflea Daphnia magna. Asazoxystrobin toxicity was up to 1.6-fold reduced in the presence of TiO₂ with increasing UV intensity (0.00 vs. 2.20-2.60 W/m²). The combination of TiO₂ and NOM enhanced the toxicity of Azoxystrobin 2-fold (0.00 vs. 1.00-1.40 W/m²). Dimethoate toxicity was 3-fold decreased with increasing UV (0.00 vs. 2.20-2.60 W/m²). The
toxicity of Primicarb was reduced 1.7-fold with increasing UV (0.00 vs. 2.20-2.60 W/m²). In presence of NOM, Primicarb toxicity was generally 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 like pesticide structure, solubility, adsorption- desorption balance and biodegradability seem to be crucial for the interaction with nTiO₂, NOM, and UV-A, and the ultimate pesticide toxicity.

**WE336**

Effects of inorganic sunscreen formulations on the algal symbionts of reef-building corals, Symbiodinium spp., and their combined toxicity with ocean warming

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Between 4,000 and 6,000 tons of sunscreens annually are washed from the skin by swimming, sunbathing, and diving released into the ocean waters, posing a potential threat to coral reef ecosystems. Titanium dioxide nanoparticles (nTiO₂) are common UV filters in cosmetic products, and in typical sunscreen formulations they are dispersed in an oil phase, a mixture of emulsifiers and emollients which can reach up to 20% of the product content by weight. In order to assess the impact of inorganic sunscreen on corals’ endosymbiotic algae (Symbiodinium spp.), three nTiO₂ with different sizes and surface coatings were dispersed in an oil phase to mimic commercial available sunscreen formulations. Two Symbiodinium phytootypes, known for their different tolerance to environmental change and stress, were exposed to oil:nTiO₂ dispersions at both ambient temperature (26°C) and thermal stress condition (32°C). Growth rates, maximum photosynthetic activity and reactive oxygen species (ROS) production were evaluated. Symbiodinium spp. exposed to sunscreen exhibited 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 decline, and dreim was released into the ocean waters, 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 North Western Province of South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations – mainly from natural sources – occasionally exceed environmental quality guidelines or toxic concentrations. Macroinvertebrates are capable to react to toxic concentrations in environmental quality standard. The abiotic stressor like the temperature can have an affect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48 hour half maximal concentration (EC50) and median effective time (ET50) values were tested with ciliate algae Daphnia magna immobilization at the temperatures 10°C, 16°C and 20°C in laboratory experiments. Cypermethrin was almost twice as toxic at 10°C (2.17 ± 0.20 µg/L) compared with 20°C (4.10 ± 0.30 µg/L). The EC50 value of 16°C was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10°C than 20°C. The temperature had statistically significant effect in the EC50 experiment. The temperature did have a slight effect in the ET50 experiment. The ET50 value at 10°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10°C and 16°C. The temperature dependent behavior of cypermethrin was not taken into account when setting the environmental quality standard for cypermethrin. A performance of fish and invertebrates in Arctic and Antarctic environments has been observed, and this may have implications for the use of cypermethrin in these areas.

**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 Moskow Region and in Moskow city as well as for marine biomindation in a few locations round Sevastopol city. Cardiac activity registration in selected mollusks was carried out as a tool for measuring deterioration of general health of local biota in the sites of the concern. Methodology with standard testing of heart rate (HR) and HR variability using functional loads (short-term temperature, salinity change, some mechanical stimuli, etc.) were carried out. In land biodynamics a 3-4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz'mink/Izmailov Park) with relatively constant HR and exposed to different kinds of chemical stressors, their by both land and marine. A performance of fish and invertebrates in Arctic and Antarctic environments has been observed, and this may have implications for the use of cypermethrin in these areas.

**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 concentration in marine surface waters are 0.008 ng/L and 0.06 ng/L respectively, one of the lowest annual average and maximum allowable concentrations in environmental quality standard. The abiotic stressor like the temperature can have an affect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48 hour half maximal concentration (EC50) and median effective time (ET50) values were tested with ciliate algae Daphnia magna immobilization at the temperatures 10°C, 16°C and 20°C in laboratory experiments. Cypermethrin was almost twice as toxic at 10°C (2.17 ± 0.20 µg/L) compared with 20°C (4.10 ± 0.30 µg/L). The EC50 value of 16°C was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10°C than 20°C. The temperature had statistically significant effect in the EC50 experiment. The temperature did have a slight effect in the ET50 experiment. The ET50 value at 10°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10°C and 16°C. The temperature dependent behavior of cypermethrin was not taken into account when setting the environmental quality standard for cypermethrin. A performance of fish and invertebrates in Arctic and Antarctic environments has been observed, and this may have implications for the use of cypermethrin in these areas.

**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 mesocosm studies are however complex and difficult to interpret. A study has been set up to investigate whether food web modelling can reveal additional patterns, trends, or interactions in existing copper and zinc mesocosm datasets. Pattern oriented food web modelling – an ecological modelling technique – is used to reveal the mechanisms underlying metal effects. With this approach, multiple trajectory patterns in the datasets will be identified and described. Models are then evaluated for their ability to reproduce these patterns. In the case of mesocosm studies, food web models can be applied to understand the mechanism behind observed patterns. A large diversity of food web models exists with large differences in their complexity and underlying theories. Food web models based on ordinary differential equations are relatively simple in structure, whereas they can still account for the interactions between species in the food web. They are therefore ideally suited to study mesocosm data. Additionally, the effects of environmental parameters such as temperature and pH, often key determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE341** Bioaccumulation and physiological conditions in Ruditapes philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Contaminant/shell weight indices

E. Cacciatore, ISPR-A Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernarelli, R. Boscolo Brusà, G. Franceschini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Virno Lamberti, ISPR-A Institute for Environmental Protection and Research Ruditapes 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 biomonitoring with data obtained from different periods of the year. In this study, bioaccumulation of metals, Poly cyclic Aromatic Hydrocarbons (PAHs) and Butyltins (BTs) in Manila clams was monitored twice a year, from November 2010 to June 2015, in order to assess impact of human activities on R. philippinarum population from the Vallona Lagoon, a transitional area located in the delta of the Po River (NE, ITALY) which is the largest and most important Italian watercourse and one of the main sources of contaminants to Adriatic environments. Although levels were quite consistent with those reported from other geographical areas with low to medium pollution, seasonal trends were showed for each contaminant with higher concentrations on autumn rather than on spring surveys. The physiological condition of clams was also examined through two indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiological indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiological indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiological indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiological indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Accordingly, the normalization enabled us to evaluate various immunological parameters (Total Haemocyte counts, decoration activity, deethylation activity) in caged mussels were also studied. Using an Integrated Biomarker response index, the various mangrove sites were eventually ranked amongst each other. Our findings ultimately indicated a clear segregation of mangrove sites, indicating that some mangroves patches were potentially more at risk than others towards chemical contamination.

**WE343** Impacts of climate change on mercury bioaccumulation in large ocean predators

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Many marine ecosystems are being affected by climate driven changes in freshwater discharge, circulation, productivity and seawater temperature. Large ocean predators such as tunas account for a large proportion of methylmercury exposure in many countries. This study focuses on the impacts of this exposure on marine wildlife. Methylmercury is a potent neurotoxicant, particularly for children, and has been associated with impaired cardiovascular health in adults. We have developed a novel 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, and trophic 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 different periods (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 potential to aquatic organisms and frequent detection. Complex mixtures of pharmaceuticals, as well as highly toxic pesticides were identified. Through a multivariate analysis including pollution data, flow variability and related physico-chemical parameters, the main stressors and possible differences at
a temporal and spatial scale were evaluated at a taxonomic and at a biological trait level. Significant responses to multiple stressors from some invertebrate taxa and functional traits (feeding habits, reproduction and respiration) were determined. Based on these results, suggestions for a biological vulnerability multivariate index, which considers more site-specific conditions, will be presented.

WE345 Long-term effects on transplanted caged-freshwater bivalves Diplodon chilenis to the assessment of water quality in a Patagonian river
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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 chileensis is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantation of caged D. chilenis to different sites in the Chimehuin river (reference site (S1), downstream from an aquaculture facility (S2), and from an open dump and from the sewage treatment plant (S3)) after 3, 6, 9 and 12 months of exposure. We combined the antioxidant response, oxidative damage, ROS production and energetic status, with water and sediment analysis (physico-chemical and biological variables, and organic matter content). Physico-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total coliform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In D. chilenis, gill SOD and GST activity was higher in both S2 and S3 than in S1 by the end of the exposure time. During the last month of exposure (month 12), GSH levels dropped dramatically 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 of transplantation of caged D. chilenis due to the degradation of aquatic and sewage. This effect is reflected by a physiological response of D. chilenis, which is especially significant during period of their highest metabolic activity (autral fall/ winter).

WE346 The influence of selected seasonal and anthropogenic phenomena on a perennial river in South Africa.
G. Van Niekerk, North West University (Potchefstroom Campus) / Zoology-School of Biological Sciences; C. Wolmarans, H. Pienaar, North-West University - School of Biological Sciences / Zoology.

The quality of surface waters worldwide is declining fast. This is due to anthropogenic impact, climate change and natural occurring floods and droughts which are predominant abiotic agents of disturbance in intermittent streams. The objective of this study was to establish whether seasonal fluctuations can reduce the effect of anthropogenic impacts on the river and whether this is reflected by macroinvertebrate assemblages, physico-chemical water parameters and metal concentrations in the water and sediment. Water quality and macroinvertebrate community data were collected in the Crocodile River (South Africa). Four surveys were conducted, two during the low-flow and two during the high-flow season. Spatial and temporal variations were found with regard to suspended solids and total organic material. The low flow surveys had a slight increase in suspended solids and total organic material, whereas a substantial increase occurred during the high-flow seasons. The highest concentrations of metals in the water column were in contrast to the sediment concentrations observed during the high-flow seasons at the majority of the sites. Only minor differences in sediment metal concentrations were noted between high and low flow seasons. The pH values increased from the origin of the river downstream. However this did not result in a clear trend with regard to either an increase in sediment metals or a decrease in the concentration of dissolved metals. The highest values were obtained during the low flow seasons, when compared to the high flow seasons. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pielou’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P>0.05). The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa collected in large numbers during both seasons were tolerant to highly tolerant.

WE347 Growth, Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat 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 photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than that from single heat wave treatment as revealed by higher level of malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of biomass processes and water content were observed between (6°C+4°C) water stressed treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by short-term heat wave treatment in the comparison with water stressed condition 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. The long-term extreme events may contribute to transformation of European crop and weed species. The aim of this study was to examine the influence of extreme events (heat wave plus drought) and CO2 on the growth of spring barley (Hordeum vulgare L.) and wild mustard (Sinapis arvensis L.). Barley and wild mustard, growing together in the microcosms at the combination 2.1, were subjected to short-term and water stress treatments were performed (5°C+10°C) under ambient CO2 (400 ppm) and elevated CO2 (800 ppm). The growth and response of photosynthesis system of both plant species were evaluated.

WE349 Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosms study
A.A. Sanchez, IMDEA Water Institute / Aquatic Ecotoxicology; I. López, L. Nozal, IMDEA Water Institute; M. Vigil, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology 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 climate pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the nearby future. In line with that, advances in ecological risk assessment recognise that stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperature and oxidative stress caused by +10 °C heat wave treatment. Different 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 statistical techniques. Effects were assessed at the community and at the...
population level. Luzefuron was the main stressor in all the environmental scenarios, with a significant decrease of Cladocera and Copepoda, and an increase of Rotifera. Temperature and drought had slight effects on community composition and accelerated insecticide dissipation, influencing community recovery capacity. Interaction between factors at community and population level was mainly observed at the beginning of the experiment. Direct and indirect responses at population level varied between environmental scenarios. The results of this study contribute to understand differences in vulnerability of aquatic ecosystems to multiple stressors in (semi-)arid regions.

WE350 Toxicity of phenoxy herbicide: the effects of elevated temperature and CO2 concentration
J. Zaltanskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetoivenie, A. Diksaityte, J. Januskaitiene, G. Kaciene, G. Juozapaitiene, D. Mikselyte, Vytautas Magnus University; S. Sakalauskienie, J. Miliauskienie, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknys, Vytautas Magnus University
Climate change and major concern for agricultural 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 competition of these groups. The aim of this 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
A. Rodrigues, University of Aveiro / Biology Department and CESAM; M.D. Bordalo, University of Aveiro; O. Golovko, O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Detritivores; J. Pestana, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology
Exposure to sub-lethal concentrations of insecticides are known to pose at risk non-target insects due to effects on physiology and behaviour. Under natural conditions, predation may also be significant. The aim of this study was to examine the influence of elevated temperature and CO2 on the effects of insecticide to freshwater detritivores we studied the behavioural and developmental responses of Chironomus riparius. First, we tested whether the responses of the C. riparius, a collector, would change in the presence of a shredder species and the associated off may persist for a variable amount of time, that amphibians are not only sensitive of responses to the historic exposure to the stressor species 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 that amphibians are not only sensitive to the environmental impacts to Brazilian territory. In tropical areas, 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 an 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 sulflurazam) 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.

WE352 How sugarcane and high temperatures are contributing to amphibian declines in Brazil? Morphological, biochemical and molecular approaches
J. Freitas, University of Sao Paulo - USP / Department of Hydraulic and Sanitation; E.A. de Almeida, Fundação Universidade Regional do Blumenau; D. Schlenk, University of California-Riverside / Department of Environmental Sciences; E. Espindola, University of Sao Paulo / USP / Hydraulics and Sanitation
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 addition, there might be a development 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 that amphibians are not only sensitive to the 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 an 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 sulflurazam) 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.

WE353 Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure
S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Baho, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / L. Maltby, The University of Sheffield / Animal and Plant Sciences; A. Boxall, Lancaster University / Lancaster Environmental Centre; E. Leu, Akgapavlilena AS; L. Nizzetto, NIVA Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulflurazam on clomazone in R. schneideri and L. nattereri. Our data demonstrated that temperature, in addition to herbicide, influences the life history of tadpoles of both species. Clomazone also increased carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulflurazam on clomazone in R. schneideri and L. nattereri. Our data demonstrated that temperature, in addition to herbicide, influences the life history of tadpoles of both species. Clomazone also increased carboxylesterase activities in tadpoles exposed at higher temperatures.

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 / Dept. of Animal & Plant Sciences; S. Beulke, Environment and Forestry; 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
pH. Temperature, rainfall, soil parameters, pest ranges and cropping patterns are all expected to alter under climate change conditions, and all of these parameters could affect pesticide use and environmental exposure patterns which will alter the risk that these compounds pose to the environment. Here, we report the results of a study to evaluate the impacts of climate change on the exposure of aquatic systems in the UK. Concentrations of a number of case study pesticides, covering a range of physico-chemical properties and uses, were modelled in streams in the UK using two models recommended by the Forum for the Co-ordination of Pesticide Fate Models and their Use, namely MACRO and PRZM. Model predictions were obtained for current conditions and for expected conditions in the 2080s by parameterising the models for current and future predicted weather conditions, cropping patterns, soil properties and pesticide use patterns. The results show that exposure patterns of the APIs are likely to change in the future. These changes in exposure vary by pesticide type and the region modelled with exposure in some chemical-region combinations increasing and in others decreasing.

WE355 Ranking micropollutants in effluent by exposure indices via suspect/nontarget screening
P. Naree, Changwon National University / Environmental Engineering; c. young hun, Changwon National University / FEED of Eco-Friendly Offshore Structure; J. Jeon, Changwon National University / Environmental Engineering Information on the occurrence and concentration of micro pollutants in effluents from wastewater treatment plants (WWTPs) provides important clues for evaluating the risk and availability of river ecosystems. However, the chemical monitoring work for the numerous trace contaminants is time-consuming, labor-intensive, and cost a lot. To overcome the problems, the efficient monitoring programs have been conducted for limited, but prioritized pollutants. In general, the prioritization has been mainly based on effect/toxicity information rather than exposure-related indices. Thus, more risky 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 micro pollutants 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 chronic wa...
TriCosm (P. subcapitata, Ceriodaphnia, Hydra) was developed as an intermediate link between simple 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 interesting factors that impact on the community dynamics in this aquatic multi-species system.

WE360 Improving tolerance to natural and chemical stressors by inducing early life stages of the rotifer Brachionus sp. Cayman
L.G. Almeida, MARE - Marine and Environmental Sciences Centre / Instituto Politécnico de Leiria; C. Ferreira, Polytechnic Institute of Leiria / Polytechnic Institute of Leiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPEleiria; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; P. Bossier, Universiteit Gent / Laboratory of Aquaculture & Artemia Reference Center; G.C. Novaes, Polytechnic Institute of Leiria / MARE IPEleiria.

Rotifers are widely used as bio-indicators and models for ecotoxicology due to characteristics such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different naturally occurring chemicals in their environment. The 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. They 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. Toxicity 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 greatest gains and assess if their maintenance can be achieved through several generations.

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem
S. Joachim, INERIS-UMR SEBIO / CIVS; V. David, INERIS; K. Nott, Société Welsaqua; J. Fauve, Université de Lorraine / Laboratoire Toxicologie; H. QUEAU, N. Delorme, Isetra Lyon / UR MALY Laboratoire Ecotoxicologie; K. Kossey, Université de Liège UlG; P. Baudoin, C. TURIES, INERIS / INERIS UMR SEBIO ECOT; A. Catteau, A. Bado-Nilles, INERIS; M. Fourage, Unamur; O. Geffard, Isetra / UR MALY Laboratoire Ecotoxicologie; J. Porcher, INERIS / INERIS UMR SEBIO ECOT; A. Goffard, 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 organisms provide important services which lead to a strong societal demand concerning the preservation of their quality. They are the receptors of human activities, species which are extremely sensitive to pollution, and more specifically by wastewater treatment plants effluents. Water resources of freshwaters 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 level models. In order to calibrate and validate these models, a lot of mesocosm experiments 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 antipodetica 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. antipodetica biomarkers and growth, zooplankton and invertebrate abundance and diversity, and fish individual physiological responses by inducing early life stages of rotifer development could improve their 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 naturally occurring chemicals in their environment. The 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. They 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. Toxicity 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 greatest gains and assess if their maintenance can be achieved through several generations.

WE362 Improving the Quality of Ecotoxicological Testing and Assessment (P)

Quantitative structure toxicity relationships (QSRs) between chemical hydrophobicity and toxicity have been shown for nearly 100 years in both mammals and fish, typically using the log of the octanol-water partition coefficient (Kow). The current study reassessed the influence of mode of action (MOA) on aquatic toxicity-log kow relationships using a comprehensive database of curated and standardized acute toxicity and consensus log Kow values, and weight of evidence classifications. Long-term MOA were developed by linear regression of log acute toxicity and log kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad, 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ionic/osmoregulatory/circulatory impairment, and reactivity. Forty-eight of the 50 MOA-based models were statistically significant (p < 0.05, most p < 0.001), but r² values were generally less than 0.5, particularly for non-narcosis MOAs. The results showed that MOA-based QSR models can improve the accuracy of aquatic toxicity predictions for a range of taxa, and that incorrect classification of a specific acting chemical can result in toxicity prediction errors greater than 1000 fold.

WE364 Data-mining: Making use of aquatic lower-tier data for higher-tier risk evaluation of agrochemicals
G. Eck, U. Memmert, E. Eschenbach, Eurofins Regulatory AG.

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 exposure magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.

WE365 Comparison of models and tools for derivation of species sensitivity distributions (SSDs) for use in pesticide risk assessment
L. Azavedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; G. 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 5% effect on the growth rate of primary producers (Er₅). 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$_x$, 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 response variables was tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The merits and caveats of both approaches will be discussed and a protocol for evaluating and documenting statistical and biological significance of a NOEC study design will be presented. We analyse whether “No Effects” may have statistical or biological causes. In the HC$_x$-study consistent dose-response curves were obtained within 4 major arthropod taxa (63 out of 776; 8%) and SSDs could be constructed for each of them. Due to full overlap of curves the classes could be combined, resulting in narrow confidence intervals. In the NOEC-study 66 from 596 (11%) taxa were valid for univariate analysis, representing all major taxa. The protocol developed for the classification of results yielded an informative evaluation and allowed results to be classified as inconclusive or conclusive on a confidence scale of 1-4. Both study designs were fit for dose-response and biologically and statistically valid results. Where the HC$_x$-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE367 α-Dominance versus β-Prominence
F.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
The NOEC or an equivalent regulatory set-EC$_x$-value are key endpoints to assess safety of pest management practices. This challenge is addressed by the assessment takes place in a multispecies context, e.g. in non-target arthropod (NTA) field studies. To date most ecotoxicological faunistic NTA field studies follow a hypothesis test design. Few examples can be found that address EC$_x$-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 type I and type II errors that I will call α and β, respectively. 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 not the same as biological insignificance and it only means that the producer’s risk is low. Safety stems from rejecting the null hypothesis when false and therefore the compliment of β is known as the power of an experiment. We show how power criteria can be derived and used to construct a biology based confidence profile for studies addressing NTA communities. We also show how relaxing α helps to identify those taxa for which an experiment does not provide sufficient conclusive data to draw meaningful conclusions. In a multi-rate study design, the proposed increase of α to 10% is shown to be off-set by applying expert criteria such as inconsistencies in dose or time.

WE368 Defining simple toxicity values (EC, BMD) is not so simple
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Effective Concentrations (ECs) have now largely supplanted No Observed Effect Concentrations (NOEC), after decades of statistical criticisms towards the latter. EC$_x$ 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-monic trends (U or Umbrella shape) as well as linear and exponential trends. But our results, sigmoidal concentration-response shape was more the exception than the rule, as also reported in the literature for such omics data. In this context, we will discuss and explain why these non-sigmoidal trends lead to several issues regarding the derivation of toxicity values. In particular, the derivation of EC does make sense only provided an asymptotic response level is observed at high exposure concentrations and, in the case of non-monotonic trends, requires the definition of a maximal amplitude of the response. Alternatively to EC, the Benchmark Dose (BMD) theory 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 EC/LC$_x$s 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
We discuss two examples of field fauna study designs with non-target arthropods (NTA). This study sheds light into the influence of probability distributions and tools on standard aquatic risk assessments and aims to give recommendations on the choice of the most appropriate combination.

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
Effect values (EC10, EC20) derived from dose-response models have been recommended to replace NOECs in the pesticide regulatory context (e.g., new Regulation (EC) No. 1107/2009) The use of NOEC is often criticized because the usage of potus determined to detect NOECs and the definition of null hypothesis testing can cause serious over- or under-estimation of ECx/LCx due to the ignorance of control variability, the improper use of binomial assumption behind the probit model, etc. On the other hand, it is nowadays recommended that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem. A practice is to choose the model on the basis of consistency 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 it is defined in other risk assessment procedures. 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.
Deriving no effect levels using probabilistic approaches: Application to trichloroethylene (TCE) and potential impacts to risk-based exposure concentrations

N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; B. Magee, S. Sager, ARCADIS US Inc

Derived no effect levels (DNELs) are indispensable tools needed to quantitatively evaluate and assess chemical exposures to humans and inform decisions related to exposure mitigation and environmental remediation. Typically, DNELs are calculated using deterministic methods that rely on single point estimates of no-effect levels, assessment factors (AFs) that allow extrapolation to human exposure scenarios and account for uncertainties in toxicological information, and allowable risk level. However, the point estimates used to calculate DNELs are by design conservative estimates that when combined lead to a phenomenon termed “compounded conservatism”. The consequence of this phenomenon is DNELs that likely overestimate potential risks associated with human exposure to chemicals. Probabilistic risk assessment (PRA) approaches can be used to characterize the level of conservatism in deterministically-derived DNELs and to directly calculate DNELs. The advantage of calculating DNELs using PRA approaches is the ability to incorporate all available data and information, the dispersion of 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 protectiveiveness 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.

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, pattern meaningful link to FOCUS exposure modelling outputs. Studies designed to reflect realistic exposure often result in lower effects. However, FOCUS exposure patterns are frequently challenged in regard to their representativeness for the variety of possible field scenarios and hence are generally not accepted as valid refinement option by several EU Member States. Besides, it is often difficult to generalize various critical patterns of different FOCUS scenarios for an efficient testing and to align these generic patterns with sensitive life stages of the organisms of concern. Practical aspects, types of effects and life traits of test organisms add to the complicacy of designing reasonable higher-tier exposure studies. The challenge is to balance representativeness and practicability of test designs. Representativeness can for example be enhanced by multi-year modelling simulations where the variability of treatment and climate constellations are taken into account. Detailed analysis of the multitude of predicted exposure scenarios as well as a detailed analysis of available standard toxicity data is required to develop meaningful test designs and strategies. Generating simplicity from complexity rather than matching exactly the FOCUS modelling exposure pattern is proposed as potential solution to concerns on representativeness as well as practicability for ecotoxicity testing and finally acceptability in a regulatory context. The poster will present examples for the generation of reasonable test designs and strategies that are considered to meet objections towards higher-tier exposure testing as adequate means for refinement of aquatic risk.

WE373 Keeping it real: multidisciplinary approaches to aquatic risk assessment


Aquatic risk assessments for plant protection products (PPPs) can often be complex, comprising multiple crops, application rates, Member States (MSs) and therefore require multidisciplinary and critical to consider that that hazard quotient (PEC/PNEC ratio) really represents and whether it is a realistic representation of the true risk. A number of assumptions and worst-case parameters are used within the Tier I risk assessment, both on the exposure (predicted exposure concentration; PEC) and the effect (predicted no effect concentration; PNEC) side of the equation. To maximise the realism within the risk assessment, it is therefore advantageous to take a multidisciplinary approach, involving specialists in environmental fate, exposure modelling, aquatic ecotoxicology testing and regulatory ecotoxicology when developing refinements for the risk assessment. By developing integrated solutions, it is possible to progress from theoretical to more practical models. An example of such an approach is the use of PRA to model field exposure profiles, using a combination of randomness and risk factors to define more realistic profiles, allowing for the derivation of refined exposure conditions and more realistic endpoint values. The focus of the presentation will be to illustrate the different disciplines can work together to challenge the default assumptions of standard aquatic risk assessment, thus enabling appropriate refinement options to be derived and together design optimal solutions that are closer to addressing the real risks, rather than the theoretical ones.

WE374 Critical aspects of higher-tier laboratory exposure testing with different aquatic organisms

G. Gonsior, Eurofins AgroSciences Ecotox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins AgroSciences Ecotox GmbH / Aquatic Ecotoxicology

Aquatic exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSAs, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulse exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, F0) were exposed to 4 pulse treatments at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by plating fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After one pulse application at the beginning of the exposure, fish were typically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PECs, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT50 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filial fish was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

WE375 Repeated pulse exposure in a partial life cycle test with zebrafish: Keep it realistic!

M. Teigeler, Fraunhofer IME / Ecotoxicology; B. Weber, D. Warnecke, RIFCON GmbH Goldbeckstr Hirschberg Germany

Repeated exposure tests can be used to transfer more realism into standardised aquatic exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSAs, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulse exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, F0) were exposed to 4 pulse treatments at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by plating fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After one pulse application at the beginning of the exposure, fish were typically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PECs, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT50 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filial fish was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

WE376 Pulsed exposure of fish at sensitive life stages: The ‘worst case’ challenge.

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Refined exposure tests have become part of the regulation framework for plant protection products in the EU (EFSA Aquatic Guidance Document 2013). A pulse dose test can be used to address areas of risk that cannot be satisfied with the standard suite of aquatic toxicity tests. A pulse dose test considers situations where the expected exposure event in the field is significantly shorter than in the standard laboratory procedures. However, this challenge is often to cover exposure from multiple scenarios within one test. Therefore, the maximum exposure (peak) concentration, the number of peaks, the duration of the peaks, and the interval between peaks are considered to simulate a realistic profile covering a large number of scenarios. In this study, three different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to the new flow-through system. 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.

E. Lanchez, C. Dupuy, A. Jouand, Groupe SGS France; L. Bertin, SGS Multilab / Ecotoxicology

Multi-trophic level bioassays are usually carried out to determine toxicity of effluents, chemicals, cosmetic ingredients, etc. Toxicity to species is different according to the compound type considered, therefore tests on plants, invertebrates and vertebrates should be conducted. On the other hand, vertebrate organisms tests should be avoided when possible, including test on juvenile fish. Alternative methods need to be developed for juvenile fish testing, with equivalent predictability and sensitivity. Several alternative methods exist for freshwater studies but there is no standardized method available for seawater fish. This study is a first step in the evaluation of a marine fish embryo and larvae test as alternative to adult marine fish test OSPAR HOCNF guideline, for example. The embryo and larval stage sensitivity of turbellarian to differentiation and attachment of the test substance (Daphnia magna l. labrax) to reference substances were evaluated. To this purpose, within 72 hours post-fertilisation, the blastula stage eggs were exposed to reference substances separately. The effects of the toxicants on embryos and larvae were observed daily on a 10-days exposure period. For each reference substance and species, EC50 and mortality rate were calculated. To avoid vertebrate testing, results of this study were compared to published data. Several reference substances had a significant impact on survival of eggs and/or embryonic development. The sensitivity of the organisms is significantly different according to reference substances. Moreover, this test was used to evaluate toxicity of waste seawater samples in multi-trophic level bioassays (i.e. combination with single-species on algae, copepod and oyster larvae tests). Based on these results, marine fish embryo test appears as a credible alternative to juvenile fish testing. Therefore additional experiments will be conducted to validate this model.

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

S. Pawlowski, M. Dammann, S. Champ, BASF SE; M. Mathis, J. Fort, Fort Environment Labs, Inc.

The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay -AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (Nieuwkoop & Faber) Xenopus laevis larvae to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hind limb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid axis disruption. Recently, the relevance of hindlimb length normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between limb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≥ NF stage 60 from the >NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r² = 0.315-0.275, 0.553). Negative or no correlation between hindlimb length and body weight was observed in 5 of the 6 studies. The correlation of hindlimb 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 determines 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.

Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Intercalibration exercises towards standardized procedure

WE379

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The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay -AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (Nieuwkoop & Faber) Xenopus laevis larvae to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hind limb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid axis disruption. Recently, the relevance of hindlimb length normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between limb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≥ NF stage 60 from the >NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r² = 0.315-0.275, 0.553). Negative or no correlation between hindlimb length and body weight was observed in 5 of the 6 studies. The correlation of hindlimb 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 determines 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.
Diatoms are not only part of the risk assessment (RA) for plant protection products, Ltd.

According to OECD Test Guideline 201, increasing complexity of ecotoxicological tests and the methodologies can be successfully handled using all available technical options, which are explained. The biological and analytical results demonstrated that every test item should be conducted, but due to the number of calculations and characteristics of these different substances, some innovation is required to find the best test design for the individual chemicals. We show examples for the toxicity testing of difficult test items starting with the investigation of the characteristics of the test item in the respective test water (water solubility, stability in water, photolysis effect, degradation, storage conditions). In conclusion, the EU Water Framework Directive (2000/60/EC) and the new Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006), both require data from ecotoxicological tests by using algae, crustaceans, and fishes. Some tests procedure have already standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were indicated more frequently than marine ones. In particular, the lack of specific acute toxicity methods on Mediterranean fish species have involved the adaptation of procedures available for freshwater fish (OECD, 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 have conducted 24h acute toxicity tests of the same test medium to replicates. In this presentation several examples for the testing of algae are presented at SETAC 2016 by Dehelean et al., 2016 Stratification of soil arthropods in topsoil layers, SETAC Europe 26th Annual Meeting, Nantes, France.

WE384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes


Soil micro-arthropod field studies are carried out as part of the risk assessment of plant protection products. Those studies followed the proposed study design for soil organisms by Römbke et al. (2009). Soil cores are taken in the field and afterwards soil organisms are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of collombolans. Especially in long periods with high temperatures and low precipitation, a high number of collombolans might mitigate in deeper soil layers as indicated in the standard sampling scenario of 5 - 10 cm soil cores. Therefore it might be useful to cover also deeper soil layers, which contain potentially more specimens at the sampling time. One characteristic of collombolans is that the time period of sampling can easily be increased in case that low numbers of individuals are caught. This would then increase the possibility of a robust evaluation of treatments. One activity based trapping method for soil microarthropods would be the slide traps which were presented at SETAC 2016 by Dehelean et al. 2016. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling.


Stefan-Bogdan 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

S. Abreu, University of Aveiro / Dept. Biology & CESAM; S. M. Leandro, Polytechnic Institute of Leiria / MARE Marine and Environmental Sciences Center, A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DEETI IEETA Copepods play an important ecological role on marine ecosystems and may act as a sentinel of environmental degradation resulting from direct or indirect human impacts. The copepod Acartia tonsa is a calanoid species with a worldwide distribution and relatively easy to maintain for several generations under captive conditions. These characteristics allow this species to be a potential biological model to be used on ecotoxicological studies or live food for larviculture. On the bottleneck for its massive utilization relies on the time consumption procedures related with counting and cultures monitoring. To overcome such constrain, the aim of the present study was to evaluate the application feasability of a new technology based automatic counting and rearing system for larviculture of copepods 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 indicates a high significant correlation between manual and automatic counting, constituting the first step for the use of this biological model on experimental studies.

WE386 Solubility limits of lanthanides in standardized ecotoxicological media

S. Abreu, University of Aveiro / Dept. Biology & CESAM; S. M. Leandro, Polytechnic Institute of Leiria / MARE Marine and Environmental Sciences Center, A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DEETI IEETA
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; B.J. Ferrari, Centre Ecotoxic EAWGFPEL; G. Lofrano, University of Salerno / Department of Chemical and Biology
In order to get an appropriate interpretation of ecotoxicological results the exposure concentrations of test organisms to the contaminant of concern must be kept constant and stable over the test duration. Increasing evidence suggests that this is often not the case when dealing with elements that tend to form chemical species with low solubility, for example, oxides and oxyhydroxides for Cu (and Sn in the case of some lanthanides). In such situations, the calculation of meaningful effect concentrations for hazard and risk assessment must consider the temporal decrease of exposure concentrations to avoid erroneous conclusions. We performed ecotoxicity tests using semistatic exposure conditions to assess if periodical medium renewal could compensate for the temporal decrease in element concentrations. We also studied how the procedure of evaluating variable vs. colloidal/particulate elemental species to biological effects by testing the ecotoxicity of solutions aged for different periods. Chromium(III) was chosen as a model contaminant, but the general approach is applicable to all elements forming poorly soluble species and potential colloidal precipitates in ecotoxicological test media. In medium aliquots amended with Cr(III) (range 0.005 to 1.25 mg/L), renewal every 24 h was not sufficient to obtain stable exposure concentrations (i.e. ±20% of the initial value) throughout the duration of the test. The actual exposure range (estimated as time weighted mean concentrations) was between 5 and 275 µg/L and was used to estimate the Cr(III) EC50. On the other hand, concentrations remained stable over time and agreed with expected values in comparative experiments performed in static conditions. When comparing the temporal decrease in Cr(III) level during tests, Cr(III) appeared about 10 times more ecotoxic than Cr(VI); in contrast with the current standard. Ecotoxicological effects persisted in solution aged for 4h and 72 h which, based on previous work, would be long enough to remove ionic Cr(III) via hydrolysis (4h) and to form colloidal Cr-bearing particles (72 h and possibly, and to a lesser extent, 4 h). The use of semistatic exposure conditions and the assessment of persistent effects in spiked test media would allow better hazard assessment for several elements (e.g., lanthanides, Sn, Ga, In) whose concentration may strongly fluctuate in standardized ecotoxicological media.

WE388
Long term ecotoxicity testing of limonene for hazard classification: not so a lemon after all
P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment; F. Balk, Royal Haskoning DHV; H. van Bergen, Para-Celsus concept; K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; A. Kamper, DHI; S. Gimen, Firmenich / Product Safety and Regulatory Affairs
Limonene is a stereosomeric substance taking its name from lemon, which dominates the composition of the essential oils of citrus fruits. When synthesised as dipentene it is a racemate. However, in botanical sources it is present as the D- or L-enantiomer in Natural Complex Substances (NCSs) obtained at anything from traces in some plant extracts to over ninety percent in orange oil. These oils are considerably used as fragrance and flavour. The poster reviews a decade range of applications (cosmetic products, food manufacture, fragrance perfumery, botanical insecticide, household cleaning products, etc.) and is predominantly released back to the environment after use. The racemate and both D- and L-limonene received a harmonised classification under Annex VI of the EU C&L legislation as: Aquatic acute toxicity category 1 (Very toxic to aquatic life) and Aquatic chronic category 1: (Very toxic to aquatic life with long-lasting effects). Both classifications have a severe impact on storage, handling and transport requirements of limonene and the many (natural) complex substances and fragrance and flavour mixtures that contain even small amounts of it. The existing classification is a result of a limited data set notably for chronic endpoints. The chronic category 1 classification is extrapolated from the acute category 1 toxicity, log Kow > 4 and erroneously assumed not-rapid biodegradability of the substance. As limonene is a narcotic substance its Chronic 1 assignment was expected to be conservative. Due to doubts on the chronic classification and the consequences for labelling, storage, handling and transport, long term aquatic ecotoxicity studies were conducted to obtain a solid basis for the environmental classification. Analysis of the expected potential effect and potential significant differences are viewed considered the ecotoxicologists’ Bible for testing difficult substances, the chronic studies were fraught with difficulties. 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 number of years, eventually, demonstrating for the first time, a long adventure lasting several years with results supporting a chronic classification. The subsequent regulatory procedure to implement the classification in the EU regulations is currently ongoing.

WE389
Is that an effect? The importance of using all relevant data in mesocosm studies
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 of evidence. The emphasis of this poster is to highlight the importance of having a multi-method approach to survey the environment and ascertain any effects in the environment. We will present an overview of our mesocosm studies (2009-2012) on the summer algal bloom event in a mesocosm experiment in The Netherlands. The differences between the standard mesocosm and mesocosm studies were fraught with difficulties. 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 number of years, eventually, demonstrating for the first time, a long adventure lasting several years with results supporting a chronic 3 classification. The subsequent regulatory procedure to implement the classification in the EU regulations is 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/Leeu; S. Schwanbeck, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; A. Bitsch, 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 (http://gmoinfo.jrc.ec.europa.eu) is available which contains information about all GMOs currently under debate. 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 purpose of the enterprise, inter alia, information regarding the GMOs and the parental organism’s nature, release, environmental interactions, monitoring, waste treatment and emergency response plans. We strive to assess information concerning the environmental risk, derived measures and the overall standard of SNIFs concerning compliance with the regulatory requirements. To do so, we picked a homogeneous group of GMOs, namely gene modified Adenovirus, the most frequently used vector in gene therapy trials worldwide. Relevant information were entered into a database and categorized, applying unified vocabulary. Different challenges regarding the information available within the SNIFs were identified by analyzing the database: in several cases mandatory information was not available, e.g. monitoring plans, and in other cases the SNIF documents were misinterpreted, e.g. the connection between replication, dissemination and survivability was interpreted herein the opposite way. Although the primary basis has been recently reviewed, the data, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

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 or vPvB 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/vPvB criteria were originally defined by using the EU (TC NES) from the early 2000’s enlarging the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPA when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such compounds (e.g. chlorophenols and aromatic compounds) were non-toxic and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to amplify oscillation 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 B criterion in the EU while perhaps the only misleading 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.

UVCB block method for estimating expected mixture toxic pressure of substances of Unknown or Variable composition, Complex reaction products or Biological materials

D. van Meent, Associate of Retired Environmental Scientists ARES / Environmental Scientists ARES; D. De Zwart, DoZ Ecotoc / 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 Concave’s Hydrocarbon Block Method for chemical safety assessment of complex petroleum substances. The tool is meant to be used for demonstrating ‘safe use’ of chemicals, as required for registration of substances under REACH. The tool makes use of scientifically up to date versions of the exposure models SimpleTreat and SimpleBox, combined with state-of-art expected mixture pressure calculation using the Van Straalen-Aldenberg convolution integral. The tool estimates the addition of toxic pressure to the ambient toxic pressures in local, regional and continental EU environments, expected from the UVCB mixture. It is proposed that ‘safe use’ is demonstrated sufficiently well by showing that the UVCB under study is expected to contribute negligibly to ambient toxic pressure in the environment. The proposed ‘safe use’ calculation method has been tested on a selection of relatively well studied UVCBs.In the poster briefly explains the new UVCB block method and illustrates its potential with the outcomes of test calculations.

Evaluation of hypopharyngeal glands development in Honeybees (Apis mellifera L.) from toxicity studies in the light of current guidelines (EFSA and OECD)


Honey Bee (Apis mellifera L.) is a species that belongs to a group called 'beneficial insects'. All arthropods from this group play the important roles in nature, albeit bees go a few steps forward and they also find application in the food, pharmaceutical and others industries. With the current decline in bees’ colony numbers, these arthropods should be handled with extreme caution. Therefore, it is extremely important to assess the risk for non-target organisms for which plant protection products are often more toxic than pests of agricultural crops. This assessment is related not only to the direct influence of chemicals on the bee populations, causing morphological mortality or morbidity, but also indirectly through the impairment of the ability to raise the larvae, for example by disturbing the work of 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 relevant to bee studies, hypopharyngeal glands do not develop correctly in these animals. Therefore, the HPG index is a valuable parameter. In order to introduce the evaluation of hypopharyngeal glands as an endpoint in toxicity testing of chemicals on bees.

Assessing toxicity to Daphnia magna using movement parameters

T. Dred, Department of Biology, University of Osijek / Department of Biology; D. Hackenberger, GeoNatura; B. Hackenberger, Department f Biology, University of Osijek

Daphnia are among the most common settlers of freshwater habitats. These planktonic invertebrates show high sensitivity to various toxicants, therefore representing a useful model organism in ecotoxicological research – with common endpoints being survival, reproductive success and observable morphological changes. Some of recently conducted scientific investigation involving these organisms focused on examining the effects of various substances on their mobility. The aim of this work was to compare and examine the changes of swimming behaviour of Daphnia over time and under the influence of sub-lethal concentrations of ZnCl₂, based on 12 chosen movement parameters. Organisms obtained from a natural habitat acclimatized to laboratory conditions were exposed to different sub-lethal concentrations of ZnCl₂. Changes in swimming parameters were measured in each transparent plastic Petri dish in prepared solutions of the selected toxicant. The recording started instantly upon exposure of the organisms to the toxicant (t₀), as well as 1 h, 24 h and 48 h of exposure (dt=1 h, dt=24 h, dt=48 h). The recording and analysis of motion were carried out in Python, implementing OpenCV, TrackPy and NumPy packages. Analysis of the obtained data showed that the duration of exposure affects the movement parameters, regardless of the concentration of the toxicant. Although, some of movement parameters showed significant correlation with concentrations of toxicants and hence can be used as an early biomarker of exposure.

The validation of analytical methods in ecotoxicology

I. Pedall, A. Rastall, A. Sagner, M. Fauqel, Rifcon GmbH

The validation of analytical methods (regulated by SANCO/30299/rev 4) used in support of ecotoxicological studies has become an important aspect of the
A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFSA Aquatic Guidance 2013 C.S. Ramsden, AgroChemex Environmental Ltd / School of Biomedical and Biological Sciences; C. Gambling, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFSA Aquatic Guidance (2013) allows aquatic toxicity studies to be modified so the exposure-profile (peak-height, pulse-duration, number of pulses) is comparable to the worst-case predicted field-exposure. In the present study on a synthetic pyrethroid (SP) insecticide, a novel method was developed to simultaneously assess effects on 3 early-life stages of rainbow trout. The TG 210 design was modified to incorporate a worst-case time-variable exposure profile in tanks containing a 10 mm sediment layer and stainless steel mesh barrier to allow water movement but prevent fish disturbing the sediment. Life stages used were firstly 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 60 eggs, 20 alevins and 20 swim-up fry. The study duration for organisms starting as ‘eggs’, ‘alevins’ and ‘swim-up’ fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coordination). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both >95%. The design allowed the direct comparison of the sensitivity of each life stage to the exposure pulse profiles. Freeze-drying of the ‘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 M. Macaron, Adolphe Merkle Institute / BioNanoMaterials; D. Bossert, A. Petri-Fink, B. Rothen-Rutishauser, F. Schwab, Adolphe Merkle Institute / BioNanoMaterials Group Since centuries, silica (SiO2) is used in large scale industrial applications, such as cement manufacturing 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 over 20 two 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 the exposure pulse profiles. Freeze-drying of the ‘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.

The occurrence of fullerene aggregates in Mediterranean rivers: Two cases of study J. Sanchis, IDAESA-CSIC / Water and Soil Quality Research Group; R. Milacic, Józef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAESA-CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry Fullerene 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 analysis protocols. This work was also detected in environmental samples from the Sava River. The results show that fullerenes are present in the aquatic environment although at concentrations far below those 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-Biogauka and by the Spanish Ministry of Economy and Competitiveness through the project Integra-Coast (CGL-2014-56530-C4-1-1). It has also received funding from the Generalitat de Catalunya (Consorciat Reserchos Groups “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefaneei, Alina, et al. Analytica chimica acta 682 (2015): 1-2. [2] Ferrà, E., et al. Environmental Research 219 (2016): 47-55. [3] Zarkia, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, Josep, et al. Environmental Science & technology 50.2 (2015): 961-969. Occurrence of fullerene aggregates in Mediterranean rivers: Two cases of study J. Sanchis, IDAESA-CSIC / Water and Soil Quality Research Group; R. Milacic, Józef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAESA-CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry Fullerene 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 analysis protocols. This work was also detected in environmental samples from the Sava River. The results show that fullerenes are present in the aquatic environment although at concentrations far below those 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-Biogauka and by the Spanish Ministry of Economy and Competitiveness through the project Integra-Coast (CGL-2014-56530-C4-1-1). It has also received funding from the Generalitat de Catalunya (Consorciat Reserchos Groups “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefaneei, Alina, et al. Analytica chimica acta 682 (2015): 1-2. [2] Ferrà, E., et al. Environmental Research 219 (2016): 47-55. [3] Zarkia, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, Josep, et al. Environmental Science & technology 50.2 (2015): 961-969. Occurrence, fate and behaviour of fullerenes in the environment M. Farre, IDAESA-CSIC / Environmental Chemistry; J. Sanchis, IDAESA-CSIC / Water and Soil Quality Research Group; Y. Aminot, University of Plymouth: E. Abad, IDAESA-CSIC; A.N. Jha, Plymouth University / Biological Sciences; J.W. Readman, University of Plymouth / Biochemistry Research Centre; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry The occurrence, fate and behaviour of carbon nanomaterials in the aquatic environment are dominated by their functionalization, association with organic material and aggregation behaviour. In particular, the degradation of fullerene aggregates in the aquatic environment is a primary influence on their mobility, sorption potential and toxicity. In this presentation, a summary of the occurrence of fullerenes in environmental matrices performed in different studies of our group will be presented. The analytical approach to investigate seven fullerenes (C60, C70, N-methylfulleropyrrolidine, [6,6]-phenyl C60 butyric acid methyl ester, [6,6]-thienyl C60 butyric acid methyl ester, C60 pyrrolidine tris-acid ethyl ester and 6,6-phenyl C60 butyric acid methyl ester) in waters, soils and sediments combines an anti-solvent-assisted solid phase extraction (UAE) with pressure photo ionisation (APPI) in negative ion mode followed by liquid chromatography (LC), using a pyrenylpropyl 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-ng/mg in atmospheric aerosols, pg/g-ng/g in soils and pg/l-ng/l in river waters. The composition of different fullerenes including pristine fullerenes (C60 and C70) and functionalized ones from the engineered origin will be discussed. In addition, different degradation studies of fullerenes in water suspensions emulating different environmental conditions and during a wastewater treatment will be presented. Degradation studies have been carried out under controlled conditions of salinity, the humic substances content, the pH and the sunlight irradiation. The results of degradation studies will show that up to ten transformation products are produced, including epoxides and dimers. Finally, the kinetics of generation of each transformation product will be well presented.
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

M. Sarette, 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 still not fully understood, but results of laboratory research using simplified, synthetic mediums has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is unknown whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether an ENMs’ engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. In Samples of a local freshwater river to represent a complex, natural medium, a suite of batch experiments were conducted. Each batch was dosed with a single model ENM, which included 12-15 nm gold-core nanoparticles (AuNPs) with different surface coatings (e.g., diverse surface charges, stabilization mechanisms). Aliquots were collected from each batch over time, immediately centrifuged to remove large particles/aggregates, and the supernatant collected for analysis via ICP-OES. From this, the concentration of unaggregated AuNPs remaining in the supernatant over time was monitored. The results of this study indicated that unaggregated AuNPs were destabilized. More importantly, however, was that both the neutral and negatively-charged ENMs remaining stable throughout the duration of the experiment (8 hrs.). This suggests that the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

V. Castaños, CSIC University of Strathclyde / Civil and Environmental Engineering; R. Skuce, Scottish Water Horizons Ltd.; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical applications and consumer products such as textile, personal care product, cosmetics and biomedicine and catalysis. NPs are parameters which matter in TiO2 removal kinetic and efficiency during activated sludge stage. The main objective of this study is to determine the engineered TiO2 nanoparticles (TiO2 ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO2 NPs in water, soil, and sediment near a production site in Vieux-Thann (68) to determine parameters which contribute to the transport of TiO2 and several environmental fate prediction methods are used in particular inductively coupled plasma with atomic emission spectrometry (ICP-AES), transmission electron microscopy (TEM) and conductivity or potential of hydrogen (pH) measurements. Then, parameters determined in the previous steps are used to calculate a fate factor of TiO2 ENPs in natural environment according to the life cycle impact assessment method calculation. During the study, it was found that organic strength, pH, percentage of organic matter, soil composition (percentage of clay, silt and sand) or size and concentration of TiO2 NPs are parameters which matter in TiO2 ENPs fate in soils, water, and sediments. Furthermore, the first results obtained show that the sampling point located upstream of the production site has the lowest concentrations of titanium dioxide in soil and sediments. This point is used as a reference and allows to consider it as the geochemical background. The other sites located near and downstream of the production site have higher concentrations of titanium dioxide that may be due to transportation of TiO2 ENPs by wind and effluent released into the Thur. Further studies are needed to determine whether the additional titanium dioxide comes from the production site or not and will confirm or invalidate the presence of TiO2 ENPs manufactured in the different environmental media.

WE403 Assessing the fate and transport of engineered TiO2 nanoparticles in sewer pipes through a dynamic multimedia model (SWNano)

K. Kim, Seoul National University / Environmental Planning Institute Graduate School of Environmental Studies

Assessing the fate and transport of engineered TiO2 nanoparticles in sewer pipes through a dynamic multimedia model (SWNano) is a powerful method that is able to characterize TiO2 NPs according to their fate in environmental media and their effects on ecosystems and human health. The main objective of this study is to determine the engineered TiO2 nanoparticles (TiO2 ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO2 NPs in water, soil, and sediment near a production site in Vieux-Thann (68) to determine parameters which contribute to the transport of TiO2 and several environmental fate prediction methods are used in particular inductively coupled plasma with atomic emission spectrometry (ICP-AES), transmission electron microscopy (TEM) and conductivity or potential of hydrogen (pH) measurements. Then, parameters determined in the previous steps are used to calculate a fate factor of TiO2 ENPs in natural environment according to the life cycle impact assessment method calculation. During the study, it was found that organic strength, pH, percentage of organic matter, soil composition (percentage of clay, silt and sand) or size and concentration of TiO2 NPs are parameters which matter in TiO2 ENPs fate in soils, water, and sediments. Furthermore, the first results obtained show that the sampling point located upstream of the production site has the lowest concentrations of titanium dioxide in soil and sediments. This point is used as a reference and allows to consider it as the geochemical background. The other sites located near and downstream of the production site have higher concentrations of titanium dioxide that may be due to transportation of TiO2 ENPs by wind and effluent released into the Thur. Further studies are needed to determine whether the additional titanium dioxide comes from the production site or not and will confirm or invalidate the presence of TiO2 ENPs manufactured in the different environmental media.

WE404 Fate factor of engineered TiO2 nanoparticles in aquatic and terrestrial natural environments

A. Schuhl, University of Strasbourg (UdS); G. Quaranta, Université de Strasbourg / CNRS / EOST/ILHYGES; S. Lewnizzak, University of Strasbourg / ILHYGES

Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical applications and consumer products such as textile, personal care product, cosmetics and biomedicine and catalysis. Metallic and oxides metallic nanoparticles (NPs), such as Ag and CeO2 NPs, have increased their global production because they have been widely used in new applications and consumer products such as textile, personal care product, cosmetics and biomedicine and catalysis. NPs-containing wastes discharged in aquatic systems...
have produced undesirable effects in many marine organisms. Marine phytoplankton is vital in marine ecosystems, as microalgae are at the bottom of the food web and, therefore, any change in microalgae population will have an important impact into the rest of food web. The direct mechanism of NPs toxicity is the physical damage in cell membrane through adsorption of NPs onto the cell leading to NPs uptake, bioaccumulation and toxicity in different organelles. Therefore, the hypothesis of our work is that microalgae lacking of cell wall will be more susceptible to the toxic effects of NPs than those microalgae with a typical cell wall. To test this hypothesis two microalgae species, Dunaliella salina, lacking cell wall, and Chlorocellula autotrophica, with a typical cellulosic cell wall were chosen. Species were exposed to ion (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 ions) caused negative effects in cell division, inherent cell properties and physiological mechanisms of both microalgae. The general trend was a decrease in active chlorophyll, effective quantum yield of PSII and cell density and an increase in cell complexity and percentage of intracellular ROS. For both marine species, Ag was more toxic than Ce and ions forms of both metals were more toxic than NPs. Contrarily to our hypothesis, D. salina, despite not having a cell wall, showed to be less sensitive to metals than C. autotrophica. Therefore, the cell wall of C. autotrophica seemed not to suppose higher protection regarding 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-discalculations, 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. Further, 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 solutions, the measured z-averages ranged from 600 nm (CPO-27 Ni) up to 8 µm (HKUST), Zn-CPO and CPO-27-Ni had the highest negative zeta-potential of -25 and -20 mV respectively, with Al (OH) fumurate and FeBTC-JM-AR forming a positive surface charge. UiO-66-COOH and HKUST had very weak surface potentials, which was also reflected in their instability in the stock and exposure media. In a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in specific dissolved metals or elements in the exposure media, both in a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in specific dissolved metals or elements in the exposure media, both in a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in specific dissolved metals or elements in the exposure media, both in
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 Gpx1-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 fluxes of oxidative phosphorylation using a high resolution respiratory measurements chamber. 

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 Solfrid Lohne. This work was supported by the Norwegian Research Council funded NanoCharm (22139/JF0) and NorNanoReg (239199) projects, and the EU NANOReg project grant agreement n° 310584.

WE409

Effect of silver nanoparticles layer on soil surface to terrestrial species
J. Kwak, S. Nam, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

With developing nanotechnology, uses and release of engineered nanomaterials are increasing. Landfill of biosolid after wastewater treatment is considered as one of indirect exposure sources of nanomaterials. This study focused on the simulation of exposure scenarios of nanomaterials landfills, and set the aim to investigate different toxic effects derived from different scenarios. Silver nanoparticles (AgNanostar) was selected as test material and 4 different exposure scenarios were considered: 1) control, 2) layer of AgNPs with low concentration (Low-Layer), 3) layer of AgNPs with high concentration (High-Layer), and 4) mixture of AgNPs and soil with low concentration (Low-Mix). Plant microcosm experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because of strong root surface adsorption to AgNPs, which was stronger than Low-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 (2016R1A2B401484).

WE410

Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight
Y. Song, Korea Institute of Ocean Science and Technology; W. Shim, S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group; S. Eo, Korea Institute of Ocean Science and Technology

Production of nano- and micro-sized plastics through weathering of plastic surface by photo-oxidation was regarded as one of major input sources of secondary nano- and microplastics. Its fragmentation process according to exposure duration and size of the plastic degrades to different particle sizes. However, it was not revealed yet. Expanded polystyrene (EPS), one of common marine plastics, was known to weather more rapidly than polyethylene and polypropylene in our previous study. Fragmentation of nano- and micro-sized particles was qualitatively and quantitatively determined from the expanded polystyrene (EPS) exposed to sunlight for 9 months. The exposed EPS cubes (3x3 cm surface area) were sampled in 2 month intervals at 2, 4, 6, and 9 months of sunlight exposure. The surface colour was changed from white to dark yellow during exposure. The fragmented particles at the top surface of each cube directly exposed to sunlight were collected in 2 ml solution consisting of HPLC grade pure water with 0.1% Triton X-100:0.1% gfp beads from prokaryotic strain E. coli (pCDF-1::gfp). The bioluminescence of luciferase was measured following addition of 10 µl of reporter strain PE255 expressing luciferase inducer, indicated the involvement of ROS defense mechanisms. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles are carried out with unlikely high doses of particles, typically above 1 mg/L while the environmental concentration is expected to be in parts per million. A major influence in altering the bacterial communities associated with MS particles.

WE412

Tracking nanoplastics in marine bivalves at environmentally realistic concentrations
M. Al SJD Cheikh, University of Plymouth / Marine sciences and engineering; J.S. Rowland, Plymouth University / School of Geography Earth and Environmental; K. Stevenson, Charles River; C. Roleau, Pesches et Oceans Canada; T.B. Henry, Heriot-Watt University / The School of Engineering, Geoscience, Infrastructure and Society; R.C. Thompson, Plymouth University / School of Marine Science and Engineering

Awareness campaigns on plastic pollution in oceans are backed by governments worldwide with recent initiatives to ban plastic products such as micro-beads from cosmetics or single-use plastic bags. The fragmentation, the persistence and the production of plastic particles (micro < 1mm, MP, to nano-size < 1µm, NPs) are among the most prominent environmental issues faced by government environmental agencies. The main routes of nanoplastics into the environment are through the incidence in altering the bacterial communities associated with MS particles. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles were carried out with unlikely high doses of particles, typically above 1 mg/L while the environmental concentration is expected to be in parts per million. A major influence in altering the bacterial communities associated with MS particles.

WE413

Plastics: does size matter? Impact of environmentally relevant nanoplastics identified in the Nordic environment

Plastic pollution is a widespread concern worldwide. Substantial amounts of plastics are produced and discharged into the environment every year, which will potentially impact aquatic ecosystems and consequently aquatic organisms. Plastic in the aquatic environment can undergo mechanical, chemical and biological degradation that can give rise to the formation of microplastics, which can be denominated as micro- (<1 mm) or nano-plastics (<100 mm) depending on size range. Microplastics are ingested by a range of aquatic organisms and this ingestion might cause adverse biological effects, however less research has been conducted on their smaller counterparts, nanoplastics (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxic potential towards aquatic organisms depending on surface characteristics and interactions with the surrounding environment. Nonetheless, their presence in the environment and any toxic mechanisms are, to a large extent, unknown. In this study, the impact of environmentally relevant plastics identified in Norwegian waters was assessed, focusing on the plastic pollution in the Baltic Sea, the Norwegian fjords, and the fjords of Norway and Svalbard. The presence of microplastics and nanoplastics was determined in suspended particulate matter and benthic infaunal samples using a combination of visual banding,optical microscopy, and micro X-ray fluorescence. The results showed that microplastics are more abundant than nanoplastics in the marine environment, with the majority of the detected plastic particles being polyethylene. The size distribution of the detected plastic particles was skewed towards smaller sizes, with a significant proportion of the particles being nano-plastics. The study also highlighted the importance of considering the size of plastics when assessing their ecological impact.
environmental samples will be evaluated at the nanoscale in three key marine species, the cryptophyte algae Rhodomonas sp, the harpacticoid copepod Tisbe battagliai and the blue mussel Mytilus edulis and compared to its microscale counterpart. The uptake, accumulation and elimination kinetics of NPLs in the three species will be evaluated under ecologically relevant conditions, as well as their potential transfer along the aquatic food chain. Furthermore, the acute and sublethal ecotoxicological effects of both plastic sizes will be investigated at individual, cellular and molecular levels using different biological endpoints. With the results obtained in this study we aim to discuss the differences in uptake, accumulation and biological responses between different sized plastics identified in the Nordic environment, and consequently bridge the current knowledge gap on the assessment of their potential hazardous effects in marine biota.

WE414 Ecotoxicity of engineered nanomaterials in relation to ecosystem complexity and functioning
W. Peijnenburg, RIVM / Center for Safety of Substances and Products; Y. Zhai, CML Leiden University; M.G. Vijver, CML Leiden University / Conservation Biology Working Group
Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposition are threatening the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplified microcosm and mesocosm model systems, extrapolation of results of these tests to real environments is complex and requires proper model systems. The question is whether ENMs, especially nanosized ENMs (e.g. specific shape, size, surface charge, coating) and extrinsic environmental characteristics (NOM, pH, electrolytes) and how ENMs interact with various components of food webs. ENMs in the environment may directly or indirectly affect a diverse array of organisms and microorganisms, which likely cascades towards distorted ecosystem processes. We further identify challenging yet promising research areas in this emerging field that are essential in pursuing a realistic risk assessment that accounts for ecosystem complexity and functioning.

The take home message is that there is a need of studies assessing not only impacts of ENMs on single species but also a need of a comprehensive framework of nano-specific toxicity in complex ecosystems. Considering the abiotic complexity of the transport of ENMs in the natural environment, studies performed with laboratory-cultured species need to include proper characterization and detailed quantification of the environmental factors that impact fate and effects of ENMs. In addition, the biotic complexity in the ecosystem especially in the aquatic and terrestrial environment indicates that risk assessment of ENMs should be conducted in an integral multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal bacteria and the host. Also, the link between microorganisms and invertebrates in a detrital food web should be included for a systematically evaluation of ENMs toxicity.

WE415 Development of rapid reacting automatic mobile lab responding chemical accident of aquatic environment in Korea
H. PARK, Hanyang Univ. / Regulatory Chemical Analysis & Risk assessment Center; S. ok, Kitech / Regulatory Chemical Analysis & Risk assessment Center; M. Song, J. Ra, Korea Institute of Industrial Technology
Most of available mobile lab developed and operated in Korea are air quality monitoring system and there is no rapid reacting mobile lab responding chemical accident of aquatic environment in Korea. We designed rapid reacting mobile lab with two major factors, 24hr operating and rapid starting within 1hr after arrival. We also considered system stability during transportation and accessibility to target river or stream, where we collected vibration information of a vehicle by exposure to real road and raised spot of a road and reduced speed. Vibration validation assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic to river by conducting sampling at the selecting sampling point. Lastly, we adopted special air-conditioning system to control the system contamination from exposure to vaporized chemicals at the accident location. We adopted dual power supplying system with 5.5kW APW, 24hr operation capacity and 24hr operation capacity with 2hr supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are established with vibration information collected. Activated carbon proved to be most effective to control our target chemicals, which was composed onto COMBI type filter. These findings will be modulated and structured to maximize system stability.

[Keyword] chemical accident, mobile lab, rapid monitoring system

WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish from a Lake Dosed with Nanosilver
C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Enineering; 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 that occur 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 correlation between Ag accumulation and Ag concentration observed in liver of 5.1 µg/g wet weight. In perch, the highest concentrations of Ag were observed in gill tissue. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 µg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake into the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish to piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are 3 orders of magnitude greater than the concentrations in water.

WE417 Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata
G. Qualhato, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Saboia-Moraes, Federal University of Goias / Department of Morphology
Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomedication, its ecotoxic effects to aquatic organism remains unclear. In this study, the hepatotoxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L−1) was investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and long-term exposure. The animals were collected at the beginning of the experiment and after 3, 7, 14 and 21 days of exposure. TEM results demonstrate crystalline and rounded IONP with an average size of 3.97 ± 0.85 nm, and DLS and ELS analysis showed that the IONPs have low hydrodynamic diameter and high surface charge in ultrapure water (14.11 ± 0.2 nm; 51.1 ± 7 mV) compared to reconstituted water (21.4 ± 0.39 nm; -19.5 ± 6.5 mV). The histopathological results showed an increase in the frequency of histopathological changes in fish after the 7 days of exposure to IONPs, such micro- and macro-steatosis, melanomaophace aggregates, exudate and hemorrhagic foci. The acute (3 and 7 days) and long-term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs.

The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; nanotoxicology; guppy. Session: (Eco)toxicology and human toxicology; from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation.
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 Geusken, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419
What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chemistry Ecotoxicology Lab; C. Martin, FCBA / Gironde. In Europe, the classification of waste is carried out by an assessment of the hazardousness of the waste using data of known waste composition according to the properties of danger. This classification can be based only on the waste composition if the available data are sufficient and relevant. This method is based on the sum of contributions from each compound with the CLP (Classification, Labelling, Packaging) regulation [European regulation (EC) 1999/2008]. In the majority of cases under complex mixtures, or of unknown nature (e.g: exterior and interior joinery, furniture, panels, wooden paneling, wood flooring, construction waste and demolition...) including wood preservative, paints, glues, the characterisation of their wastes is considered to be difficult. Ecotoxicological testing seems to be the most relevant because the effects of all contaminants (synergistic effects, additives and antagonists) are integrated. It is a major advantage in the characterisation of waste. In this case, the waste has to be then subjected to a battery of bio tests (aquatic and terrestrial) in order to evaluate one of the 15 existing properties: Eco-toxicity for the environment (HP14). Test strategies will allow wood wastes to be recovered or recycled.

WE420
QUALITY STANDARDS FOR URBAN WASTE FERTILIZERS: PUTTING ECOTOXICOLOGY IN THE PICTURE S. Chelinho, CFE / Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies only on physico-chemical/biochemical analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I; theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed municipal solid waste (group II) were selected and tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the highest and lowest toxicity were observed in the two UWF from group I. Among soil organisms the range of sensitivities was: E. andrei > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridissima > R. subcapitata > C. vulgaris > H. incongruus > B. calyciflorus. The observed toxicity was probably related with UWF high salinity rather than with metal contents. The obtained data also reinforce the need to include information from biological susceptibility of the potentials receptor 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 are a source of the reclaimed asphalt, which is suitable to continue to use. It is also necessary to deal with the environmental impact of these materials within their ongoing life cycle, except testing their mechanical properties. Currently, the environmental impact tests of reclaimed asphalt are carried out in crushed condition, according to the leachability test of granular materials with grain size Scenedesmus subspicatus, Sipinis alba, Daphnia magna were carried out in aqueous extracts. The results were compared with the legislation and were evaluated in terms of the content of the monitored substances and the type of test material.

WE422
Leaching tests - a useful tool for the environmental impact assessment of construction products N. Bandow, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgens, BAM Federal Institute Materials Research and Testing; U. Schoknecht, BAM Federal Institute for Materials Research and Testing Construction products and waste materials used for construction can be in contact with the environment and may release potential harmful compounds. Information on the total content of these substances in the product is not sufficient to assess its environmental impact since it does not consider realistic exposure conditions. Concerning the pathway to soil and groundwater by contact with rain or seepage, water leaching tests are available. The aim of this presentation is to show exemplary results of existing leaching methods and underline the strength and weaknesses of this kind of test with selected examples of our work: Concrete roofing tiles with terbutryn were leached according to CEN/TS 16657-2 with permanent immersion into water and according to EN 16105 with nine immersion cycles each consisting of immersion and dry stages. The eluates were divided into subsamples for different parameters as pH, conductivity, total organic carbon, anions, cations and terbutryn. Concerning the assessment of this leaching data it is important to notice that the eluate concentration do not represent necessarily environmental concentrations. Thus, the concentration in the leaching test cannot simply be considered as equal to environmental concentrations. 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. Drygajski, Texas Tech University / Department of Civil Environmental and Construction Engineering; G. Burton, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Bejar, Texas Tech University; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.B. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosen, SPAWAR Systems Center Pacific; V. Jandova, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; I. Drygajski, Texas Tech University / Civil and Environmental Engineering; M. Bejar, Texas Tech University; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.B. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosen, SPAWAR Systems Center Pacific; V. Jandova, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Huzlik, K. Effenberger, Transport Research Centre

Stormwater sources are difficult to understand because of the poor characterization of the irregular, event-driven inputs and the difficulty of managing diffuse sources of large volumes of runoff. The study objective is to develop methodologies to quantify the consequences of ongoing low-level sources on chemical concentrations, contaminant availability, and effects of biological receptors in surficial sediments. The study area was in Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and chemical analysis. Receiving and outfall waters collected using auto-samplers, which were triggered at each location during two different seasons. The samples were analyzed for a variety of metals, PAHs, and PCBs, as a function of particle size. Sediment traps and sediment cores were also collected from the Creek and subjected to bulk chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively, and were analyzed using ICP-MS and MERX-T. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressurized Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and PCBs on GC/MS. Results showed that storm-events were dominated by coarse particles initially most likely to lead to sediment recontamination in the near field of the receiving, U (e.g., PAH, and Cd). Cu was associated to the dissolved and clay fraction, however the depositing loads were more influenced by resuspension and redistribution of sediment than stormwater. Data suggested that PAHs and PCBs, due to low bioavailability as determined with passive sampling and bioaccumulation testing, are not a strong contributor to sediment toxicity which appeared to be better correlated to the presence of metals. This observation indicated that the size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relating the stormwater discharges to sediment recontamination. The particle associations in stormwater along with spatial distribution particularly in sediment traps, and less in the sediment cores, can identify contributing locations, effective remedial approaches, and help to propose best practices for stormwater and sediment management.

WE424
Development of active capping materials for oil spill contaminated sediment remediation L. Leija, Norwegian Geotechnical Institute; P. di palma, IRSAACN; C. Riccardi, INAIL; E. Erek, s.e. hale, Norwegian Geotechnical Institute; p. viotti, Università La Sapienza; M.P. Papin, Università La Sapienza / Chemistry Petroleum is extensively used for making oil-based chemical and energy; its daily use
consume is on average 20 million tons and this is not predicted to decrease. The increasing use of the petroleum is inevitably connected to an increase in oil spills. Oil spills can occur for many reasons including human error or equipment failure and whenever an oil spill occurs it can represent a worldwide environmental problem. Effective remediation strategies are required. The aim of this study is to develop different sorbent materials for the active capping of oil spill contaminated sea-sediment. The experimental investigation was performed on an oil spill contaminated sea-sediment. Different sorbent materials were tested for the active capping: a commercial Activated Carbon (AC) Carbonatia, an organophilic clays (OC) CETCO Inc. and a biochar (BC). The sorption properties of the materials were first investigated in aqueous solution by performing equilibrium tests (isotherm) using a mixture of polycyclic aromatic hydrocarbons (PAHs) as target contaminants. The bioavailable concentration was assessed by using polyethylene (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 seawater (4 cm) on top. The capping efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, antrachene 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 simulator. Other sorbent materials were tested: bentonite, activated carbon, organoclay, and biochar. The survival of 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 studies are limited to bioavailability assessment, reducing the bioavailability of PCBs to the bent-nose clams (Macoma nasuta) in shallow intertidal sediments when aided by chemical mixing. This study assessed the effectiveness of AC placements without chemical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Test bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine how bioavailability can contribute to a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

WE425 PCB Tissue Concentrations and Benthic Community Impacts at a Carbon Amendment Pilot Study in the Intertidal and Subtidal Zones of San Francisco Bay
C.J. McCarthy, CH2M / Environmental Services; C.A. Irvine, RBL / Ecosystem Services; T. Himmer, CH2M; s. Clark, Pacific EcoRisk; R. Zajac, J. Eby, CH2M Historical site activities at the Hunters Point Naval Shipyard (HPNS) in South San Francisco Bay resulted in the release of chemicals, including polychlorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments alternatives were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PAC™ or Sediment™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Previous studies are limited to bioavailability assessment, reducing the bioavailability of PCBs to the bent-nose clams (Macoma nasuta) in shallow intertidal sediments when aided by chemical mixing. This study assessed the effectiveness of AC placements without chemical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Test bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine how bioavailability can contribute to a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

WE426 Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms
M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center
The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) on metal toxicity and bioavailability was assessed in an acid (A) and an alkaline (B) mine waste before and after incubation under different simulated field conditions (irrigation versus drying flooding periods). Metal (CaCl$_2$)-extractable fractions, survival and metal tissue concentrations in the earthworm Eisenia fetida exposed to bulk (mine wastes) were measured. Survival of E. fetida was recorded after 21 days of exposure to six serial dilutions of mine wastes mixed with uncontaminated Lufa 2.2 natural soil containing waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and internal tissue metal concentration in surviving earthworms were measured. No signs of toxicity and no significant effects on survival of the organisms were observed in alkaline mine waste B. In contrast, exposure at time 0 to untreated acid mine waste (A) caused a 71% of mortality. The addition of biochars decreased toxicity in mine waste A and Cd internal concentrations in surviving organisms, indicating a lower metal bioavailability. Over time, survival in the untreated acid mine waste increased and internal metal concentrations in organisms decreased. No significant differences observed among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl$_2$-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 biochars 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. Diez-Ortiz, Leitat Technological Center
The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailable fraction and risk of exposure. Survival of E. crypticus exposed to mine waste water solutions and bulk solutions in an in situ experiment and metal 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 (LC50) 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 CaCl$_2$-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 / Environmental Sciences; D. Schlenk, University of California-Riverside / Environmental Sciences; J. Wang, University of California Riverside / Environmental Sciences; A.R. Taylor, University of California Riverside / Environmental Sciences
Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, antrachene 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 simulator. Other sorbent materials were tested: bentonite, activated carbon, organoclay, and biochar. The survival of 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 studies are limited to bioavailability assessment, reducing the bioavailability of PCBs to the bent-nose clams (Macoma nasuta) in shallow intertidal sediments when aided by chemical mixing. This study assessed the effectiveness of AC placements without chemical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Test bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine how bioavailability can contribute to a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

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 / D. Schlenk, University of California-Riverside / Environ. Sciences; J. Wang, University of California Riverside / Department of Environmental Sciences; A.R. Taylor, University of California Riverside / Department of Environmental Sciences
Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical 

419 SETAC Europe 28th Annual Meeting Abstract Book
High performance biochar synthesized via co-

University of Ulsan / Department of Civil and Environmental Engineering

biochar: Effect of pH, hydrophobicity, and deprotonation

(NRF

infiltration of remediation reagents increased the contact with contaminants, be a good media to spr

peroxide was used for pretreatment of Diesel prior to bioaugmentation. All oxidants

chemical

Fuel oils are a complex mixture of hydrocarbons. Low

serial surfactant foam spraying

WE430

fertilization. This study quantified PAH deri

embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post

leachate extract samples at 6 hours post fertilization.

Danio rerio

study quantified PAH derivatives after SEE, and it will identify implications for risk assessment and developmental toxicity outcomes.

WE430

Enhanced total petroleum hydrocarbon removal without soil disturbance by serial surfactant foam spraying

R. Bajagain, Y. Park, Kunsan National University; S. Jeong, Kunsan National University / Department of Environmental Engineering

Fuel oils are a complex mixture of hydrocarbons. Low

WE430

field work with dehalogenated zebrafish (Danio rerio) embryos

(equilibrated for 7 days prior to uptake). To determine if the biochar was beneficial in the remediation of soil and thus, climate change mitigation. Its application to

agricultural soils has been shown to increase soil fertility, mainly due to improved carbon sequestration and thus, climate change mitigation. Its application to

sbse 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 in this study to investigate the potential for bioaugmentation. All oxidants were applied to the soil surface 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 biodigestion 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 effective infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodigestion. Fractional analysis of TPH showed C18-C22 present in diesel as biodigestion recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodigestion alone only reduced the recalcitrant fraction by 25%. (This work was supported by National Research Foundation of Korea (NRF-2015R1D1A1A01059664)).

WE431

Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and deprotonation

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 donar-acceptor interactions. Removal of polymer residues and increasing aromaticity of polymer/RS-derived biochar at elevated pyrolysis temperatures affected the sorption capacity of halogenated phenols. Surface charge of biochar and deprotonation of the halogenated phenols affected the sorption. The 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 upgrading biochar as a sorbent for various types of contaminants.
adoption capacity the material was 40% in nature, reaching a value of 78.4% after modification, demonstrating the feasibility of the process and material.

WE434 Field sampling and ex-situ bioassays for assessing the ecotoxicological risk of trace elements in different rehabilitated bauxite residues

E. Di Carlo, R. Courtney, University of Limerick / Department of Biological Sciences & The Bernal Institute; A. Boulemtou, RíoTinto; L. Pozar, Alteo-Alumina

Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. They could pose an environmental risk mainly because of their alkaline nature and the presence of trace elements (TE). For their rehabilitation and phytostabilization purposes, it 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 TE concentrations measured in the extracts of 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 risk 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.

Ecotoxicology of micro and nanoplastics: Mechanistic approaches to understand their risk for the environment and human health (P)

TH001 Synthetic textile fibers end up in agricultural soils - Can these microplastics pose a threat on soil organisms?

S. Song, University of Helsinki / Department of Ecological Sciences; C. Gesteil, Vrije Universiteit Amsterdam / Ecological Science

An important route of microplastics (MPs) to the environment is the release of synthetic textile fibers to waste water due to laundry. The major part of the fibers is retained in the sewage sludge during waste water treatment and ends up in green spaces and agricultural fields. In this study, we explored the accumulation and effects of polyester polymers in soil using two exposure concentrations of 0.02 %, 0.06 %, 0.17 %, 0.5 % and 1.5 % of PES fibers in dry Lufa 2.2 soil. The fibers were mixed in with the soil to achieve an homogeneous 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 andrei. Some of the measured endpoints seemed to show a negative response to the fibers, but the variation within the treatments was high, possibly also because it was difficult to achieve a completely homogenous distribution of the fibers in the test soil. The results of this study indicate that synthetic textile fibers can have slight negative effects on soil-dwelling enchytraeid worms, whilst arthropods were not markedly affected by the fibers. However, not only enchytraeid worms (E. crypticus), but also isopods (P. scaber) and the oribatid mite (O. nitens) were negatively affected by the incubation. The measured endpoints of accumulation 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

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Nowadays, the ecological impact of microplastics is not well understood [1]. Here, we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. PCC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and its potential degradation products of a MiliMol batch by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). Then, we have evaluated the biological effects of PHB on cellular growth, pigment content and several physiological parameters (metabolic activity, formation of intracellular reactive oxygen species and cytoplasmic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoparticles. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilliQ finding a wide range (75 - 300 nm) of PHB nanoparticles. PHB induced a decrease in cellular growth and chlorophyll content in both photosynthetic organisms. Furthermore, PHB induced an increase in the level of intracellular reactive oxygen species and induced changes in membrane potential. In conclusion, microplastic particles of PHB exhibited toxicity towards photosynthetic organisms and their effects in release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation. [1] Koelmans AA, Besseling E, Shim WJ. 2015. Nanoplastics in the aquatic environment. Critical review. In Marine anthropogenic litter (pp. 325-340). Springer International Publishing. Acknowledgement - This research was supported by CTM2016-74927-C2-2-R grant from MINECO/FEDER EU.

TH003 Differential responses of biomarkers in tissues of the blue mussel Mytilus edulis exposed to microplastics at environmentally relevant concentrations

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Since the early 1970s, the occurrence of floating plastic has been reported in marine waters with great accumulation in gyres. In recent years, the presence of plastic debris < 5mm called microplastics (MPs) which result mainly from macroplastic’s fragmentation has also been reported in aquatic ecosystems even in remote areas. Scientists have reported the presence of MPs and their effects in release of organisms. However, it appears necessary to investigate their potential toxicity especially at environmentally relevant concentrations. The aim of our study was to evaluate the bioaccumulation and toxicity of polypropylene (PP) and polyethylene (PE) fragments towards the blue mussel Mytilus edulis. These polymers were selected according to a previous study conducted in situ in the Region Pays de la Loire. Mussels 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 (GSTM), Catalase (CAT) and superoxide dismutase (SOD) were evaluated, as well as assessment of immune system and DNA damage. Results showed the presence of PE and PP particles in digestive glands of mussels exposed to the highest concentration tested (100 µg/L) of MPs, and in biodeposits where MPs were observed at all tested concentrations. Significant increases in SOD and CAT activities were observed in the digestive glands of mussel’s exposed to 0.008 and 10 µg/L and in gills from mussels exposed to 100 µg/L of MPs that could be indicative of an oxidative stress. This study brings new results on the potential sublethal effects of MPs at environmentally relevant concentrations of MPs.
Due to the constant increase of plastic use and production, microplastics (MPs) have become a contaminant of serious concern for the marine environment. However, detailed information about biological pathways affected by the exposure to different MP polymers is still lacking, in particular at transcriptome level. The present study focused on the identification of the molecular pathways affected by a chronic exposure of zebrafish (Danio rerio) to different concentrations of a combination of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing to elucidate the transcriptional impact of MPs in the zebrafish model organism. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

TH005 Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palaeomon varians
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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 size of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaeomon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescent microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the supernatant tissue extract of the midgut gland. Degradation of 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 reacts first, the activity of catalase was clearly lower. It can be assumed that any particles < 170 nm enter the cells of the midgut gland and induce oxidative stress. Following optical detection of reactive oxygen species (ROS) via confocal laser scanning microscopy will help to identify cellular reactions after exposure to microparticles.

TH006 Microplastics in the sub-surface layers of the South Atlantic Ocean
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Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the ocean surface when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and tend to concentrate on the ocean surface when examining microplastic pollution. Microplastics are therefore recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and 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 dump plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition ad irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in juvenile Solea senegalensis, using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (< 200 µm and 300-500 µm) and two concentrations of each (562 and 14 µg/g diet) and two concentrations of each (562 and 14 µg/g diet) and two concentrations of each (562 and 14 µg/g diet). Fish were reared in flow-through seawater tanks. The exposure period was 28 days. Fish were starved for 24 hours before each treatment and excised. The liver and stomach of zebrafish were pooled and homogenized. The liver and stomach of zebrafish were pooled and homogenized.

TH007 Effects of dietary microplastic exposure on fish intestinal physiology
G. Asmonaite, H. Sundh, N. Asker, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences
The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route for plastic debris for a wide range 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 intestinal tract are largely unknown. To address this, we designed a study aimed at assessing if ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MPs cause inflammatory responses and disturb intestinal barrier and transporting functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS MPs/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MPs) and diets containing untreated PS particles (PS-virgin) or particles exposed and treated with (PS-activated) as a reference for natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaeomon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescent microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the supernatant tissue extract of the midgut gland. Degradation of 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 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.

TH008 Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile Solea senegalensis
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Microplastics (MPs) have dramatically increased in marine environments, being recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and intentionally manufactured MPs and the secondary MPs which result from the fragmentation of dump plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition ad irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in juvenile Solea senegalensis, using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (< 200 µm and 300-500 µm) and two concentrations of each (562 and 565 MPs per day) and other without MPs (control), making a total of five diets: control (no PS MPs) and diets containing untreated PS particles (PS-virgin) or particles exposed and treated with (PS-activated) as a reference for natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaeomon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescent microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the supernatant tissue extract of the midgut gland. Degradation of 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 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.

TH009 Nanoplastic impacts on physical, biochemical, and nutritional characteristics
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of pacific whiteleg shrimp

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Because of enormous amounts of plastic wastes in marine environment, the concerns about marine pollution and ecological damages on marine organisms have increased. Especially, among these plastic wastes, the polymeric particle size depending on microplastics (<5 mm in diameter) and nanoplastics (<100 nm) are getting a lot of attention due to the unique physical 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 shrimps (Litopenaeus vannamei) exposed to nanoparticles. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with nanoparticles (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, nanoparticles 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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Nanoplastic debris is ubiquitously distributed in aquatic environments and are considered an emerging environmental issue for 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 nanoparticle (PSNP). A sub-lethal concentration of 5 mg L\(^{-1}\) fluorescent PSNPs (25 nm) was used to monitor accumulation in adult animals as well as their embryos in the open brood pouch. A time series throughout embryonic development within the brood pouch revealed accumulation of PSNP in lipophilic cells in the early stages of embryonic development while the embryo is still surrounded by a chorion and before beginning of organogenesis. In contrast, PSNP particles were neither detected in the gut epithelium nor in lipid droplets in adults. An \(ex\) vivopex of embryonic PSNP influx was monitored to show similar intensity of accumulation in the first stages of embryogenesis, illustrating the likelihood of brood pouch-mediated PSNP uptake by embryos. Whether the observed brood pouch-mediated PSNP uptake ultimately translates to long-term effects under chronic exposure to environmentally relevant concentrations remains a challenging area for further research. By demonstrating embryo PSNP uptake via the brood pouch, data presented here give novel insights in bioaccumulation of nanoparticles and likely other lipophilic contaminants. Since this uptake route can occur within a diverse array of aquatic organisms, this study warrants consideration of brood pouch-mediated accumulation in efforts studying the hazards and risks of nanoparticle contamination.

TH101

Micro- and nanoplastic ingestion in blue mussel larvae

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A large number of aquatic species have been found to ingest microplastics in the field and in laboratory studies. Benthic invertebrates seem to be especially exposed to this form of pollution and the blue mussel Mytilus edulis is one of the species that has been investigated most in this respect. Studies have not only shown that the mussels ingest microplastics but have also reported diverse adverse effects on a cellular to a physiological level. However, the work has so far only focused on adult mussels and it is unclear how blue mussel larvae interact with and are affected by plastics. The present study was motivated by a recent study on nanoplastic uptake by mussel larvae, 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.

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 mussel Mytilus galloprovincialis. To do so, we employed a multibiomarker approach encompassing immunological responses (lysozyme and phagocytosis), lysosomal endpoints (lysosomal membrane stability and neutral lipids), oxidative stress (catalase activity, malondialdehyde and lipofuscin content) and detoxification (glutathione S-transferase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is a known general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP; however, only in MP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by both MP or NP treatments. In general, the NP treatments showed lower immune system efficiency. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 150 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was noted only at 15 ng/L NP. Biomarker data were integrated in the Mussel Expert System (MES), which estimates the stress level induced on mussels by calculating a \(A\) E scaled health status index (HSI). The MES did not identify health alterations in control and at 1.5 ng/L NP (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 treatments was highest at 15 ng/L NP (HSI = B) and low at 150 ng/L MP. 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 cationic amino (PS-NH\(_2\)) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses

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The accumulation of plastic litter on beaches and open oceans has been identified as one of the major threats in marine ecosystems worldwide. Laboratory experiments have proved that the formation of nano-sized plastics during the polymer degradation may reach marine ecosystem, considered as the most in danger. In present study, the effect of 50 nm cationic amino polystyrene (PS-NH\(_2\)) 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 by means of both sub-lethals suspensions of PS-NH\(_2\) (0.1, 1 and 10 µg/mL) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carboxylesterase (CbE), glutathione S-transferase (GST), superoxide dismutase, SOD; heat shock protein (HSP70), lipid peroxidation (LP) and catalase (CAT), involved in important physiological processes, such as biotransformation of xenobiotics, neuronal transmission and oxidative stress. The effects of PS-NH\(_2\) (0.1 and 1 µg/mL) on the expression of genes related to metabolism, biosynthesis and embryogenesis during the development of brine shrimp was also investigated. Gene expression of HSP26, HSP70, mitochondrial uncoupling protein 2 (UCP2), chaperon-containing TCP (TCP) and late embryogenesis abundant (LEA) were measured. Acute exposure to sub-lethal suspensions PS-NH\(_2\) caused a significant decrease in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for LP. A significant up-regulation of HSP26 and HSP70 was observed in nauplii exposed to 1 µg/mL of PS-NH\(_2\) as well as the modulation of TCP, the latter not significant. This supports the results obtained from biomarkers, suggesting a stress response and 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 excretion, this study contributes to enhancing the mechanistic understanding of microplastic – blue mussel interaction.
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.

**TH011 The impact of nano-particles 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 nano-particles (< 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 (NS, 34‰, 2°C) was also investigated by Dynamic Light Scattering. PS-COOH formed nanoscale aggregates (average size of 862 nm) in Antarctic NS, 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 β-gal gene induction in new feeding experiments. Similary in cultured Giardia microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to control. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FP properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

**TH015 Exposure to nano-polystyrenes as a potential stressor on Mytilus galloprovincialis**

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Physical and chemical properties of marine microplastics in the environment is a worldwide problem, especially since plastic materials degrade into nano-size particles, becoming more bioavailable and constituting a source of entry of other contaminants into marine organisms. The present study aimed to assess the effects of polystyrene nanoparticles (PSNP) and clarify their modulation of short-term carbozepine (cbz) toxicity on bivalve Mytilus galloprovincialis. Muscles were exposed for 96h to different concentrations of CBZ (0-300 µM), separately and in combination with a mixture of CBZ and nanoparticle (NP), 300 µm. Chemical body burden was measured after 21 days to one concentration of EE2 (10^-8 M) and a low and a high concentration of PA-particles (1 and 100 mg L⁻¹) separately and in combination with each other. Stress hormones and larval development as well as sexual differentiation were assessed by gross-morphology and histology. Biomarkers, e.g. vitellogenin, were analysed as EE2 specific endpoints. The concentration of EE2 in water was assessed analytically for treatment of EE2. Physiological effects of the microplastic particles themselves on larval development and sexual differentiation were not observed. Only increased levels of the hepatic biomarker vitellogenin showed higher exposure of EE2 in treatments including PA particles in comparison to treatments without microplastics. All other EE2 specific endpoints were not influenced by PA particles. These results indicate that microplastics only play a minor role for the effects of a hormonal active chemical in amphipods and thus provide insights for a deep risk assessment of MP in the environment.

**TH018 Kinetics of POPs sorption and plastic additives release to a variety of polymers under realistic conditions**

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The PLASTOX project investigated the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. PLASTOX combines field-based observations, laboratory tests and manipulative field experiments to study the ecological effects of MPs. The use of common microplastic reference materials, including a marine litter-derived MP produced from an environmentally weathered fish box, allows a meaningful comparison of data generated by different partners and across the different activities of PLASTOX. As part of a long-term field experiment conducted at marine locations across Europe (Mediterranean to
Arctic). a range of different virgin polymer pellets (LDPE, PP, PS and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SPMD 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 18 months after deployment. Hydrobiotic persistent organic pollutants such as PCBs, PCDDs, PBDEs and PAHs were separated and identified to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrasonic and nonpolar solvents, followed by GPC and SPE clean up. Chemical analyses using GC/MS/MS and GCxGC/MS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common phthalates, bisphenol-A, organochlorine pesticides, bisphenol-A and fluorinated chemicals were estimated from other four post-industrial virgin pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-MS/TOF.

TH019 Characterization of microplastics present in personal care products and evaluation of their toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis. G. Albenzí, 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 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 chlorified. The particles were identified by Fourier transform-infrared spectroscopy (FT-IR) and abscence spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity test. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12h light/12h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ±0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5–80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l, microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (aceton). In these assays no mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers of acute exposure. In this study, cholinesterase, and their activity were measured in brain tissue. 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 PE contaminated particles showed similar pattern with the non-plastic particles, while PE contaminated particles showed increased in brain. AChE activity and a general increase in median activity of AChE. This was in agreement with the results obtained in previous studies using different chemical contaminants such as chlorpyrifos. Additionally, mRNA levels of established biomarkers (CYP1a, ERα, α and β, AR, MT, VTG) were quantified to provide additional insights into xenobiotic-related hepatic responses to dietary PS MPs exposures. The findings of this study revealed an indication of NFR2-mediated oxidative stress regulation.

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. Asmaone, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; V. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences.

Plastic pollution is a recognized global issue and the ubiquity of microplastics (MPs) in aquatic environment is a cause for concern. Potential effects on organisms are still not fully understood, and mechanistic understanding, required to fully reveal consequences of exposure, especially in connection to chemical mixtures, is still lacking. Studies have shown that MPs have capacity to sorb and concentrate hydrophobic organic chemicals (HOCs) in the aquatic environment. There is an ongoing debate about MPs as vectors for chemical contaminants and their relative importance compared to other naturally occurring particulates. The goal of present study was to quantify particle-mediated chemical transfer and using biomarker approach examine associated biological effects in three spined stickleback (G. aculeatus). A range of different virgin polymers pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-MS/TOF. In this study, juvenile rainbow trout (Oncorhynchus mykiss) were exposed 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 three different genes: CYP1a, CYP1b and CYP1c were quantified at mRNA level in the liver and gut. Acetylcholinesterase (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 increased in brain. AChE activity and a general increase in median activity of AChE. This was in agreement with the results obtained in previous studies using different chemical contaminants such as chlorpyrifos.
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 lower 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 Nanoplastyrene and the Co-Contaminant Tributyltin on the Nemalote Community Structure in Sandy Sediments A. Catarino, A. Homer, Heriot Watt University / ILES; L. Duran Saja, Heriot Watt University / CBI; E. Navarro, University of the Basque Country / EPS; M. AL SID CHEIKH, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Navarro, University of the Basque country UPV/EHU; A. Orbea, 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. Due to their hydrophobicity and relatively large surface area, microplastics (MPs) may 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 oxygen demand (BOD) and chemical oxygen demand (COD) and on bacterial communities (represented by diversity and structure indices) and meiofauna communities (represented by nematode communities). The main finding was that MPs and co-contaminants (TBT, tributyltin) interact with each other and influence the composition and structure of meiofauna communities. The results presented in this study will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

TH024 Nanoplastyrene Induces a Decrease in the Oxygen Uptake of Zebrafish Larvae and Enables Sorbed Benzo[a]Pyrene Bioavailability A. Catarino, Heriot-Watt University / ILES; M. Clement, Polytexe Nice Sophia; M. Tait, Heriot Watt University; D. Boyle, Plymouth University; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society. Microplastics (MPs, 5 mm–1 µm) and nanoplastics (NPs, ≤ 1 µm) can result from larger plastic debris released in the environment and can pose a risk to marine organisms and ecosystems. The risk of NPs can be exacerbated because toxicants sorbed to NPs may be transported to and become more bioavailable in organisms. It is likely that NPs are the most abundant plastic particles present in marine environments, and as in the case of microplastics, they are expected to accumulate in benthic ecosystems. However, there is no information on the impact of NPs on benthic meiofauna assemblages. It is critical to understand impacts of NPs on sediments of NPs because meiofauna communities play key roles on ecosystem functions such as food production and nutrient cycling. Nematodes are well established as pollution indicators and structural shifts in their communities reflect environmental changes. The goal of our work was to assess the effects of nanoplastyrene (nPS) and nPS with the sorbed co-contaminant Tributyltin (TBT) on free living nematodes on sandy sediment within a mesocosm experiment. Sediment was collected (up to 5 cm depth) at the Eden Estuary, St Andrews, Scotland, UK. The mesocosms (12°C) consisted of glass beakers (1 L) and the exposure took place for up to 2 months. Core samples of sediments were taken at each of the following: 1) Control sediment, 2) Sediment with spiked TBT (0-100 ng/kg), 3) Sediment with nPS (0-12 ng/kg) and 4) Sediment with nPS spiked with TBT (0-10 ng/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 TBT concentrations in the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

TH025 Impacts of exposure to microplastics alone and with adsorbed benzo[a]pyrene on biomarkers and scope for growth in marine mussels M. galloprovincialis J. Hatfield, N. González-Soto, University of the Basque country UPV/EHU; A. Katsumi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Navarro, University of the Basque country UPV/EHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE. Nanoplasti...
supernatant by SPME/GC/MS. To measure BaP adsorbed to the plastics (A-BaP), plastic solutions were freeze-dried and subjected to microwave-assisted extraction before GC/MS analysis. The ad/sorption capacity of the plastics was calculated in mass of adsorbed BaP per gram of plastic (μg/g) for different sizes of plastic in order to determine the capacity of ad/sorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that the sorption capacity of A-BaP was higher compared to ad/sorption capacity of BaP than 4.5 μm MPs. The percentages of adsorbed A-BaP from the total BaP solution were 90.88% and 37.18% with a Qmax of 217.39 μg/g and 18.33 μg/g (Langmuir model; R²: 0.9862; 0.9477) for 0.5 μm and 4.5 μm MPs, respectively. In both cases the applied methodology was successful to characterise the adsorption process of BaP to MPs and is currently being applied to NPs. * Funded by French ANR (NANTEX-03-12 and Cluster Excellence COTE (ANR-10-LABX 45), Spanish MINECO (NACE project — CTM2016-8130-R), Basque Government (consolidated research group IT509-13) and UPV/EHU (UI 11/37 and grant to IMA).

TH027 Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord
A. van Oyen, ECOLAB UMR2545 CNRS UPS INPT; C. G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Politecnico University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences
The exponential production and use of plastics has generated millions of tons of plastic waste over the past decades, and the presence of microplastics has been reported throughout the world’s oceans. The ingestion of microplastics in situ has been shown in various species, but important knowledge gaps remain, as most studies focus on pelagic fish species or bivalves used for human consumption. Here, we report the presence of microplastics in ten sediment-dwelling and epibenthic species representative of different feeding modes and trophic levels. The species analyzed include fish, bivalves, echinoderms, crustaceans and polychaetes. Organisms were sampled in the inner Oslofjord (Oslo, Norway), which is a fjord subject to strong anthropogenic pressures. High occurrence of plastic contamination was observed, with microplastic particles found in all species and in half of the individuals on average, and present in 75% of the individuals for some species. The extracted microplastics had various shapes (fibers, fragments, flakes), colors and sizes. Micro-FT-IR analysis revealed the presence of various plastic polymers: polystyrene, polypropylene and polyamide were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishery activities are the main source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polyster, polycrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

TH028 Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment
Accumulation of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aquatic environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3 ), fluorene (log Kow = 4.46) and fluoranthene (log Kow = 5.16). The plastic samples tested here are LDPE pellets with low amount of additives. LDPE pellets were previously characterised by CARAT GmbH (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 bath was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

TH029 Comparison of spiking and dialysis tubing methods for the determination of sorption capacity and plastic-water partition coefficient of three different polycyclic aromatic hydrocarbons on microplastics
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: polystyrene, polypropylene and polyamide were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishery activities are the main source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polyster, polycrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

TH030 Microplastics in food and beverages - a distorted perspective on risk
S. Rieg, DTU (Technical University of Denmark) / Department of Environmental Engineering; B.C. Alnroth, University of Gothenburg / Department of Biological and Environmental Sciences; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; T.M. Karlsson, University of Gothenburg
Microplastics are ubiquitous in aquatic environments and they are ingested by a wide range of animals, including species for human consumption, i.e. bivalves and fish. Additionally, plastic particles have been reported in other food products and beverages, like honey, salt, beer and drinking water. This has triggered a discussion on the health impacts of plastic usage and consequential exposure to plastic materials in our everyday lives. The focus and extent of this debate, however, stands in contrast with scientific findings, which have gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which have gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which have gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which have gained increasing attention in the scientific and public debate in recent years.
Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

L. Winberg von Friesen, University of Gothenburg, Sweden / Marine Sciences; M. Hassellöv, University of Gothenburg / Department of Marine Sciences; G.W. Gabrielsen, H. Hop, Norwegian Polar Institute; T. Brown, Scottish Association for Marine Science; M.E. Granberg, IVL-Swedish Environmental Research Institute / Research (SFI)

Where is all the plastic, and what concentration of microplastics are ecosystems being exposed to? These are puzzling questions to the scientific community when comparing estimated values on annual plastic pollution with the actual measurements in the world’s oceanic habitats. Recent investigations find plastic far away from any known sources, such as in deep ocean sediments and buried within polar sea ice. The Arctic Ocean has, despite its remoteness, been suggested as a sink for plastic. Fed by the thermohaline circulation driven deep-water formation, the Arctic Ocean’s bottom might be a dead end for plastics. However, very few studies have quantified the actual environmental concentrations of plastics in this remote area, thus the exposure to organisms living in this environment and potential effects are unknown. In this study, we investigated the occurrence, potential sources and distribution of microplastics in the Norwegian Arctic. We quantified and characterized anthropogenic particles >10µm in different environmental compartments (sediment, water, benthic invertebrates and sea ice) around the western and northern coasts of Svalbard. Samples were collected close to a sewage outlet and far from human activities close to the sea ice front in the Arctic Ocean. By sampling at different locations and times associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and sewage (coprostanol) enabled correlations to be made on potential sources, pathways and fate of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a system already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

Microplastics – an ecotoxicological issue? How to balance facts and perception without marginalizing an environmental problem

C. Völkel, ISOE – Institute for Social-Ecological Research / Water infrastructure and risk analyses; J. Kramm, ISOE – Institute for Social-Ecological Research While plastic has been known 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 caused a hype – and a lot of misunderstanding. One of the main reasons is the variety of microplastics, which has been exposed to the public by certain in vitro studies that suggest to be released within the organism, and their potential to cause harm. This is not covered in this scientific discussion, and the public perception of microplastics is driven by what has been released. The risk assessment and the regulation of microplastics are facing a lot of criticism, and the regulatory framework is often not adapted to this challenge.

Addressing species diversity in biotransformation: variability in expressed transscripts 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 fish liver transcript data for 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


Organophosphate flame retardants (PFRs), as widely used alternatives of bromine flame retardants, are present in a wide array of consumer and technical products in aquatic environments. Considering the adverse effects of PFRs, many researchers have paid their attention on the absorption, bioaccumulation, metabolism and internal exposure processes of PFRR in wildlife and human. PFRRs can be rapidly metabolized in the body. The general metabolic pathway of PFRRs revealed by certain in vitro studies includes dealkylation, hydroxylation, carboxylation, oxidative dehalogenation and phase II conjugation, resulting in a wide array of metabolites. De-alkyl phosphates (DAPs) from the dealkylation metabolism were recently identified important biomarkers in human biomonitoring studies. As very limited information is available on DAP metabolites in environmental biotic samples, we first investigated...
the accumulation and tissue distribution of eight common OPs and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs were relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of DAPs and DAPs than the other tissues of fish. It suggested the extensive metabolism of DAPs in wild animal studies. In the subsequent laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of *Gobiobryopsis rara*. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-QTOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, deamination, 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-TNBPE 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, this study emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

**TH036**

Bioaccumulation and biotransformation of prochloraz in the aquatic invertebrate *Hyalella azteca*

D. Fedrizzi, Eawag - Swiss Federal Institute of Aquatic Science and Technology; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology; G. Zeller, Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; N. Cederberg, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry

Prochloraz is a widely applied fungicide for pest management purposes. Due to spray drift and surface runoff, prochloraz enters the aquatic environment where it can cause adverse effects on non-target organisms. Prochloraz has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of cultivation and its sensitivity to xenobiotics. Biotransformation is a primary detoxification process through which organisms defend themselves from xenobiotics. Biotransformation can reduce the internal concentration of parent compounds but influence 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 L kg⁻¹. Finally, the data will be modeled using a toxicokinetic model, influencing the bioaccumulation and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH037**

Toxicokinetics and metabolite identification of two emerging pollutants, Acesulfame-K and 4-MBC, in the manila clam *Ruditapes philippinarum*. N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Tonini, Alma Mater Studiorum - University of Bologna; P. Lara-Martin, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucia / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR - University of Cadiz

Marine ecosystems have been historically sinks for many pollutants and chemicals whose effects awoke social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and eventually discharged into marine ecosystems in unknown quantities and with no regulation. Due to the improvement of new analytical technologies, many of these chemicals, the so called "emerging pollutants" (EPs), are being currently identified and their occurrence is being reported in the environment. However, very little is known about the possible adverse effects of these emerging pollutants in exposed non-target organisms. In this context, the present work evaluates the toxicokinetics (TK) of two EPs (the UV filter 4-Methylbenzylidenecamphor (4-MBC) and the artificial sweetener acesulfame K (ACE-K)) in the Manila clam *Ruditapes philippinarum*, focusing on determining the bioconcentration factors (BCF) and identifying and quantifying the metabolites produced by *R. philippinarum*. Adult clams were exposed to 7 days of exposure and 3 days of depuration, target compounds were extracted from both water phase and organisms and their concentrations were measured by liquid and gas chromatography coupled to tandem mass spectrometry (UPLC/GC-MS/MS). Additionally high resolution mass spectrometry (HRMS) and automated data analysis software (Metabolynx™) were used to identify possible TPs in the tissue of the Manila clam at different nominal concentrations (1 to 100 μg L⁻¹). For the UV filter, the estimated BCFs were between 61 553 and 539 13 L Kg⁻¹, and several metabolites were identified, such as the reduction or hydroxylation of the compound. On the other hand, the artificial sweetener BCF was consistently lower, around 7 L Kg⁻¹ and no metabolites were identified. These results suggest that 4-MBC was highly bioaccumulated and metabolized to facilitate its excretion and they are directly related to the physicochemical properties of the target EPs, since ACE-K is highly soluble in water (log Kₔ, 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log Kₔ, 5.92). Additionally, the present study provides important information about the toxicokinetics of 4-MBC and ACE-K, which could be useful for understanding the mechanism of action of these compounds. Furthermore, this work demonstrates the potential of the UPLC-GC/HRMS approach using Metabolynx™ software for fast and accurate identification of metabolites of EPs.

**TH038**

Organophosphate Esters, Including Alkyl-Substituted Triphenyl Phosphates, in East Greenland Polar Bears and Ringed Seals: Adipose Tissue Concentrations and In Vitro Deposition and Metabolite Formation A. Strobel, Carleton University; W.G. Willmore, Carleton University / Biology department; C. Sonne, R. Dietz, Aarhus University / Department of Biosciences, Arctic Research Centre; R. J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Branch

In East Greenland, a contamination “hot spot” for long-range transported anthropogenic chemicals, including organophosphate esters (OPEs). High concentrations of OPEs have been reported in Arctic air (particles) while very little is known for wildlife although recent reports for Hudson Bay polar bears (*Ursus maritimus*) indicate that OPE residue levels in fat tissues are very low or non-detectable and appear to be strongly influenced by biotransformation. In the present study, the hepatic in vitro metabolism of six environmentally relevant organophosphate (OP) triesters and corresponding OP triester formation were investigated in East Greenland (Scoresby Sound region) polar bears (PBs) and ringed seals (RSs; *Pusa hispida*). The in vitro OP triester metabolism assay results were compared to fat (adipose) levels of selected OP triesters in field samples from the same individual animals. In vitro OP triester metabolism was generally rapid and structure-dependent, whereas PBs metabolized OPEs more rapidly than RSs. Exceptions were the lack of triethyl phosphate metabolism and slow metabolism of tris (2-ethylhexyl) phosphate in both species. OP diester metabolites were also formed with the exception of triphenyl phosphate (TPHP) which was not metabolized in PBs and RSs. The resulting OP diesters were introduced to their corresponding diester. However, the mass balances showed that OP diester formation corresponding to tris (2-ethylhexyl) phosphate, tri (n-butyl) phosphate, and tris (2-butoxyethyl) phosphate did not account for 100% of the OP triester depletion, which indicated alternate pathways of OP triester metabolism. TPHP was completely converted to its OP diester metabolite in PBs but not in RSs suggesting species-specific differences. Alkyl-substituted TPHP analogs also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

**TH039**

Proteomics of a metabolic simulation system - a look inside rat S9 A. Schiwy, EWOMIS; B. Thalmann, RWTH Aachen University, Institute for Environmental Research / Bio5 - ESA; P. Huesgen, Forschungszentrum Jülich GmbH / Central Institute for Engineering, Electronics and Analytics (ZEA); S. Schiwy, Institute of Environmental Research/RWTH Aachen / Department of Ecosystem Analysis; H. F. Hulet, RWTH Aachen University / Institute for Environmental Research

The liver is the key organ in metabolism and detoxification of xenobiotics. Simulation of this organ in various bioassays is achieved via the application of either single cytochrome P450 enzymes produced via biotechnological processes or complex enzyme mixtures obtained from animals. Especially, this second process is used when the hepatic metabolism of xenobiotics is known for wildlife although recent reports for Hudson Bay polar bears (*U. maritimus*) indicate that OPE residue levels in fat tissues are very low or non-detectable and appear to be strongly influenced by biotransformation. In the present study, the hepatic in vitro metabolism of six environmentally relevant organophosphate (OP) triesters and corresponding OP diester formation were investigated in East Greenland (Scoresby Sound region) polar bears (PBs) and ringed seals (RSs; *Pusa hispida*). The in vitro OP triester metabolism assay results were compared to fat (adipose) levels of selected OP triesters in field samples from the same individual animals. In vitro OP triester metabolism was generally rapid and structure-dependent, whereas PBs metabolized OPEs more rapidly than RSs. Exceptions were the lack of triethyl phosphate metabolism and slow metabolism of tris (2-ethylhexyl) phosphate in both species. OP diester metabolites were also formed with the exception of triphenyl phosphate (TPHP) which was not metabolized in PBs and RSs. The resulting OP diesters were introduced to their corresponding diester. However, the mass balances showed that OP diester formation corresponding to tris (2-ethylhexyl) phosphate, tri (n-butyl) phosphate, and tris (2-butoxyethyl) phosphate did not account for 100% of the OP triester depletion, which indicated alternate pathways of OP triester metabolism. TPHP was completely converted to its OP diester metabolite in PBs but not in RSs suggesting species-specific differences. Alkyl-substituted TPHP analogs also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

**TH040**

A critically evaluated database of in vitro and in vivo toxicokinetic data for...
mammals and fish
J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; A. Loory, 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 - Environment & Scarcroft; R.D. Scarcroft / Physical and Environmental Sciences; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHCP EURIL ECM; A. Lostia, European Commission Joint Research Centre; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit EURIL ECM

Toxicokinetics (TK) plays an important role in ecological and human health assessment. We have developed TK data from various models to support TK data to 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 (k₆) are key determinants and sources of uncertainty in bioaccumulation assessment. k₆ can be determined in vivo with whole animals or models 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 NRC CRC.F.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 strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate constants
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. Embry, ILSI / Environmental Sciences; K.A. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Sciences; C. Kropf, University of Bern / Centre for Fish an Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL / Swiss Federal Institute of Technology

Our research seeks to improve alternative methods to estimate bioaccumulation of organic chemicals in fish. We follow a tiered strategy that integrates toxicokinetic (TK) models, quantitative structure-activity relationships (QSARs), in vitro extractions and bioassays, in vivo gill and tissue residue determinations and in vitro-in vivo extrapolation methods. In the first step, we derived a list of candidate chemicals for in vitro testing based on model discrepancies, availability of reliable in vivo BCF and BMF data, and availability of in vitro biotransformation rates. The resulting chemicals were divided into three K₆ categories based on predominant exposure route(s) to guide in vitro testing: 1) log K₆ = <4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K₆ = 4-5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K₆ = >5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support are used to determine the combined biotransformation/permeation rate through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound). Permanently cell lines of gills, liver and intestine, exposed in monolayer, complement the use of in vitro methods applied, yielding parent compound loss rates as well. In vitro models are each applied under their respective optimal conditions, taking e.g., 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 model 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 validated by multiple sources of fish biotransformation. The 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 depletion assays using the two biological systems. Based on the successful results of this ring trial, two OECD test guidelines (TG) (“Determination of in vitro intrinsic clearance using cryopreserved rainbow trout hepatocytes” and “Determination of in vitro intrinsic clearance using rainbow trout liver S9 sub-cellular fractions”) have been drafted and are accompanied by a Guidance Document (GD). The OECD GD provides detailed information on how to conduct the tests as well as how to apply the measured in vitro biotransformation rates to predict bioconcentration factors (BCFs). In addition, guidance on development of the assay system (e.g., primary hepatocytes versus 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
J. Toose, ARC Arnot Research & Consulting; J.M. Armitage, University of Toronto - Environment & Scarcroft; R.D. Scarcroft / Physical and Environmental Science/Department of Pharmacology and Toxicology; N. Bramaz, Eawag / Environmental Sciences; K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); M. Embry, ILSI; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Chemicals are being assessed for bioaccumulation (B) potential in regulatory programs using various methods, metrics and criteria. B data can be obtained from various data streams including laboratory studies, field studies and model predictions using mass balance models and quantitative structure-activity relationships (QSARs). Examples of bioaccumulation metrics include: the bioconcentration factor (BCF), bioaccumulation factor (BAF), biomagnification factor (BMF), trophic magnification factor (TMF), and bioconcentration factor (BMF) data. In addition, guidance on development of the Bioaccumulation Assessment Tool (BAT) 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

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well as in silico data (e.g., BCF-QSARs) can be included in the QWQE. This presentation provides an overview of the BAT and demonstrates its application with two case studies. The first example is a typical “data poor” scenario in which only chemical structure information is available. From chemical structure relevant physical-chemical property and biotransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich scenario in which two different exposure scenarios (DE) exist (e.g., 3 lab BCs, various BCF-QSARs, biotransformation rate QSARs, in vitro biotransformation rates). Future work for improving the BAT is discussed.

TH044
Towards the use of elimination rates in bioaccumulation assessment – Current challenges and future advances
G. Treu, German Environment Agency / REACH Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; C. Rauter, Umweltbundesamt / International Chemicals Management

The capacity of chemicals to bioaccumulate in biota is recognized as critical property that contributes to a chemicals risk. The bioconcentration factor (BCF) reflecting the uptake of a chemical from water and the biomagnification factor (BMF) following dietary uptake in fish remain the preferred metrics in bioaccumulation assessment. The test systems are expensive, time consuming and are not suitable for screening purposes. Still, terrestrial bioaccumulation is hardly considered. A comprehensive bioaccumulation assessment should consider both, the aquatic and terrestrial organisms. Recently, it has been suggested that BCF and BMF can be derived by only determining the elimination rate constant (k2) experimentally while the uptake rate (k1) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to k2 is from in vitro experiments while the effect of the other pathways (excretion via urine and feces, and ventilation) are estimated with in vitro to vivo extrapolation models. Biotransformation often reduces the extent to which chemicals accumulate in fish and mammals. Thus, a Tier 1.5 can be introduced between Tier 1 (screening based on physico-chemical data) and Tier 2 (exposure studies with animals) where in vitro biotransformation rates (k2) obtained from in vitro tests with fish or mammalian cells are extrapolated to whole organisms and then incorporated into to existing chemical mass-balance models to predict a BCF or BMF. Only if this model indicates an increased bioaccumulation a potential a higher-tier vertebrate test is then needed. In practice, animal tests are mandatory for chemicals exceeding a certain level of hydrophobicity but may turn out as non bioaccumulative due to metabolisation. A k2 based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k2od different tissues, e.g. gills, liver and gastro intestinal tract, could be serve as alternative screening criterion under REACH. This tier 1.5 should at least experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionic substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the k2 based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH045
SETAC Bioaccumulation Science Interest Group
L.P. Burkhard, U.S. EPA / ORD/NHEERL/Mid-Continent Ecology Division

Advances in evaluating and regulating endocrine disruptors (P)

TH046
Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2016
K. Yamazaki, Ministry of the Environment / Environmental Health Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of chemical substances “EXTEND2016” in June 2016. It is developed upon achievements on development of framework, development and improvement of test protocols and implementation of testing and assessment in the preceding program “EXTEND2010”. While basic concepts and framework was inherited from EXTEND2010, EXTEND2016’s focus has been shifting to implementation of testing and assessment and consideration of appropriate risk management measures. During fiscal years 2016-17 progress has been made in development of test protocols, evaluation of existing knowledge, identification of candidate chemicals for testing, implementation of testing and assessment and communication to the public, as well as in international collaboratory projects with the United Kingdom and the United States. One of the most significant achievements should be finalization of the data obtained from the medaka extended one generation reproduction test (MEQGRT) for 4-nonylphenol, which are expected to be referred to in regulatory environmental risk assessment. The reproduction tests are being conducted for additional chemicals within the program. Updated progress in testing and assessment under EXTEND2016 will be presented at the Annual Meeting.

TH047
Effects of endocrine disruptors on reproductive health: A new approach to integrating ecotoxicological and human health data
L. Parent, Télé-université / UER Science et Technologie; P. Grigorova, Université TELUQ / Département Science et Technologie; M. Nikolaros, Université TELUQ / Science et Technologie

Exposure to synthetic and natural chemicals is almost inevitable in our daily lives. Some of them raise concerns with their endocrine disruptive potential and possible interference with endocrine system leading to the variety of adverse health effects. It was initially through clusters of presumptions that the potential effects of endocrine disruptors (EDs) on human health and the environment were highlighted. EDs, as a growing source of concern, now need to better document the complexity of the relationship between exposure and effects, hence the development of new evidence-based approaches to better document decision-making-in-health policy. Among these approaches, we retained the systematic reviews, based on objective methods, to integrate multiple sources of evidence (epidemiology, wild animals, laboratory animals, in vitro and in silico data) relevant to the evaluation. Our project aims to systematically review the data published the last 10 years linking the exposure to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, perfluorinated compounds) with the effects on the development and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development. 16 701 articles were screened and 744 met the inclusion criteria for the review. The data was extracted from 155 EU legal frameworks and 422 in silico data sources. 377 ecological studies and the ROB (risk of bias) analysis was performed for the relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and bioindicators for each of the EDs.

TH048
Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities
A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVM; Z. DANG, RIVM / LIEC CNRS UMR; S. van der LINDEN, JRC-EC

In the last decade, with the increased awareness of potential effect of endocrine disruptors (EDs) on wildlife, fish toxicity test guidelines have been developed by administrative bodies or scientific associations to develop screening methods for these chemicals. In the present poster, a comparison of the advantages and disadvantages of in vitro and in vivo experiments will be presented and a selection of the endpoints that are currently used for these tests will be discussed. The presented examples of fish toxicity data are based on 155 EU legal frameworks, these fish tests are required on the basis of the existing information case by case. Due to a difference in sensitivity of species and life stages, many EU discussions have focused on which test should be suitable. However, due to practical considerations, (e.g. regional preference, practical use, and specifically sensitivity,) it is unlikely to meet all of these requirements within one test. In order to avoid further additional testing, species selection should always consider these 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, 240 and guidance document (GD) 148. The number of fish used in each fish test, the covered lifestage, the investigated EDs-related endpoints, their robustness (and to which extent these have been validated) and the species sensitivity in response to chemicals with EAS modes of action will be compared. To this aim, publically available data on different fish species tested according to TGs or TG-like protocols will be collected and analyzed. Analysing these fish toxicity data will help identifying which fish test, which species, which life stage of test are needed for the identification and/or risk assessment of EDs. Based on the overall data analysis, we will propose an environmental testing strategy, which is important for minimizing vertebrate testing and costs.

TH049
Towards developing a list of reference chemicals for endocrine assay validation
C. Prosseg, ExxonMobil Biomedical Sciences, Inc.; M.R. 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 throughout the entire validation process. 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 set list of reference chemicals for the validation of endocrine assays.

TH050 Assessment of endocrine disrupting properties of pesticides and biocides: data processing to support data analysis

A. Lostia, Joint Research Centre - European Commission - Institute for Health and Consumer Protection; S. Munn, European Commission; S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignard, European Commission Joint Research Centre; E. Joosens, European Commission DG Joint Research Centre

In 2016 the Commission completed an impact assessment to estimate possible health, environmental and socio-economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the substances resulting in getting structured and filterable information available for a certain chemical thus facilitating the data analysis to identify EDs. For instance the data-matrix visually reports if certain toxicological endpoint has been observed across different studies to support evaluation of consistency and reproducibility of toxicity findings. Focusing on all the pesticides and biocides screened (about 400 substances), the data-matrix for all these substances were merged together in order to build a heat-map summing all the toxicological information collected by endpoint. The heat-map can be used to group chemicals based on the similarity of their toxicological behaviour as a mean to prioritise chemicals for further analysis or to build read-across strategy to fill data-gaps.

TH051 Assessment of endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs

S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. Lostia, European Commission Joint Research Centre; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignard, European Commission Joint Research Centre; S. Munn, European Commission

Before pesticides and biocides are allowed to enter the European market, a minimum set of toxicological data is required to be submitted in order to evaluate their (unintentional) toxicity and approve their use. In case of concern(s), specific conditions may apply to limit their use or approval might not be granted at all. The data that is required to be submitted is (mostly) coming from standardized test guidelines (TGs). While these TGs focus on a diverse range of toxic effects, none of the TG studies currently in the data requirements are specifically developed for the assessment of endocrine disruption (ED). However, ED specific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available data to assess and categorise all pesticides and biocides currently registered in the EU. This assessment covers all chemicals of human and environmental health. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH052 Plausible or Causal: Bioactivity and mechanistic potency as a critical piece in hazard characterization of endocrine active chemicals

E.M. Simon, ER2; K. Plotzke, Dow Chemical Company / Toxicology, Environmental Research & Consulting

While methods have been and are being developed and validated, and regulatory programs around the world are moving forward with evaluating chemicals for their potential interaction with the endocrine system of humans and wildlife, the challenge still remains in distinguishing between effects that are specifically elucidated from other biocides and pesticides screened (about 400 substances) the data endpoint has been observed across different studies to support evaluation of the screened chemicals, allows getting an overview of all toxicological effects obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.
TH054 Structural Alerts for Potential Endocrine Disruptors
R. Kühne, N. Oest, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry; L.A. Baumann, University of Heidelberg / Aquatic Ecology and Toxicology; H. Segel, German Environment Agency / UBA / Chemicals; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disrupters are labelled as substances of very high concern (SVHC) and are subject of regulations as REACH. However, there are so far no internationally harmonised criteria for endocrine activity. Furthermore, the endocrine system is rather diverse. Existing tests are rather expensive, and it is still not clear whether they comprise all relevant pathways. Thus, the number of existing data is limited. In silico tools may provide alternatives at least to allow prioritisation of tests by screening compound lists. This study aimed at identifying structural alerts for potential endocrine disruptors of two relevant hormone systems, estrogen/androgen and thyroid hormones. Chemicals binding to the estrogen/androgen receptor 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 coregulating protein to a part of the LBD (AF-2) triggers gene expression. Chemicals binding to LBD may again yield agonistic or antagonistic effects, for binding to AF-2 only antagonism is known. However, adverse effects to thyroid hormones can also result from other mechanisms as enzyme/protein interaction e.g. with the transporter protein and aryl-hydrocarbon-receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For the estrogen/androgen systems structural alerts have mainly been refined. The model identifies 91% of the active chemicals, and false negative results are weakly active only. The models for LBD and AF-2 binding only miss one active compound. For other thyroid hormones effects a screening level model detects 95% of the known active compounds, but there is suspect of missing compound classes due to the lack of respective experimental data. Particular remark was given to characterize the applicability domain and reliability of the predictions. All models are implemented as automated tools in the software system ChemProp (UFZ Department of Ecological Chemistry 2017. ChemProp 6.6. http://www.ufz.de/cochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 371463 412 (2).

TH055 Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae
L. Birgersson, J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences

Endocrine disrupting chemicals (EDCs) in the aquatic environment can have severe effects on the health of aquatic organisms as well as human health. Numerous anthropogenic EDCs, such as plasticizers, fire retardants and antibacterial agents, enter aquatic ecosystems from wastewater treatment plants and land runoff. Several of these have been shown to have adverse effects on fish, including disruption of reproduction, growth and life span. Previous studies have mainly focused on single compound exposures or simple mixtures and further evaluation of complex mixtures at low concentrations is needed. Within the framework of the European Horizon2020 project EDC-MixRisk, EDCs linked to adverse effects on neurodevelopment and growth in a pregnancy cohort study have been identified. Mixtures of these chemicals (phthalate metabolites, phenois and PFASs) were synthesized and tested in a range of in vivo and in vitro systems. The thyroid hormones (THs) are one of the targets of interest as they are essential for brain development and disruption of this axis may lead to alteration of neurodevelopment. The current study aimed to determine the effects of the EDC-mixtures on larval behaviour and to identify disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix X and Mix G (mixtures correlated with adverse effects on neurodevelopment or growth in the epidemiological study) for 48h in concentrations equivalent to 0.01x – 100x human levels. Alterations of larval behavior caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be activated by sub-lethal toxicity of endocrine disruptors. Larval locomotion was tracked using the ViewPoint ZebraBox and a protocol of alternating dark/light cycles. Quantitative PCR was used to determine the effects of the EDC mixture on the expression of thyroid related genes. Our results show that acute exposure to the mixtures significantly alter larval locomotion and expression of genes involved in TH signaling, including thyroid hormone receptors thra and thrb as well as the deiodinases dio1 and dio2 at concentrations corresponding to those found in pregnant mothers. These results will be combined with results from other model systems in the EDC-MixRisk project to improve risk assessment of EDC-mixtures.

TH056 Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures in multigenerational exposure studies
N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

In aquatic ecosystems such as the North American Great Lakes watershed, organisms are exposed to complex chemical mixtures throughout life, producing effects not anticipated in laboratory settings designed to test acute effects of single chemicals. By exposing fathead minnows through three generations, we aim to capture exposure effects during sensitive life stages. Through two separate multigenerational studies, we analyzed the effects of both urban and agricultural co-occurring contaminants at environmentally relevant concentrations in the Great Lakes watershed. Fathead minnows were housed in a flow-through exposure system and propagated for three generations (approximately one year of continuous exposure). Larval fish were analyzed for predator avoidance performance, feeding efficiency, and growth. Adult fish were analyzed for fecundity, biological indices, and pathomorphological 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 induced higher fecundity at both first and second generation, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway in the transcriptome analysis of fathead minnow. Our laboratory found 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, which potentially lead to reductions in fecundity, and elevated egg-yolk precursor protein in male fish. Potential, yet unknown, consequences to the population level of exposed aquatic organisms may exist and warrant further study.

TH057 Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity, environmental mixtures, and multigenerational effects
S. Koho, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concerns (CECs) have been detected ubiquitously in aquatic environments and their endocrine disrupting effects concern us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol 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 CECs. Both first and second generation exposure inducing 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, 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 CECs.
Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures

U. Hashay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented endocrine disrupting effects and increased stress 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 moderate concentration (environmental exposure to ibuprofen showed a potential therapeutic effect at the moderate concentration). We also observed indication of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH059 Contaminants of emerging concern in the North American Great Lakes: Load reduction and biological recovery after wastewater treatment upgrades

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmiston, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/de-chlorination). The receiving aquatic ecosystem adjacent to these two wastewater treatment plants has been the focus of intense biological and chemical study for the past seven years and provides a unique opportunity to assess two divergent treatment technologies of wastewater and also observed indication 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 Endocrine disruptors used in polymers in the offshore oil and gas industry

C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suerling, University of Toronto; A. Smith, Cefas / Ecotoxicology and Molecular Ecology

Concentrations were raised by regulatory assessors that a number of polymer substances found in products registered for use and discharged offshore as a result of the activities of the oil and gas industry are based on monomers that are known and suspected endocrine disruptors. These polymers were described by the registration data as being moderately or readily biodegradable substances and might therefore have the potential to biodegrade into the endocrine disruptors on which they were based. In a recent collaborative study supported by MOST cooperation, FKZ: 02WIL1387. The results from the presented study show that at least one of the analysed products has a high potential for releasing EDs and highlights the importance of well-informed environmental protection to prevent endocrine disruptors from impacting the marine environment.

TH061 Towards a multiparallel detection of biological effects caused by anthropogenic micro-pollutants

C.E. Reigard, German Federal Institute of Hydrology; L. Moscovici, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Aquatic Toxicology Laboratory; S. Belkin, D. Shabtai, The Hebrew University of Jerusalem; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology Organic micro-pollutants (MPs) can enter the aquatic environment via diverse pathways and sources such as waste water treatment effluents, agricultural activities or the disposal of various consumer goods. Tracking the occurrence, distribution and fate of MPs in the subsurface is challenging and purposeful directed analysis, which directly links chemical analysis of contaminants to their potential adverse biological effects. The project “TREE[S]” [1] (TRacking Effects of Environmental organic micro-pollutants in the Subsurface) aims to develop an innovative technological platform for monitoring MPs based on the assessment of their biological effects. The proposed setup will be composed of the following steps: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) bioreporters. 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 fluorescence reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC and mass spectrometry introduces a new dimension to the monitoring of complex mixtures and allows parallel detection of endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoid acid receptor) was successfully performed using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of adapted sensor-strains, (iii) the simultaneous assessment of biological effects (eco)toxicological effects and (iii) method development for the detection of compounds by chemical analysis after separation by HPTLC. <br clear="all" /> [1] A German-Israeli research and development project in the field of water technology within the framework of the BMBF-MOST cooperation, FKZ: 02WIL1387.

TH062 Endocrine disruptors used in polymers in the offshore oil and gas industry

C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suerling, University of Toronto; A. Smith, Cefas / Ecotoxicology and Molecular Ecology

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Thyroid disorder screening using zebrafish as vertebrate model

J. Iurria, O. Jaka, C. Martí, A. Alzuade, BioBide; A. Muriana, BBD BioPhenix S.L. / RD

Endocrine disrupting compounds are frequently found in the environment and have a profound impact on the development and physiology of vertebrate organisms. Thyroid Disrupting Compounds (TDC) specifically affects the function of thyroid hormone, interfering with their synthesis, transport and/or binding, altering important physiological processes. Several environmental contaminants such as polybrominated diphenyl ethers or halogenated organophosphates, used as plasticizer and flame retardant, are suspected to produce a thyroid-disrupting effect.

Given so, chemical manufacturing entities could benefit from cost-effective methodologies for the screening of TDC in order to deselect candidates during the early phase of the development. In this work, we present an assay for the screening of potential TDC using zebrafish embryo. This vertebrate model is extensively used as a biosensor for the evaluation of acute and developmental toxicity, and several assays in zebrafish are described by the OECD guidelines for the testing of chemicals. Besides, the embryo’s small size and transparency allow to carry out fluorescence-based assays with high throughput. In this work, the thyroid hormone disruption potential of several environmentally relevant contaminant was assessed. For this end, an initial acute toxicity assay was performed in order to estimate the EC50 and NOEC of the tested compounds, and subsequently select concentrations with no systemic toxicity. Afterward, change in the thyrogbulin (TG) synthesis was assessed using a zebrafish transgenic line expressing cGTPase-knockout embryos in line with the 3R principles in relation to TG gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

TH064 Development of stably transfected cell lines with zebra fish thyroid hormone receptors alfa and beta for assessing endocrine disruption in environmental samples

V. García Herranz, INIA National Institute for Agricultural and Food Research and Technology; E. Sánchez Martínez, Institute of Aquaculture Torre de la Sal-Spanish National Research Council; M. Fernandez-Cruz, J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment; J. Cerdá Reverter, Institute of Aquaculture Torre de la Sal-Spanish National Research Council

Endocrine-disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feed, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents… Accordingly, they suppose a threat to animal and human health through different expositions. Aiming at providing a sensitive and rapid system to evaluate their potential effects. In addition, they are used in clinical systems a

Fourty-eight hours post-transfection, cells were harvested and seeded in 96-well plates in Dulbecco’s Modified Eagle’s Medium (DMEM) supplemented with 0.4 mg/lG-418, 10% fetal bovine serum and 1% penicillin/streptomycin (selection medium). To test the stable integration as well as the expression level of the receptor positive clones were plated in 96-well plates and exposed to a range (from 1 µM to 1 µM) of triiodothyronine (T3) concentrations. Finally, the clones showing better EC50 values were selected to determine the presence of thyroidal hormone activity in livestock residues including agricultural amendments. These transactivation systems are also used for distinguishing the contribution of each TR to the residue-induced thyroidal activity. Acknowledgments - Supported by RTA2012-00053-00-00, RTA2015-00041-00-00 and AGL2016-74857-C3-R.

TH065 Screening endocrine disrupting potentials of alternative plasticizers using thyroid hormone receptor

G. Lee, H. Kang, Seoul National University Graduate School of Public Health; K. Choi, Seoul National University / Environmental Health Sciences

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 tributyl citrate (ATBC), dioctyl terephthalate (DOTP), tricetyl trimellitate (TOTM), bis(2-ethylhexyl) adipate, and diisethylhexyl adipate (DEHA). A series of in vitro assays employing a human breast (MVLN), a human adrenal (H295R), and a rat pituitary (GH3) cells, were employed. The test doses for each plasticizers applied were determined based on preliminary cytotoxicity assays for each cell line. While none of alternative plasticizers showed significant cytotoxicity, they supposed a potential thyroid disruptor activity through altering hormonal pathays to thyroid gland. Our observation shows that DINCH, DEHA and TOTM may disrupt balance of important hormones. Further investigations using in vivo models are warranted.

TH066 Development of reporter gene system for assessing cherry shrimp ecdsyne receptor agonist using mammalian cells

K. Chan, The Chinese University of Hong Kong / Life Sciences; Y. Chan, K. Chu, The Chinese University of Hong Kong / School of Life Science

Ecdysteroid is a key steroid hormone that regulates growth, development and molting in animals under the phyllum of Arthropod, which includes the insects and crustaceans. The hormone targets the receptor complex which recognizes the ecdysone receptor (EcR) and retinoid X receptor (RXR). The activated complex anchoring on the ecdysone responsive element (EcRE) stated on the promoter subsequently initiates transcription of the responsive gene(s). Chemicals act as receptor agonists do not necessarily adopt the structure of the native hormone, as in the case of estrogenic endocrine disruptors. Recently, for insect pest control, synthetic diacylhydrazines, DAH (hexahydropyrimidine, C3R00 and AGL2016), as well as synthetic steroidal agonists, all of which were developed to disrupt ecysone/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 17α-ethinylestradiol.

E. Michiels, University of Antwerp / Zebrafishlab Dept Veterinary Sciences; F. Lai, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; L. Vergauwen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences SPHERE; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; A.L. van Nuijs, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; S.J. Van Cruyten, University of Antwerp / Applied Veterinary Morphology, Dept Veterinary Sciences; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences

Pharmacetical companies have to perform an environmental risk assessment for every drug that is launched to the market. The mandatory tests for potential endocrine disrupting (EDC) chemicals are mainly performed in in vitro aquatic toxicity tests. However, it is often difficult to expose fish to poorly water-soluble EDs pharmaceuticals 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 traditional exposure route via water. As a first step in this study, 17α-ethinylestradiol (EE2, an estrogen receptor (ER) agonist) was chosen as a model compound to compare both exposure routes. Zebrafish embryos were exposed either via water or via injection within the first two hours post fertilization (hpf) until 120 hpf. Different endpoints at different levels of biological organization were assessed. Morphological (i.e., different types of abnormalities) and physiologial (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

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was different between both exposure routes, while vitellogenin (vtg1) 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 14 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 vtg1. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

**TH068**

Vitellogenin expression, ovarian growth and hormone levels are affected by atrazine in the crayfish Procambarus clarkii

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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 occurred. It is possible that the low estradiol concentration together with the observed data showed that atrazine exposure was able to inhibit vitellogenin production in the crayfish P. clarkii, altering on the other hand the normal balance of sex steroids.

**TH069**

Identification of molt-inhibiting hormone and ecdysteroid receptor sequences in the crayfish Procambarus clarkii and consequences of endocrine disruptor exposures

E. Gismondi, University of Liege

Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent the first step in the path of the contamination, because they are crucial for their functioning (e.g. litter degradation, food resource). Moreover, gammarids are hosts of hidden parasites such as vertically transmitted microsporidia (microsporidia VT), which could be confounding factors in assessment of EDC effects, since microsporidia VT could feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to observe the endocrine disruption in gammarids. The present work focused on EDC effects on the molt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the molt-inhibiting hormone (MIH) and the ecdysteroid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an exposition of four days to a sublethal dose of atrazine (4HT). 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.

**TH070**

Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius

S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; V. Esser, RWTH Aachen University / Physical Geography and Geocology; A. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; H. 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 invertebrates. The potential of sediment-bound EE2 to disrupt the reproductive function of exposed organisms is of great importance to know how sediment-bound EE2 affects the structure and function of ecosystems, and is therefore crucial for their functioning (e.g. litter deglomeration, food resource). Moreover, gammarids are hosts of hidden parasites such as vertically transmitted microsporidia (microsporidia VT), which could be confounding factors in assessment of EDC effects, since microsporidia VT could feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to observe the endocrine disruption in gammarids. The present work focused on EDC effects on the molt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the molt-inhibiting hormone (MIH) and the ecdysteroid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an exposition of four days to a sublethal dose of atrazine (4HT). 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.

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**TH071**

Assessing acute toxicity of Bisphenol A on Daphnia magna by passive dosing approach

H. Kwon, Y. Jeong, H. Jeon, S. Kim, KIST Europe / Environmental Safety Group

Bisphenol A (BPA) is a raw material for widely used polycarbonate plastics, but it is known to have negative effects on human health and the environment. It was classified as an endocrine disrupting chemical (EDC), which requires an accurate and reliable toxicity data for robust risk assessment. However, currently available ecotoxicology data (48h-EC₅₀) on Daphnia magna showed a significant discrepancy of 3.9-16.0 mg/L. Therefore, our aim is to determine the reliable toxicity of daphnia to BPA. Passive dosing as well as the existing toxicity testing protocol (i.e., spiking with co-solvent) were used to administer BPA to daphnia. Conventional spiking method often fail to control the exposure concentration of (semi-)hydrophobic organic compounds due to the loss of target concentrations from sorption to the test vessel and volatilization. Here, passive dosing technique compensates for the concentration loss by using a biocompatible polymer as a reservoir. Moreover, the adverse effect of the only target compound can be considered in this format as passive dosing does not require a co-solvent to dissolve and deliver the target compound. In order to test the reliability of passive dosing method, we were able to determine the silicone-water partition coefficient of BPA and control stable concentrations over the test period. The uniform concentration of BPA induced the maximal effective concentration of daphnids at the lower concentration. We expect that the application of this method in a chronic toxicity test will provide more reliable environmental hazard and risk assessment of BPA. Furthermore, this result suggests that passive dosing could be adjusted to less hydrophobic compounds like BPA (log Kow of 3.64).

**TH072**

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

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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 arthropods, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Nevertheless, the increasing quantities of insecticides leached into water bodies severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disrupters known to interfere with the natural 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 growing in use in agriculture both locally and globally, and their impact to the aquatic ecosystem is needed to be further clarified. In the present study, the acute and chronic toxicity effects of two juvenile hormone analogue insecticides, fenoxycarb and methoprene, on new born N. davidi were investigated. The 24h and 48h median lethal concentrations (LC50) of fenoxycarb and methoprene were 1.40, 0.97 mg/L (4.64, 3.20 mmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 mmol/L) 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 hr3 (hormone receptor 3) and c75 in N. davidi were up-regulated, while Chdh4 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydroxylase) and JHAMT (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. Kin, Greenecos Inc.; Y. Kim, Greenecos Inc. / CEO

Multimedia fate model (multimedia fate model for HUMAN 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 consisting of environmental, meteorological and geographical data of hazardous chemicals was developed. Second, Environmental concentrations of various chemicals were predicted, applying different fate processes according to different chemical properties. Third, advection and dispersion by wind in air grids, runoff in watershed, flows of water in water segments are considered in the watershed-based multimedia fate model, which was linked to a risk assessment system. Applications of predicted multimedia (Endocrine Disrupting Chemicals) and assessing human risk in this area. HURAME is valuable tools for predicting the fate of chemicals in evaluative and real environments with areas consisting of many watersheds. These models are an integral component of exposure assessment and risk assessment strategies, and are used in detailed assessments of contaminant fate. The aim of these models is to describe contaminants and migration in a defined watershed region, with water segments and air grids inside of the region of interest treated more complicatedly. As a result, regional levels of environmental contamination are controlled by environmental parameters and processes and meaningful evaluation requires assessment of contaminant fate in neighboring regions. A linked set of regional models has the potential to describe quantitatively the impact of chemical emissions over a wider geographic scale with significant spatial differences in environmental characteristics and chemical use patterns.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural atmospheric PM extracts on JEG-3 human trophoblasts

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Endocrine disruptors (EDs) are chemicals compounds that send confusing messages to the body, causing various disruptions 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 fetuses exposure to EDs (BPA and DEHP). To address this issue, recently, pregnant women recruitment has begin. 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 detection obtained from this cohort (such as, physiological data, dietary habits and lifestyle, among others) was implemented into a physiological basic pharmacokinetic (PBPK) model, which assesses the absorption, distribution, metabolism and excretion of a chemical compound into human body, as well as the internal exposure to target organs. To estimate the early exposure of the child, the model was implemented with fetus compartment for these chemicals. Results indicates that for both, BPA and DEHP, diet is the main contributor to the total exposure. However, indoor environment and dermal exposure also contribute significantly to the total DEHP exposure. Levels of both EDs were monitored 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).

TH075 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 toxicology studies has prompted the need for a sensitive assay for T3 and T4, which could not be fulfilled when using the traditional immunofluoroassay technique. A liquid chromatography with tandem mass spectrometry (LC-MS/MS) method was developed for the clotting process to generate the serum sample (a) plain plastic tubes and (b) tubes containing clot activator). A trend was observed in samples obtained using plain tubes for the clotting process resulting in suppressed analytical instrument responses. Hence an appropriately labelled internal standard is imperative, however this does not safeguard data points where low pg/mL concentration levels are measured in the samples, with particular prevalence 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 cardboard in dairy farm watersheds regardless of effluent management practices
L.A. Tremblay, Caithorn Institute; J.B. Gadd, NIWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited
Steroid estrogens contamination has been linked to adverse effects on exposed aquatic biota. Steroid estrogens are excreted by all mammals and are therefore found in most agricultural wastes including dairy manure and dairy shed effluent (DSE). Some previous studies have demonstrated elevated levels of free and conjugated estrogenic steroids in DSE and this source has increased as New Zealand has experienced rapid expansion and intensification of dairy farming. This research used an approach incorporating analytical chemistry and bioassays to evaluate the levels of estrogenic activity in environmental samples from representative dairy watersheds with differing DSE management practices: either alone or in combination with seasonal constraints. The toxicodynamic 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 (Eeq)) was found at low levels in 83% of the stream samples (highest 1.44 ng L-1 Eeq) and 75% of the groundwater samples (≤0.15 ng L-1 Eeq). While estrogenic activity was generally -1. one (of 10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L-1, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH078
Toxic receipt: Why You Should Avoid it?
J. Milos, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randeljović, L. Šoćić, ALHem - Safer Chemicals Alternative
Bisphenol A (BPA) is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. 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 (Eeq)) was found at low levels in 83% of the stream samples (highest 1.44 ng L-1 Eeq) and 75% of the groundwater samples (≤0.15 ng L-1 Eeq). While estrogenic activity was generally -1. one (of 10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L-1, a level potentially harmful to aquatic biota. Comparable steroid 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.

TH079
SETAC Endocrine Disruptor Testing and Risk Assessment Interest Group
H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science (P)

TH080
Evaluate the ecological risk during product development: safe by design case study - Met@link project
R. Mertens, VITO / ARCHE; J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF
As part of the REACH Substance Evaluation for silver, new data was required to be generated in order to further justify the read-across from ionic to nanosilver. Literature data learn that Ag-NP particles are indeed highly toxic to aquatic ecosystems, mainly due to the leaching of Ag+ ions. Potential exposure? Looking at the production process the aquatic ecosystem is of concern because of the waste water generated during production of the inks. Two prototype inks with suitable technical properties were formulated. Both were tested for their leaching potential and for their ecotoxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the ecotoxic effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH081
REACH Substance Evaluation of silver - justification of read-across from ionic silver to nanosilver
K. Aulis, ARCHE; J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF
As part of the REACH Substance Evaluation for silver, new data was required to be generated in order to further justify the read-across from ionic to nanosilver. Literature data learn that Ag-NP particles are indeed highly toxic to aquatic ecosystems, mainly due to the leaching of Ag+ ions. Potential exposure? Looking at the production process the aquatic ecosystem is of concern because of the waste water generated during production of the inks. Two prototype inks with suitable technical properties were formulated. Both were tested for their leaching potential and for their ecotoxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the ecotoxic effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH082
Revising REACH technical guidance on information requirements and chemical safety assessment for engineered nanomaterials for aquatic ecotoxicity endpoints - recommendations from the EnvNano project
S.F. Hansen, Technical University of Denmark / DTU Environment; S.N. Sorensen, DTU Environment / DTU Environment; L. Skjolding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Bagger, Technical University of Denmark / DTU Environment
The European Commission (EC) and the European Commission's Joint Research Centre (JRC) is responsible for the Environmental Chemical Agency (ECHA) is in the process of revising its guidance documents on how to address the challenges of ecotoxicological testing of nanomaterials. In these revisions, outset is taken in the hypothesis that ecotoxicological test methods, developed for soluble chemicals, can be made applicable to nanomaterials. European Research Council project EnvNano - Environmental Effects and Risk Evaluation of Engineered, which ran from 2011-2016, took another outset by assuming that: “The behaviour of nanoparticles
Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental fate. By using findings from our project we discuss the advantages and limitations of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (fate bond = 1 to 3 for high) for a so-called “fate bond” which will be included in a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in the considered compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not needed to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, for daphnia tests we suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that determination of uptake, depuration and transfer processes for these materials is needed 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

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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 project aims at developing test matrices, test procedures and evaluation criteria to assess the environmental fate and effects of these materials and products. Initial efforts have focused on identifying criteria for environmental risk assessment (ERA) models and tools for such governance framework. It was recognized that some criteria are applicable to both environmental and human risk assessment (HRA), and these so-called “overall” criteria were identified through joint efforts of the ERA and HRA working group experts in 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 outcome on hazard, exposure and risks. The identified criteria were listed against the Cooper stage-gates®, thus forming a table in which the importance or relevance of each criterion could be assessed for each of the stage-gates. This was formed into questionnaires with defined response options for each environmental management (EM) and innovation stage of these materials and products. The questionnaires were sent to stakeholders representing regulators, consultants, researchers and industries, who provided their feedback, either by filling the questionnaires or by listing general input on their current RA approaches or needs. Efforts to obtain input from NGOs and insurers remain ongoing. The feedback clearly illustrated different requirements between stakeholder groups. For example, not all use the (same) stage-gate approach or have the same level of expertise for RA. Other criteria were similar or similarly important to most stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria suggested useful for use by calIBrate partners included the use of modelling/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.

TH084

Considerations of nanomaterial's environmental fate to support grouping and environmental risk prediction

M. Herchen, Fraunhofer IME; C. Nickel, Institute of Energy and Environmental Technology e.V. - IUTA / Air Quality & Sustainable Nanotechnology; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schwim, German Federal Environmental Agency UBA; T. Kuhlbusch, BAvA; C. Asbach, Institute of Energy and Environmental Technology eV IUTA

Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental fate. By using findings from our project we discuss the advantages and limitations of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (fate bond = 1 to 3 for high) for a so-called “fate bond” which will be included in a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in the considered compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not needed to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, for daphnia tests we suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that determination of uptake, depuration and transfer processes for these materials is needed 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.

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. Schwim, German Federal Environmental Agency UBA; T. Kuhlbusch, BAvA

Grading 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. This matrix is based on a so-called “release bond” which gives weight to the toxicological hazard properties (ecotox bond; present at an additional poster) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: transformation, transport, fate grouping Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no. 03XP0002

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. Schwim, German Federal Environmental Agency UBA; D. Volker, German Environment Agency; E. van der Zalm, German Federal
The grouping of engineered nanomaterials (ENMs) is being intensively discussed in order to develop approaches that allow an adequate hazard assessment of ENMs while reducing the testing effort or to rank them regarding their environmental hazard. Two approaches differing in their focus have been developed and evaluated with a set of 25 ENMs. Based on systematic testing using aquatic test designs used in regulatory testing, the physicochemical (PC) properties, including morphology and reactivity as well as eco-toxicological characteristics were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the parameters ecotoxicity of the bulk chemical, solubility and reactivity we decided upon a pragmatic approach with questions which have to be answered “yes” or “no”. Approach I (ecotocx flow-chart) is characterized by maximum 24 groups whereas 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 (ecotocx-bond) was developed for risk assessment by using an approach similar to control banding. For risk assessment the hazard information has to be combined with properties influencing environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotocx-bond every “yes” for an answer gives one point. The points are added together resulting in five groups in a range or band of 1 to 5 which is used for further assessment. The same number of points can be achieved by different properties resulting in groups of ENMs which can differ significantly in their PC-properties. This procedure is considered suitable for the initial prediction of risk and it is more important that the data 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**

Y. Adam, EMPA Technology & Society Lab / Technology and Society Lab; A. Cabaliero-Guzman, EMPA / Technology and Society Lab; B. Nowack, Emph Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab

The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO₂ flowing in different forms in the environment. The methodology considers different ENM forms such as: EnM solubilization, 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 within a whole product, going to solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variabilty of the data obtained in the literature was used to assess the width of these distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO₂ presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%, 94% and 99%, respectively). The only transformation identified was occurrence of agglomeration of nano-TiO₂ forms in which ENMs are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

**TH088**

**Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials**

J.T. Quik, RIVM / DMG; J.A. Meester, E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Loffs, NERC Centre for Ecology & Hydrology / Shore Section; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox® modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox model was recently extended for use with nanomaterials (SimpleBox4.0-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this study we show the sensitivity of SimpleBox4.0-nano to the newly added process parameters. This shows that in addition to the dissolution rate, the attachment efficiency, as well as the concentration of natural particles and their size play a role. In order to use SimpleBox4.0-nano we provide guidance on measuring or calculating the relevant input parameters. Furthermore, we indicate the relevance of the different fractions of PECs as calculated by SimpleBox4-nano for estimating the risk quotient. 1. **www.rivm.nl/simplebox4** 2. Meester, 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**

J.T. Quik, RIVM / DMG; M. Bakker, RIVM / VSP; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; M. Poikkimaki, M. Dal Maso, Tampere University of Technology / Aerosol Physics; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

There is an increasing need for predictive risk assessment of nanomaterials (NMs) along the life cycle that are subject to environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.
OECD Test Guidelines and Guidance Documents for Environmental Safety Assessment of Nanomaterials

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The OECD test guidelines (TGs) for nanomaterials 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 TGDs applicable and adequate? For the regulatory 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 new deals with the data obtained. The poster will present the status quo on recent TGs and GDs development for nanomaterials at OECD level with relevance for an adequate environmental safety assessment of nanomaterials. Selected activities on TG/GD development will be presented in detail regarding their objectives, challenges and status. Emphasis will be given to the OECD TGs on dispersion stability in simulated environmental media, which was published by OECD, Oct 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

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OECD Test Guideline 305 (OECD, 2012) is used to evaluate the bioaccumulation of chemicals in fish. The last version (October 2012) considers several possibilities for the exposure of fish to chemicals. The first approach, suitable for soluble chemicals, is based on aquatic exposure with two phases: exposure (usually 28 days) and post-exposure (deposition). A bioconcentration factor (BCF) is calculated both as the ratio of the chemical concentration in/on fish and in the water. It is actually a kinetic parameter as a first order kinetics (KON) estimated as the ratio of the rate constants of uptake and depuration assuming first order kinetics. TG 305 also proposes the use of a “Minimised Aquaeous Exposure Fish Test” as a simplified approach with the objective of confirming a BCF estimated on the basis of KON and QSARs. A third approach corresponds to a “Dietary Exposure Bioaccumulation Fish Test” that should be used, for instance, for very low soluble substances that do not allow reaching stable water concentrations. In the uptake phase (normally 7-14 days), fish are fed with feed spiked with the test substance. In the depuration phase (up to 28 - 42 days), fish fed untreated fish feed. This method allows the calculation of a kinetic biomagnification factor (BMF), if it is estimated that steady-state was reached in the uptake phase and that a BMF could be calculated. For the study of bioaccumulation of manufactured nanomaterials (MNMs) in fish these approaches should cover all possibilities. In a number of cases MNs are highly insoluble and a dietary exposure approach with these type of MNMs would be preferred. In this case it is necessary to implement methods ensuring the chemical incorporation in food and tissue samples was carried out by ICP-OES. The determined tissue concentrations 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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From detection to action: advancements in assessing and managing highly fluorinated compounds (P)

TH095
Assessment of persulfate oxidation liquid chromatography tandem mass spectrometry for the analysis of perfluoroalkyl and polyfluoroalkyl substances in water

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corbinula fluminea.

The identification and scientific assessment of compounds that bioaccumulate in organisms and biomagnify in food webs play a key role within the PBT-assessment. The bioaccumulation potential of compounds is commonly expressed in form of bioconcentration factors (BCF) determined in flow-through studies with fish according to OECD 305. Comparable studies with manufactured nanomaterials (MNMs) are difficult to carry out due to the lack of suitable test systems that allow a permanent and constant exposure of the compounds. MNMs tend to sediment in water and are supposed to be primarily taken up by benthic species in aquatic ecosystems. Different studies have shown that mussels are able to ingest and to incorporate MNMs suspended in water. However, existing standardised test methods to investigate the bioaccumulation of substances in mussels have been developed and optimized for soluble, non-particulate substances. Therefore, an alternative test concept was developed allowing to investigate the bioaccumulation of MNMs in the mussel Corbicula fluminea. The test systems were carried out with the freshwater mussel Corbicula fluminea.

TH093
A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel

A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel
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The global distribution of certain perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible toxicological effects. The present study investigated a variety of PFASs in a film for foam system (AFFF) impacted sites may be contaminated by the relatively limited number of certified standards to ensure a rigorous quantification. A possible solution is the implementation of a surrogate approach such as the total oxidizable precursor (TOP) assay, relying on the oxidative conversion of potential perfluorooctyl acid precursors (Pre-PFASs) into readily measurable perfluoroalkyl carboxylic acids. However, in order to ensure a fully legitimate comparison between conventional (i.e. before oxidation) and after TOP analyses, a number of critical knowledge gaps remain to be bridged. Two of the two water samples (i.e. before TOP versus after TOP) might reveal differential instrument matrix effects or necessitate different clean-up strategies, which could de facto impact the method reporting limits and preclude a consistent comparison between the two approaches. The present work aimed at assessing the applicability of the TOP assay to various water matrices through stringent validation. The performance of a workflow involving persulfate oxidation followed by ultrahigh performance liquid chromatography tandem mass spectrometry (TOP-UHPLC-MS/MS) analysis was therefore evaluated using various environmental waters. The validation endpoints ascertained included, notably, the evaluation of oxidation yields in the various matrices and TOPs have thus been used for the metal contamination. It was observed that even though fluoroelutetomer sulfonates (ZFTSAs) were the target pre-PFASs predominantly reported before oxidation in most instances, they could only partially account for the observed APFAs (molar concentration increases upon oxidation). The unexplained APFA portion likely results from the oxidation of untargeted pre-PFASs for which oxidation yields are yet to be determined.

TH096

Use of biochars 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 PFASs, both organic and inorganic contaminants removal from soil. Biochar (BC) has a high adsorption potential for organic and inorganic contaminants and can be made at a low cost. Biochar is thus a promising and economic alternative to other carbonaceous materials, such as activated carbon, for this environmental application. In this study, three BCs were used as sorbents: a wood BC (wBC) made from wood chip waste (used for all the treated soils), an iron enriched BC (Fe-BC) (used for the metal contaminated soils) and an activated biochar (aBC) (used for the PFAS contaminated soils). Isotherm batch tests have been carried out using a water and soil mixture (L/S=10) to which BC was added at increasing doses (from 0 to 20%). The aim of this work is to investigate i) whether biochar can be used as a sorbent material for the treatment of industrial contaminated soil, ii) whether BC can sorb PFASs in soils with both high and low TOC contents, iii) if iron enriched BC increases the sorption of metal as compared to non-enriched BC and iv) whether there is a correlation of BC properties (surface area, pores, surface property, etc) with sorption.

TH097

Sorption of 14 PFASs to organic soil constituents - the effect of H+, Na+, Ca2+ and Al3+ ions

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Environmental risk assessment of perfluoroalkyl substances (PFASs) requires accurate prediction of their sorption in soils. The aim of this study was to investigate sorption of 14 PFASs, including perfluorocarboxylates (PFCAs), perfluorosulfonates (PFSAs) and perfluorooctanesulfonamido (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 0.32 ± 0.11 log units per unit pH and the SOM bulk net negative charge (∆-1.41 ± 0.40 log units per log unit 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 CF moiety, respectively. Comparing the effect of the PFAS functional head group on sorption, affinity followed the order PFCAs < PFSAs < FOsA. Effects from cation competition showed that sorption was reduced for the C4-containing PFCAs and perfluorohexane sulfonate (PFHxS), and for these substances, the SOM bulk net charge was the better sorption predictor as compared to the pH value alone. However, for sorption of the most long-chained substances (i.e. the C6- and C13 PFCAs, PFOS and FOsA), cation effects were small and instead sorption was more strongly related to the pH value. This suggests that the most long-chained PFASs have a binding preference towards the highly condensed parts of the humin fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

TH098

Environmental degradation rates for new PFAS via decarboxylation potential in water, in a MS collision cell and in silico

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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 perfluoropropionic acid loses CO2 so fast at room temperature that its spontaneous decomposition is a synthetic method for nonafluoroisobutane. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PFCS 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. Relating to the above, relying on the oxidative conversion of potential 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 instability of PFOA and other perfluoroalkanes could be satisfactorily predicted by DFT calculations at standard B3LYP/6-31+(G,d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carboxylic acids also correlate well with MS and DFTrived 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 carboxylic acids (PFCAs) in soil and invertebrates (Isopoda) near a fluorochromal 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 humans and impact the method development. There is therefore a need for new and relevant environmental models. The present work aimed at assessing the applicability of the TOP assay to various water matrices through stringent validation. The performance of a workflow involving persulfate oxidation followed by ultrahigh performance liquid chromatography tandem mass spectrometry (TOP-UHPLC-MS/MS) analysis was therefore evaluated using various environmental waters. The validation endpoints ascertained included, notably, the evaluation of oxidation yields in the various matrices and TOPs have thus been used for the metal contamination. It was observed that even though fluoroelutetomer sulfonates (ZFTSAs) were the target pre-PFASs predominantly reported before oxidation in most instances, they could only partially account for the observed APFAs (molar concentration increases upon oxidation). The unexplained APFA portion likely results from the oxidation of untargeted pre-PFASs for which oxidation yields are yet to be determined.
observed among the studied sites, but TOC was positively correlated with multiple PFASs, including PFOS and PFOA. At this moment (November 2017), isopods were not detected in any of the sampling points, but below the detection limit in 3 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 µg/L. Based on these and further results, it will be discussed if regulations should be tightened due to the linkage of these compounds to adverse effects in humans and the environment. Surface waters in the northeastern United States in particular have displayed elevated concentrations of PFASs. Here we utilize passive samplers to gain a better understanding of the sources and spread of these contaminants. Thirty-two microporous polyethylene (PE) passive samplers (containing Hydrophilic-Lipophilic-Balanced sorbent) were deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each. Deployment sites ranged from wastewater treatment plant and industrial outfall, to more pristine areas. Presence of PFASs in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Sampling was performed in two semi-confined coastal areas, one of them an area with high agricultural activity (Mar Menor) and the other one with high tourist and military and industrial activities (Ría de Vigo). PFOS, PFOA, PFOSA, n- and p-MSFOSA, as well as 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 (Concha-Graña et al. et al. 2017). 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 detection limit. PFOA was measured in 39 % of samples, most of them from Mar Menor. In Ría de Vigo PFOA was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than the quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 ng/g in Mar Menor and below 0.1 ng/g in Ría de Vigo, being the total concentration of PFOS similar than the detected in similar areas. Some characteristic of the sediments were taking into account in order to find the correlation between these parameters and the obtained data. Moreover, the environmental risk was evaluated. Acknowledgements: Financial support by the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) (reference: ED431C 2013/28) and by the Ministry of Economy and Competitiveness (project reference: CTM2013-46943-C2-2-R, and ARPA-ACUA, project reference: CTM2015-77640-C3-5-3-R), References: Concha-Graña E. et al., VII Reunión de la Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas, CTM2016-77945-C3-3-R, References: Concha-Graña E. et al., VII Reunión de la Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas, Furanos y Compuestos Orgánicos Persistentes Relacionados (2017)

TH100

Utilization of passive samplers to detect per- and polyfluoralkyl substances (PFASs) in wastewater treatment plants C. Gardiner, Graduate School of Oceanography, University of Rhode Island / Chemical Oceanography; A. Robuck, Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island 02882 / Chemical Oceanography; M.G. Cantwell, D.R. Katz, Office of Research and Development, US Environmental Protection Agency, Narragansett, Rhode Island 02882 / Atlantic Ecology Division; I. Benčanová, R. Loehmann, Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island 02882 / Chemical Oceanography

Poly- and perfluoralkyl substances (PFASs) are of growing concern worldwide, due to the linkage of these compounds to adverse effects in humans and the environment. Surface waters in the northeastern United States in particular have displayed elevated concentrations of PFASs. Here we utilize passive samplers to gain a better understanding of the sources and spread of these contaminants. Thirty-two microporous polyethylene (PE) passive samplers (containing Hydrophilic-Lipophilic-Balanced sorbent) were deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each. Deployment sites ranged from wastewater treatment plant and industrial outfall, to more pristine areas. Presence of PFASs in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Sampling was performed in two semi-confined coastal areas, one of them an area with high agricultural activity (Mar Menor) and the other one with high tourist and military and industrial activities (Ría de Vigo). PFOS, PFOA, PFOSA, n- and p-MSFOSA, as well as 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 (Concha-Graña E. et al. et al. 2017). 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 detection limit. PFOA was measured in 39 % of samples, most of them from Mar Menor. In Ría de Vigo PFOA was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than the quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 ng/g in Mar Menor and below 0.1 ng/g in Ría de Vigo, being the total concentration of PFOS similar than the detected in similar areas. Some characteristic of the sediments were taking into account in order to find the correlation between these parameters and the obtained data. Moreover, the environmental risk was evaluated. Acknowledgements: Financial support by the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) (reference: ED431C 2013/28) and by the Ministry of Economy and Competitiveness (project reference: CTM2013-46943-C2-2-R, and ARPA-ACUA, project reference: CTM2015-77640-C3-5-3-R), References: Concha-Graña E. et al., VII Reunión de la Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas, Furanos y Compuestos Orgánicos Persistentes Relacionados (2017)
Perfluoroalkyl and polyfluoroalkyl substances (PFASs) are common and ubiquitous by-products of various industrial telomerization processes. They can degrade into various perfluorinated carboxylic acids (PFACs) 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 also performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 µg/mL), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PE}, were derived. A deployment at a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{PW}, during the 3-week uptake experiments. Derived log K_{PW} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSA and EtFOSA, derived log K_{PW} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSA and EtFOSA.

**TH107**

Analytical strategy to study the distribution of perfluoroalkyl substances in fish tissue of Italian deep subalpine lakes


Perfluoroalkyl substances, such as perfluorinated sulfonic acids (PFASs) and perfluorinated carboxylic acids (PFACs), are ubiquitous contaminants in the aquatic environment, including wildlife and humans. Perfluoroalkyl acids bind to proteins and the resting in bioaccumulation behaviour differently from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biota cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFSA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these compounds. Several fish species were sampled in Italian deep lakes. Italian deep lakes were seasonally collected for the analysis of 10 perfluorocarboxylates, 7 perfluorosulfonates and 5 perfluorosulfonamides. Individual fish were measured, weighed and dissected in three fractions: whole viscera, the muscle and the rest of the carcass (head, fishbone, skin and fins). The fractions of six fish were analysed separately or in one or two samples for the subsequent analysis. The dry weight, the lipid and the protein content were measured in each fish fraction (muscle, viscera and the rest of carcass). PFAS analysis were carried out with fresh samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2.5 g) was performed by sonication with ACN/H₂O mixture enhanced by salting out and acidification; extracts were purified on HybridSPE and were analysed by GC×GC-TOFMS. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) concentrations were dominated by FTOHs (average 9.9 – 16 µg/mL), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PE}, were derived. A deployment at a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{PW}, during the 3-week uptake experiments. Derived log K_{PW} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSA and EtFOSA, derived log K_{PW} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSA and EtFOSA.

**TH106**

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers

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Objective of the Study The study compares PFOA and PFOS concentrations detected in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected perfluorinated compounds in biota was performed on four rivers in the Czech Republic. Monitoring comprises two profile sets containing 21 and 22 monitoring samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2.5 g) was performed by sonication with ACN/H₂O mixture enhanced by salting out and acidification; extracts were purified on HybridSPE and were analysed by GC×GC-TOFMS. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) concentrations were dominated by FTOHs (average 9.9 – 16 µg/mL), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PE}, were derived. A deployment at a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{PW}, during the 3-week uptake experiments. Derived log K_{PW} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSA and EtFOSA, derived log K_{PW} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSA and EtFOSA.

**TH108**

Potential contribution of targeted and unknown precursors to the apparent biomagnification of perfluoroalkyl acids (PFAA) in the food web of an urban river

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This study assessed the potential contribution of targeted and unknown fluorinated precursors to the apparent biomagnification of perfluoroalkyl acids (PFAs) in the trophic web of the urban river Orge (near Paris, France). A total of 16 PFAs and 10 of their potential precursors (pre-PFAs) including 4 perfluorooctane sulfonamide derivatives, 4 fluorotelomer sulfonates (FTSAs) and 2 polyfluoralkyl carboxylic acids (PFCAs), are ubiquitous contaminants in the aquatic environment, including wildlife and humans. Perfluoroalkyl acids bind to proteins and the resting in bioaccumulation behaviour differently from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biota cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFSA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these compounds. Several fish species were sampled in Italian deep lakes. Italian deep lakes were seasonally collected for the analysis of 10 perfluorocarboxylates, 7 perfluorosulfonates and 5 perfluorosulfonamides. Individual fish were measured, weighed and dissected in three fractions: whole viscera, the muscle and the rest of the carcass (head, fishbone, skin and fins). The fractions of six fish were analysed separately or in one or two samples for the subsequent analysis. The dry weight, the lipid and the protein content were measured in each fish fraction (muscle, viscera and the rest of carcass). PFAS analysis were carried out with fresh samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2.5 g) was performed by sonication with ACN/H₂O mixture enhanced by salting out and acidification; extracts were purified on HybridSPE and were analysed by GC×GC-TOFMS. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids. Perfluoroalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to their analytes separation effects by phospholipids.
precursors to the apparent biomagnification of PFCAs, via their biotransformation. In addition, the Total Oxidisable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFCAs in sediments/biofilm/leaf litter samples (64-80% of total PFAAs 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-PFCAs.

TH109
PFAAs and their precursors in the Environment. First indications from a large scale environmental monitoring study


Per- and polyfluorinated Substances (PFAAs) 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 applications. Our study set out to apply two large scale methods capturing short (e.g. C2 to C6 PFAs), medium and long chain PFAAs (e.g. C6 to C14 PFAA and PFSA), and also precursors (e.g. PAPs, diPAPs, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH110
A physiologically based toxicokinetic (PBTK) model describing the bioaccumulation of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss)


Per- and polyfluorinated Substances (PFAAs) have 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 pellets spiked with PFOS (0.05 mg/l) and PFHxS during several weeks. Then, fish were allowed to depurate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFAAs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood.

Absorption, metabolism, distribution and elimination (ADME) are concerned as well. For accurate predictions of organic contaminants biomagnification it is therefore important to take into account temperature variations. Also, to our knowledge, no study on the effect of the temperature on the ADME of PFAAs in fish has been carried out yet. The aim of this work is to determine to what extent temperature affects absorption and elimination rates, and distribution within the fish. Two perfluorinated acid compounds, namely perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS). Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2009. Two dietary exposure experiments were performed on adult rainbow trouts (O. mykiss) at two water temperatures (7°C and 11°C). Fish were fed pellets spiked with PFOS (0.05 mg/l) and PFHxS during several weeks. Then, fish were allowed to depurate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFAAs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in muscle, liver and blood.

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TH111
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 great zebrafish (Danio rerio) embryo (ZFE). ZFEs are increasingly used as an in vitro model for in vivo bioaccumulation. Our study set out to apply two large scale methods capturing short (e.g. C2 to C6 PFAs), medium and long chain PFAAs (e.g. C6 to C14 PFAA and PFSA), and also precursors (e.g. PAPs, diPAPs, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH112
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 acid (HFPO-DA); also referred to as GenX, FRD-902 or PFPrOPrA). 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 PFAAs substances, the assessment of the bioaccumulation potential is a key aspect 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.

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The bioaccumulation factors in the aquatic environment appeared to be dependent on the exposure concentration. For both the terrestrial and aquatic food chains, the specific protein-binding behaviour of PFOA requires different methods for normalisation of the concentration values, than those normally applied to hydrophobic substances, i.e. based on lipid and organic carbon. Not only exposure via food, but also the human toxicological threshold value of PFOA itself is dependent on the exposure concentration. Higher sensitivity to terrestrial and aquatic test systems may be needed because of the difference in toxicokinetic half-life between human and laboratory animals, like rats and mice. For HFPO-DA kinetic data are only limited, which hampers the derivation of a human-toxicological threshold. It is further investigated based on the available data for both substances whether these findings for PFOA can be extrapolated to HFPO-DA, taking into account the structural differences between both compounds. Additional experimental bioaccumulation data for HFPO-DA is probably needed to complete the ERL derivation.

TH114
Perfluoroether carboxylic acids - are these substances appropriate
PFOA-Alternatives regarding their environmental concerns?
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Perfluoro-octanoic acid (PFOA) is a persistent, bioaccumulative and toxic substance. To minimize the exposure of humans and environment a restriction according to REACH will come into force in the EU in 2020. For a global restriction the Aarhus Protocol (1998) and the Stockholm Convention has been signed. As a result of the regulatory activities as well as voluntary measures, PFOA has been replaced with other fluorinated as well as non-fluorinated alternatives. The use of PFOA as processing aid in fluoro polymer production has been mainly substituted with perfluoroether carboxylic acids (PFECA). PFECA are structurally similar to perfluoralkyl carboxylic acids such as PFOA. Due to the difference in the perfluoralkyl chain it could be expected that PFECA are equally hazardous to the environment. Thus, the German Environment Agency has assessed the environmental hazards in the context of substance evaluations under REACH for certain PFECA such as ADONA (ammonium 2,2,3,3,4,4,5,5,6,6,7,7,8,8,2,2,2-undecafluorododecanoyl fluoroacetate) and GenX (ammonium 2,3,3,4,4,4,5,5,6,6,7,7,8,8,2,2,2-tridecafluorotridecanoyl fluoroacetate). The poster will present a summary of the substance evaluations. PFECA are expected to be very persistent under environmental conditions. The substances have a low bioaccumulation potential in aquatic organisms. However, just as PFOA, PFECA may not fit into the common accumulation pattern. Furthermore, the substances are probably accumulated in the aquatic environment and can reach groundwater and consequently drinking water resources. PFECA have already been detected in surface water, groundwater and drinking water around fluoro polymer production plants [1-4]. In conclusion, further data are necessary, but the available information on PFECA already demonstrates that these substances are hazardous for the environment and further risk management measures are needed. [1] Gebbek WA, van Asseldonk LM, van Leeuwen SPJ. 2019. Environ. Sci. Technol. 53: 1107-11085 [2] Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, Pickett A, Smith C, Knappe DRU. 2016. Environ. Sci. Technol. Lett. 3: 415-419 [3] Schreiber J. 2014. Untersuchung des Transportverhaltens von ADONA in Boden und Grundwasser anhand von Feld- und Laborstudien. Diploma thesis [4] Heydебreck F, Tang J, Xie Z, Ebhinghaus R. 2015. Environ. Sci. Technol. 49: 8386-8395: 49: 14742-14743

TH115
Fluoropolymers: Polymeric PFAS That Satisfy Global Polymer of Low Concern Criteria
B. Henry, W.L. Gore & Associates, Inc.
Fluoropolymers, such as polytetrafluorethylene (PTFE), constitute a distinct class within the polymeric category of the PFAS group. Fluoropolymers are resistant to chemical, hydrolytic, oxidative, photochemical and biological degradation. They are thermally stable within their intended processing temperatures (e.g., 260°C for PTFE). Fluoropolymers have negligible residual monomer, low molecular weight (generally below 1000 Da), are soluble in water and are not mobile or subject to long-range transport in the environment. Their very high molecular weight prevents fluoropolymers from crossing the cell membrane and thus they are not bioavailable or bioaccumulative. The nontoxic nature of PTFE is supported by numerous Good Laboratory Practice (GLP) studies including acute and subchronic systemic toxicity, irritation on implantation, cytogenicity, in vitro and in vivo genotoxicity, hemolysis, complement activation, and thrombogenicity. Clinical studies of patients receiving permanently implanted PTFE-containing medical devices demonstrate no chronic toxicity or carcinogenicity, reproductive, developmental or endocrine toxicity. Fluoropolymer medical devices have been implanted in over 40 million patients for over 40 years. This poster includes fluoropolymer biocompatibility/toxicology, human clinical, and physical-chemical-thermal-biological data to show that fluoropolymers satisfy globally recognized assessment criteria to be considered as “Polymers of Low Concern” and to be recognized as being a low hazard class of PFAS.

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
B. Henry, T. Kennedy, W.L. Gore & Associates, Inc.; H. Fiedler, Örebro University, Örebro, Sweden
Fluoropolymers, such as polytetrafluorethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoralkyl substance (PFAS) classes, such as perfluoralkyl acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of Persistent (Pers), Bioaccumulative (Bio), or 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
T. Vollmer, Eurofins Agroscience Services EcoChern GmbH / Field Ecotoxicology; O. Klein, Eurofins Agroscience Services Ecotox 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 power for 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 duration) and initial earthworm population, e.g. minimum requirements, potentially derived from typical MDD values for a given endpoint, Land-use of the field site (arable fields vs. permanent grassland): is there a preferred option, and/or does this depend on characteristics of the substance under test? Site management/maintenance in general (soil cultivation, crop rotation vs. minimum disturbance) and more specifically in the case of testing a substance with herbicidal action (impact on vegetation coverage in test-item treated plots vs. plots of positive and negative control). Plot size and distance between neighbouring plots, plot allocation patterns, and plot separation, especially with a view on potential migration of earthworms between plots and on external re-colonization. Testing of persistent substances (e.g. how to establish a plateau concentration in soil)? Toxic reference (positive control): reduced replication for the toxic reference? Alternatives to the standard reference item Carbendazim? Examples and suggestions will be given and discussed in this contribution and areas for further research will be identified. EFSA [European Food Safety Authority], 2017: Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms. EFSA Panel on Plant Protection Products and their Residues (PPR). EFSA-Q-2011-00978, Parma, Italy. ISO, 2014: ISO Guideline 11268-3: Soil quality – effects of pollutants on earthworms. Guidance on the determination of effects in field situations.

TH118
Regional Differences of the Environmental Risk Assessment of Pesticides in Soil with a special Focus on the European Union
I. Kamoun, National School of Engineering of Sfax, Tunisia / Laboratory of Water, Energy and Environment; J. Sousa, University of Coimbra / Department of Life Sciences; J. Roembke, ECT Oekotoxikologie GmBH
In the European Union (EU) the environmental risk of chemicals is regulated in various ways. Probably the most complex approach in place is the one for pesticides, mainly because these chemicals differ from other chemical groups by three reasons: (1) They are intended to harm organisms, i.e. those which are impacting agriculture. However, many of the pest species affected by pesticides belong to the same taxonomic groups being responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spray application. (3) They act 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 process 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. Proposals will be made how to improve the ERA process but keep it at the same time practical (e.g. by using a tiered approach). These ideas will include the selection of representative reference soils and test conditions for Mediterranean regions. In addition, we will discuss whether the range of standard test species used so far is sufficient. In this context comparisons such as using the frog, the toad or the leech will be discussed. This data as soil scientifically evaluated could be 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 animal facilities. This data will be statistically evaluated to 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, precision and flexibility. In these discussions various options were checked, all of them with the intention to improve the quality of the output but without increasing the efforts in routine application of the new design. In simulation studies, the number of plot replicates dedicated to either NOEC- or ECx-derivation were varied as well as the number of samples per plot. Additionally, the number of treatments of the chemical to be tested (carbendazim, because it is the reference substance for earthworm field tests for more than 20 years) was also modified in order to cover a broad range. This study can be considered as the biggest earthworm field studies ever conducted. In April 2017, the pilot study was started in a design with 30 plot replicates. After this pre-sampling two further samplings have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

TH120
Soil ecotoxicology and ecological risk assessment in southern African mining landscapes
M. Habert, North-West University / Unit for Environmental Sciences and Management; H. Eijsackers, 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: (1) An inventory of research on the ecotoxicity of metals in various landscapes and ecosystems worldwide. An example of this is southern 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 southern continents of gold and platinum mine waste, we conclude that these wastes still contain considerable amounts of other chemical elements. The extraction methods, moreover, result in very alkaline or acidic conditions. Further the mine waste is very fine grained and therefore susceptible for wind erosion. Consequently these wastes, given the prevailing wind conditions in these areas, will be dispersed over a wide area causing risks for organisms in natural and built areas surrounding these deposit areas. The coal mine study illustrates that mining in or around natural protected area cause risks due to the irradiating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess the impacts on the natural ecosystems present in the area, and compare these with the outcomes of a Potentially Affected Fraction of species PAF analysis. Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

TH121
Establishment of tiered risk assessment approach of pesticides for soil in China
J. Jiang, Nanjing Institute of Environmental Sciences, MEP; J. Zhou, Nanjing Institute of Environmental Sciences, MEP

The aim of the risk assessment for soil organisms is to prevent negative acute or long-term effects on soil functions and functionally most important species. The risk assessment approach established in China considers ecologically relevant groups of soil organisms and takes into account the acutely or chronically effects on species. Based on the results of a Potentially Affected Fraction of species PAF analysis. Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

TH122
Ecoological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks
M. Hagen-Kissling, Eurofins-Mitot; S. Aldershof, Bioresearch and Evaluation; F.M. Bakker, Eurofins

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 agrochemicals which are intrinsic or due to biological interactions, as individuals are embedded in complex food and interaction networks. However, the recovery of a network depends on the fact that all ecological and functional roles within such a complex entity are still realised by a certain number of species (and their individuals). Usually, only abundance criteria are applied in ecological recovery investigations. For example, if numbers of individuals trapped are similar to a control group on two subsequent occasions, recovery is concluded upon. But if the proportion of one functional role (e.g. predators, parasitoids, pollinators or herbivores) in the focal group is far below the proportion of the same functional group in the control group, recovery is not
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 network 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 metazoan organisms and play a crucial role for ecosystem processes. Microcosm communities are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg\(^{-1}\) (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg\(^{-1}\) dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg\(^{-1}\) dw) and 28-d NOEC of Folsomia candida (125 mg kg\(^{-1}\) dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg\(^{-1}\) dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH124
To what extent do soil micro-arthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products
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The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980’s culminating in the paper by Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issue does raise important questions pertaining to single species and at the landscape level to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the inter- and temporal scales when assessing the potential of non-target populations dynamics of non-target arthropods in the context of the risk from the use of plant protection products. It is therefore important to consider what the evidence base is for source-sink dynamics in the agricultural environment and what this tells us about how or whether it is manifested in relevant populations. A structured approach can then be adopted in terms of identifying suitable surrogate species and generating the necessary information for them and at the landscape level to allow the development of suitable population models. This work was initiated and funded by the ECpa non-target arthropod group

TH126
Classification of uncertainty in ecological risk assessment of pesticides
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Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and expert uncertainty estimates are often not presented with the Toxicity Test Reports on individual species. The most frequently identified sources of uncertainty, classify different uncertainties and link them to recognition of source, data gaps and risk management decisions. At the moment it is still unclear which sources of uncertainty influence the decision outcome more than others and our preliminary results indicate that it is possible to uncover non-obvious relationships between uncertainty and risk assessment outcomes. It is, for instance, possible to describe how different sources of uncertainty affect the process of ERA (e.g., duration, effectiveness of a Rapporteur Member State in producing a draft assessment report) and compare how uncertainty is addressed in risk assessment for different environmental compartments, especially soil versus ERA for aquatic organisms which is much more developed. We aim to provide a typology of recognized uncertainties in ERA and discuss how it could help inform the establishment of the surrogate reference tier and the subsequent calibration of lower tiers in the new risk assessment scheme for in-soil organisms, which is currently being developed by EFSA. Ultimately, we aim to link the typology of uncertainties in ERA to risk management techniques, in order to help ERA practitioners to better
address and manage uncertainties.

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 (1988) are typical for total concentrations ("aqu regia"). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc.) and various metal extractions (1M NH₄NO₃, 0.1M CaCl₂, Ca(NO₃)₂) with tonic strength corresponding to soil solution, DTPA/CaCl₂, 0.43M HNO₃, plus aqua regia). Arsenic was chosen due to its high relevance as a soil contaminant, its low data availability compared to other metals and is an element of concern included in many soil regulations. Six soils covering a wide range of Central European soil properties were chosen and spiked with sodium arsenate dibasic heptahydrate (Na₂HAsO₄•7H₂O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC₅₀ and, preferably, EC₃₀ values), based on the six extraction methods, have been determined. The variation in EC₅₀ values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH₄NO₃ < CaCl₂ < Ca(NO₃)₂ < DTPA < Ca(NO₃)₂ < HNO₃. Soils which could not be cultivated in laboratory 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 (Ref=Soil-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. Dehlema, 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 cores followed by heat extraction such as Berlese-Tullgren or McFadyen methods. Activity-based sampling implies installing hypogean traps and collecting the catch at pre-determined intervals. Soil core sampling provides an instantaneous assessment of the fauna at the exact moment and at the very location of sampling, whereas hypogean traps provide an assessment of the activity in a wider area and over a longer time span. Clearly, higher tier (field) assessment implies using more active activity-based 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. Dehlema et al. SETAC 2016, Sims et al. 2016, Bakker et al. 2017) and seems to have a certain degree of selectivity. For purposes of method development and evaluation we have performed a comparative study in which soil core sampling and hypogean trapping (mine traps) were performed in the same fields. The study comprised both a hay meadow and an arable field. Soil cores were taken from the top 10 cm of soil, mine traps collected from various depths. With this contribution we will highlight the differences in species spectrum, numbers collected and variability observed with the different methods and discuss the implications for data analysis and interpretation.

TH129 The application of the CPCAT approach reduces shortcomings of effect detection for earthworm field studies
B. Daniels, RWTH Aachen University / Institute for Environmental Research; S. Jansch, R. Minati, ECT Oekotoxikologie GmbH; P. Ottermanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; R. Köppnick, B. Schulz-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 fully 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 study compares 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 appropriate response than the test for determining earthworm field studies because data distribution and variance are adequately considered and smaller differences between control and treatments can be detected.

TH130 Relationship between soil microbial biomass methods used in environmental fate laboratory studies
P. Massey, Smithers Viscent; P. Pearson-Davies, B. Earnshaw, Smithers Viscent ES; S. Swales, Smithers Viscent ES Ltd
The determination of microbial biomass activity is a pre-requisite for OECD laboratory studies that are designed to investigate the environmental fate of chemicals in soils. By determining soil microbial biomass prior to, during and after a study, the viability and suitability of the experimental soil can be demonstrated. Choosing the appropriate methodology for soil microbial biomass is critical for conducting successful environmental fate studies. One common method, referenced in the OECD guidelines, for determining soil microbial biomass is the fumigation extraction method. This method determines the carbon content of the soil biomass, via fumigation, using ethanol-free chloroform. During fumigation, cells are lysed by the chloroform, which results in a flush of organic carbon into the soil environment. This organic carbon is then extracted and quantified. Another suitable way of estimating soil microbial biomass is by substrate induced respiration. This method uses a suitable labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response is then used to determine microbial biomass activity. 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 1213 and 2034, 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.

TH131 Where are the Springtails? New data on the vertical distribution of Folsomia candida (Collembola) and its population dynamic in artificial soil
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Folsomia candida (Collembola) and its population dynamic in artificial soil}
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 oscillatory growth pattern at its maximum size at the end of the study. In a second experiment the vertical dispersal of F. candida in relation to food location is investigated. Transparent PVC columns were filled with an average 350 g of OECD soil up to a level of 20 cm soil column height and 86 F. candida of different age classes. Each column was closed with Parafilm on top and a gauge on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity was set to 50 percent of the maximum water holding capacity of the soil. The columns were separated into six compartments at different heights: 1, 2.5, 5, 10, 15 and 20 cm. Septa in the middle (4°) and bottom (6°) compartment allowed for watering and feeding. We varied the location of feeding by four different regimes while all other parameters were kept constant. The columns were provided either with food at the top, in the middle, in the ground or at all three compartments. Our hypothesis is that food is a main trigger for the vertical distribution of F. candida in soil. Two of three large examination dates have been processed so far. The data confirms our hypothesis and the results of the study will present new data for the otherwise well investigated Collembola species F. candida.

TH132 Why zinc doesn't matter: habitat quality drives invertebrate response to zinc, not concentration
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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 enchytraeids and collembo 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, stunting, body size and bioavailable zinc were determined after 28 days. Habitat quality did not change zinc bioavailability which remained at 2% across all three habitat indices. Instead, mite fitness improved with increasing habitat quality and mites were able to tolerate higher zinc body burdens in better habitat qualities. Furthermore, the zinc response (measured as the slope of the EC50) was more pronounced in lower habitat qualities. Our data suggest that habitat quality is more important than metal concentration for soil protection. Ecorestoration, rather than remediation, will likely be a more effective means of ameliorating zinc toxicity.

TH134 Effects of atmospheric hydrogen chloride and ammonia on Paronychiurus kimi (Collembola : Onychiuridae)
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As the use and distribution of various chemicals increases, there is a possibility of chemical accumulations in Korea, the incidence of chemical accidents is also increasing. Damage caused by chemical accidents is not only widespread but also has a long-term impact, making it difficult to predict damage and respond appropriately however, there are very few studies on chemicals that can cause accidents. Especially for chemicals exposed to gaseous state, little is known about the effects on soil biota. *Paronychiurus kimi* was exposed to hydrogen chloride and ammonia in bioassays. The experiment was carried out in PS container filled with 30 g soil according to modified OECD 232 guidelines. The effects of gaseous hydrogen chloride and ammonia on *Paronychiurus kimi* (Collembola), the test vessels with *P. kimi* were exposed to two different concentration of toxic substances in the enclosed chamber for 20 minutes. After exposure, the test vessels with *P. kimi* were transferred to an incubator (20°C, constant darkness) in a closed state, and the mortality and reproduction rate of *P. kimi* were observed after 1 hours, 2 weeks, and 4 weeks. There were no deaths after 1 hour, but the mortality rate was increased over time from 2 weeks. Also, after 4 weeks, the number of juveniles produced by adults *P. kimi* were decreased as concentration-dependent manner. These results show that the long-term effects of gaseous phase chemicals can occur at concentrations that are not acutely affected.

TH135 Toxicity assessment of methyl ethyl ketone using earthworm and soil algae
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science
Methyl ethyl ketone (MEK) is a kind of ketone-based volatile organic compound and widely used as industrial solvent. There is a high possibility of leakage of this compound into soil environment, but few studies for ecotoxicity of MEK were present. This study evaluated the toxicity of MEK using earthworm Eisenia andrei and algae Chlamydomonas reinhardtii and Chlorococcum infusionum. Eisenia andrei were exposed with 1.5% of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including gangling, fragments, swelling, bleeding, and mucous secretion were measured. For soil algae, *Chlamydomonas reinhardtii* and *Chlorococcum infusionum* were exposed with 2.5 g of control or MEK soils in 15 mL glass test tube, and chlorophyll intensity was measured after 6-day exposed. As results, 7d-LOEC and 7d-E50 of MEK to *Eisenia andrei* were calculated as 1136 mg MEK/kg dry soil and 1910 (1643.00-2221.58) mg MEK/kg dry soil, respectively. For soil algae, *C. infusionum* was more sensitive than *C. reinhardtii* for MEK, 6d-E50 to *C. reinhardtii* and *C. infusionum* were calculated as 3400.44 (3132.01-3690.94) mg MEK/kg dry soil and 60.97 (51.19-72.62) mg MEK/kg dry soil, respectively. These results can be used for risk assessment of MEK in soil ecosystem. This work was supported by Korea Environment Industry & Technology Institute(KEITI) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment (MOE)(No. 2016001970001). <strong>Key word: methyl ethyl ketone, earthworm, soil algae</strong>

TH136 Effects of endocrine disruptor chemicals (EDCs) to soil algae
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science
There were many data for endocrine 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 (NP) on soil algae. Soil algae *Chlamydomonas reinhardtii* were exposed to varying concentrations of BPA, DEHP and NP. Soil algae *Chlamydomonas reinhardtii* and *Chlorococcum infusionum* were exposed at 0.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algae culture medium after 6-d exposure, and the chlorophyll intensity was measured by fluorescence microplate reader. We observed that the BPA was most toxic following NP and DEHP. The effect of DEHP was insignificant to *Chlamydomonas reinhardtii* and *Chlorococcum infusionum*. The results can be used for risk assessment of BPA, DEHP and NP in soils. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1458014458) *Key word: bisphenol A, bis[2-ethylhexyl]phthalate, nonylphenol, soil algae*

TH137 Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in natura and after pH adjustment
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The use of sugarcane vinasse as fertilizer in crops has been widely used in order to provide an adequate destination for this residue however, it has properties that can be prejudicial to the animals present in the soil, as already verified in numerous studies. Therefore, the objective of this work was to treat vinasse with lime (CaO) to adjust pH to 7.0 (neutral), in an attempt to reduce its toxicity for later use in the soil. In this context, the development of ecotoxicological tests presents itself as a tool of great assistance in the analysis of residues released to the soil. Thus, reproduction tests were conducted using animal soil biocatalysts to evaluate the effects of vinasse may have on reproductive behavior of these animals. Earthworms of the species *Eisenia andrei* (Annelida) and enchytraeids of the species *Enchytraeus crypticus* (Annelida); both tests were developed according to the protocols proposed in ISO 11268-2 (ISO, 2011) and ISO 16387 (ISO, 2013), respectively. In the reproduction test with *Eisenia andrei* in natura in comparison to the animals exposed to the treated vinasse there was an increase in the number of animals, which suggests that the vinasse treatment for pH adjustment was valid for this test. The reproduction test with *E. crypticus* exposed to the same conditions cited above also showed an increase in the number of individuals exposed to treated in biosaies vinasse compared to exposed to vinasse in natura. The results allow us to indicate that the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in both species used, since the environment favored the reproduction of the animals tested.

TH138 Ecotoxicological Characterization of Nitrogen-Based Energetic Soil Cocontaminants
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Environmental Toxicology

We provide an overview of ecotoxicological effects of nitrogen-based energetic materials (EM) of notable ecological concern, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and 2,4,6,8,10,12-hexanitro-2,4,6,8,10,12-hexaazaazowurtzitane (CL-20), 2,4,6-trinitrotoluene (TNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitromethyl methane (2,4-DNT), 2,4-dinitrotoluene (2,4-DNT), 2-amino-4,6-dinitrotoluene (2-ADNT), 4-amino-2,6-dinitrotoluene (4-ADNT), and nitroglycerin (GN). Ecotoxicological effects of these EMs were determined in definitive studies with Sassafras sandy loam (SSL) soil using soil invertebrate, terrestrial plant, and biological activity endpoints. SSL soil was selected because it has physicochemical characteristics (low organic matter and clay contents) that support very high relative bioavailability of organic chemicals. Data for reproduction (soil invertebrates), growth (plants), and critical soil processes (basal substrate-induced respiration, litter decomposition) were independently analyzed using appropriate regression models to determine the EM concentration producing 20 percent decrease (EC20) in the measurement endpoint compared with carrier (acetone) control.

Ecotoxicological benchmarks developed in studies with soil invertebrate and terrestrial plants were used to derive draft Ecological Soil Screening Levels (Eco-SSLs) for use in screening-level ecological risk assessment of EM-contaminated soils. Additionally, we developed species sensitivity distributions (SSDs) for select EMs using toxicity data for all three soil ecological receptor groups (invertebrates, plants, and soil processes). These SSDs were then used for derivation of Soil Contaminant Values (SCVs). Benchmark data plus draft Eco-SSLs values developed in these studies will be submitted to the USEPA Eco-SSL Work Group for use in establishing soil invertebrate- or plant-based Eco-SSls for the individual EMs, and will be made available for use in Ecological Risk Assessment of terrestrial habitats at U.S. Army testing and training sites and other military locations. The SCVs can provide site managers and regulators with a risk assessment tool which allows them to predict species-specific threshold concentrations (e.g., HC5 or HC95 protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139

Organomineral responses of oligochaetes in bacterial inoculum amended copper oxychloride spiked soils

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The excessive release of heavy metals such as copper via anthropogenic sources into the soil environment has raised some global concern. Copper oxychloride, a common agricultural metal-based fungicide applied to fungicidal treatment, consists of 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna. Metal-tolerant bacteria such as Bacillus cereus strain have been identified for their bioremediative traits in metal polluted soils. We examined the effect of Achromobacter sp - Bacillus cereus consortium on the ecotoxicity of copper oxychloride. Bacillus and Achromobacter strains isolated from copper oxychloride sludge and ecotoxicity values developed in this study, the bacterial strains used (Achromobacter sp and Bacillus cereus) were previously isolated from gold and gemstone mining sites and confirmed to tolerate to 200 mg kg⁻¹ Cu. Twenty-four hours pure broth cultures of the two bacterial strains were inoculated into fungicide spiked soils. Utilizing standard ISO and OECD protocols, 10 mature Eisenia fetida and Enchytraeus albidus were exposed separately to both copper oxychloride inoculated copper oxychloride and uninoculated soils for fungicidal control, contains 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna. The presence of mine tailings may promote metal Availability and phytoavailability in agricultural soils receiving long-term organic waste amendments. Isolated plasmids were individually transformed into E. coli JM109. The presence of mine tailings may promote metal-tolerant capabilities using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/μl after extraction. Incompatibility groups were determined by subjecting plasmids to PCR amplification using IncQ, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were 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, Pb, Ba and Cu with metal resistance order of Ni > Pb > Ba > Cu > Zn > Hg. Moreover, protein profiling was used to determine the impact of plasmids on E. coli JM109. Proteins were extracted from both transformed and un-transformed E. coli JM109 and subjected to one-dimensional (1D) and two-dimensional (2D) SDS-PAGE. One dimension SDS-PAGE illustrated general similarity of the profiles except for two banding positions in the 30 to 35 kDa region where bands were present in the transformed bacteria which were a homologous in the AI/Na alloy containing media. Two-dimensional electrophoresis PAGE analysis showed that some of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15 – 75 kDa. Since the plasmids rendered the E. coli JM109 tolerant to metals, it can be concluded that the change in the protein profiles was due to the effects of the plasmids. Furthermore, that plasmids isolated from various heavy metal-tolerant bacterial species were successfully transformed into E. coli JM109 rendering the new metal-tolerant bacterial strain highly promising. The characteristics of the plasmid characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

TH141

Sensitivity of the waterside species, Yuukianura szetpycki (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 szetpycki, known as the species in which they live waterlogged, and their bioaccumulation amount were examined based on the ISO guideline 11267. After 28 days of exposure to tested metals, LC50 for adult survival and EC50 for reproduction were estimated. These toxicity values of Y. szetpycki were also compared to those of other collembolan species (F. candida and Paraschizaphorus kim) reported in literature to investigate their suitability as a new test species in toxicity test. Not only the adult survival but also the juvenile production of Y. szetpycki was tested in a concentration dependent manner after 28 days of exposure duration. Although the response of Y. szetpycki to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szetpycki to chemicals in the soil is considered to be very important. Because their special habitat can provide an understanding of ecotoxicity against certain environmental conditions.

TH143

Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments

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Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments

in a simplified soil solution system under the assumption that soil pore water is the main route of exposure to metals. After 7 days of exposure, survival and internal metal concentrations in P. kimi were determined. The free metal ion activity for each metal was calculated by the Visual MINTEQ using inputs of soil metal concentrations, cation and anion components of the soil solution, and pH of the soil solution. The toxicity of cadmium and zinc was linked to the fraction of biotic ligand sites occupied by free metals (i.e. Cd²⁺ and Zn²⁺). The results showed that the fraction of the biotic ligand occupied by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors affecting bioaccumulation and toxicity of metals.
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 to see whether such seasonal differences can be important for ERA. This study was supported by National Science Centre, Poland (2015/19/B/NZS/01939)

TH146 The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluvials - effects of soil and pest factors
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Organic wastes (OW) are used as soil amendments and fertilizers but they are also the major source of copper (Cu) and zinc (Zn) contamination in agricultural soils. The potential ecotoxicological effects of OW application on soil invertebrates depend on Cu and Zn availability in soils. The availability of Cu and Zn itself depends on their chemical speciation and consequently to the temporal evolution of soil parameters such as pH and organic carbon content and reactivity. These soil parameters are key parameters both influenced by the application of OW and the activity of soil organisms on the surrounding soil, i.e. the rhizosphere for plants. However, the ecotoxicological effects of OW applications and the compost effect are poorly documented when taking into account long-term impacts. Accordingly, we aimed at studying the relationship between the availability in soil and the phytoavailability of Cu and Zn in four decidual field trials that received different types of OW for more than ten years. Soils in the four field trials exhibited very different pH and organic carbon content. Copper and Zn availability was determined on 102 soil samples from the four field trials by (i) an equilibrium-based method using cupric ion selective electrode and the winemakers humic aqueous model (WHAM) to quantify Cu\(^{2+}\) and Zn\(^{2+}\) activities in soil solutions (pCu\(^{2+}\) and pZn\(^{2+}\)) and (ii) a kinetic method using the diffusive gradient in thin films (DGT) directly on soil samples. We measured key soil parameters in soil solutions to assess the relationship with pCu\(^{2+}\) and pZn\(^{2+}\). Copper and Zn phytoavailability is currently determined using the RHIZOtest which is a standardized biotest that is used to enable the measurement of 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. We then calculated the Cu and Zn phytoavailability for each sample by using the measured concentrations will enable to test whether Cu and Zn availability in unplanted soils determined Cu and Zn phytoavailability or whether root-induced chemical changes in the rhizosphere additionally determined it.

TH144 Toxic Effects of Cadmium on Chinese Cabbage, Foliosa 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 ,Foliosa candida(collembola) were used as the research object. The germination and root elongation of cabbage under different concentration of cadmium in soil were measured. The endpoint of the F. candida was reproduction. The results show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxicity threshold and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.

TH145 Do we plant protection products correctly? Impact of agrochemicals on non-target beetle, Bembidion lampros (Coleoptera: Carabidae)
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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 (NTAs), including the ground beetles (Carabidae), which are natural pest 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 moments to stop using pesticides. We need, therefore, to make every effort to enable the assessment of: (1) the magnitude of treatment effects on a study requires multiple sampling methods such as pitfall traps, mine traps, soil cores and sweep nets to account for different life histories of NTAs species and a team of qualified taxonomists to identify all organisms. In this study NTAs populations will be monitored for a three year period that covers at least two generations to enable the detection of any trans-generational effects that might occur. The current EU risk assessment scheme considers that effects on populations are acceptable for the in-field area above the threshold value of 50% if recovery or potential for recovery is demonstrated within 1 year. This study has been designed to enable the assessment of: (1) the magnitude of treatment effects on non-target
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 rate constants with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalyzed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

TH149 Effects of diuron and imidacloprid on eight nematode species
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To assess the potential and potential hazard using the herbicide imidacloprid (insecticide) on ubiquitous organisms at the basis of food webs, we performed multispaces toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. Diuron and imidacloprid belong to the top 15 of the most frequently detected pesticides in French rivers. Both chemicals show an elevated DT50 (time to 50% degradation) in sediments, about 130 days for imidacloprid and more than 30 days for diuron, constant with results comparable with steady-state bioavailability, a representative for the response of nematode species to toxic stress, showed no significant response to imidacloprid at high concentrations up to 119 mg L−1 regarding growth or reproduction. Diuron inhibited 82% of reproduction success of C. elegans, but showed no significant effect on growth at high concentration (33 mg L−1). Then, we compared the lethal effects of diuron and imidacloprid on eight species of free-living nematodes: Apherelochoides sp, Cuernorhabditis elegans, Pristionchus pacificus, Diploscapter coronatus, Rhabditoides sp, Plectus velox, Plectus opisthocrilus, Plectus acuminatus. Nematodes were exposed in water for 48h to two concentrations (35 and 350 mg L−1 for imidacloprid and 10 and 100 mg L−1 for diuron). Results indicated a low risk of these pesticides to nematodes, as the chemicals did not affect significantly the survivorship at their solubility limit in water for every tested species.

TH150 Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida
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The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (BDE47) on the springtill Folsomia candidae were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or BDE47 for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method and F1 generation in the second method. This suggests that PCP influences the reproductive capacity of adult springtails and the hatching of eggs or the mortality of juveniles. For BDE47, significant effects were only observed on F1 generation in the first method, which shows that BDE47 affects egg hatching, although the reproductive capacity of adults or the affected endpoints of springtails can be inferred by the two methods. PCP and BDE47 do not influence completely the same endpoints.

TH151 Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioaccumulation soil accumulation factor (BSAF) for risk assessment
K. Kots, ARCHE; J. Chowdhury, International Lead Association / Senior Scientist -Environment

Secondary poisoning to mammals and birds is a critical pathway for risk assessment of Pb in soil. This risk is generally assessed for the food-chain soil => earthworms => earthworm eating predators. Therefore, a correct evaluation of bioaccumulation of Pb in earthworms is essential for risk assessment of Pb in soils under the REACH Regulation and a literature review of biota-to-soil accumulation factors (BSAF) for Pb in earthworm species was made. To ensure that biota Pb burdens are in equilibrium with soil Pb concentrations, only data from field studies or laboratory studies using soil and biota collected at the same field site were considered. Data from laboratory studies where Pb was added to the soil as a Pb salt were only used as supporting evidence. In total, 248 BSAF values for earthworms were identified that meet the reliability criteria, ranging from 0.01 to 22.05 (dry weight basis, median 0.23). Results are available for several earthworm species, belonging to different ecological groups of earthworms: anecic, endogeic and epigeic earthworms. No distinct differences in BSAF values across these groups could be identified. BSAF values are derived in a wide range of soils and the data available can be considered as representative of earthworms in Europe. One of 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 cCEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.028 for soils with low and high cCEC values and are not significantly different for cCEC values in European soils. Implementation of effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

TH152 Hazard assessment of liquid organic hydrogen carriers in terrestrial environment
Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology; S. Stolte, University of Bremen / Centre for Environmental Research and Sustainable Technology Sustainable Technology; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology

A proactive environmental hazard assessment of liquid organic hydrogen carriers (LOHCs) – a novel energy system which can efficiently and relatively safely store and transport hydrogen – was conducted by characterisation of potential behaviours and ecotoxicities of these chemicals in soil environment. Adsorption properties of promising LOHC candidates including indoles, quinolines, carbazole derivatives, benzyloleulones and dibenzyloleulone in terms of carbon-water partition coefficients (Koc) were investigated via HPLC screening. Further characterisation was performed via adsorption isotherm modeling and soil column leaching with the examination of soil-water partition coefficients of the two analogues (Quin-2Me) as examples. Soil ecotoxicity was estimated for the quinolines in the soil bacteria Arthrobacter globiformis and Collembola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles > quinolines > carbazole derivatives > benzyloleulones > dibenzyloleulone. The mobility of LOHCs was thus classified as highly mobile, moderately mobile or immobile. Adsorption isotherm and column leaching showed the strongest adsorption and retention of the partially hydrogenated form (Quin-2Me-H) in soils. The H-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-lean form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH, while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinolines in the Arthrobacter at the highest test concentrations (500 mg L−1 and 750 mg kg−1 dry weight (dw) soil). Higher toxicity was found in the Collembola and malfonations
of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10 < LC₅₀ < 100 mg L⁻¹ (liquid-only exposure) and 100 < EC₅₀ < 1000 mg kg⁻¹ dw soil (calculated soil pore-water based) of the quinolines assigning these chemicals to category “harmful” to soil organisms. Predicted no-effect concentrations showed 1–3 orders of magnitude higher the effective concentrations than the former suggesting potential risks of the chemicals toward the soil environment and proper monitoring is needed in the application of the LOHCs. Key words: adsorption, bioavailability, hazard assessment

TH153 Combining field measurements and biotest to assess lead and zinc phytoavailability in contaminated urban soils M. Brunet, C. Chevassus-Rosset, CIRAD; L. Lemal, MetRHIZlab; M. Montes, G. Moussard, E. Simon, M. Tella, CIRAD; M. Valimier, MetRHIZlab; E. Doelsch, CIRAD / UPR Recyclage et risque; F. Feder, CIRAD; S. Legros, CIRAD / LITEN Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soils. 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 biotesti (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 them. As expected, field-collected plants exhibited a large range of Pb and Zn concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

TH154 Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation? K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; A. Huenmller, Fraunhofer IME; K. Schlich, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; F. Wege, Fraunhofer IME; G. Broll, University of Osnabrunck/ Institute of Geography Assessments of soil microflora under irrigation 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 needs of regulation into account. Lab-collected plants exhibited a large range of Pb concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.
A novel method for the simultaneous quantification of bracken fern-produced carcinogenic ptaquiloside-like compounds and their derivatives

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Significant variety of toxic secondary metabolites produced by plants appear in chemical structures of glycosidic molecules. These compounds are highly water soluble and mobile in soils and sediments. In cases when toxic glycosides are persistent and released in high loads from vegetation, evaluation of the risk to aquatic environments adjacent to drinking water supplies is needed. Nevertheless, there is no widely accepted approach and fatality of cyanobacteria species are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aquatic ecosystems. Bracken ferns (Pteridium aquilinum) are known to produce up to 6 kg/ha of carcinogenic ptaquiloside. Previous studies demonstrated laeching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – pterosin-aquillinum 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 pterosin-aquillinum and their respective pterosin-derivatives (6 compounds in total) to be used for the abovementioned study. The novel LC/MS method (Agilent 1200 Infinity HPLC / Triple Quad) could be applied for the separation and identification of the 6 compounds (3.0x50 mm, 2.7 µm), enables simultaneous determination of all 6 compounds with low limits of detection (1 ng/l) using loganin as an internal standard. The total time of analysis is 6 minutes and the system is operated under semi-UPLC conditions with a max. pressure of 400bar. Mobile phase with a low fraction of acetonitrile is applied (10% v/v). These features are favorable 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 Training Network NaToxAQ, 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 (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

A novel method for ptaquiloside and pterosin B preservation in groundwater samples

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Analyzing natural toxins in groundwater is challenging due to their labile and temporal variation of the six compounds in in plants, soils and surface waters. The project is part of the European Training Network NaToxAQ, 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 (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms

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New technology: Kentucky University and the U.S. EPA Office of Research Development in Cincinnati Agency are collaborating to develop a harmful algal bloom detection algorithm that estimates the presence of cyanobacteria in freshwater systems by image analysis. Green and blue-green algae exhibit different Hue-Saturation-Value color histograms in digital photographs. These differences are exploited by machine learning techniques to train a smart device (cellular phone, tablet, or similar) to detect the presence of cyanobacteria in a small surface portion of a freshwater system. The Harmful Algal Bloom Classification Application (HAB APP) has been field tested and verified to classify both green and blue-green algae. Specifically, the APP has been tested on several small streams and ponds, correctly classifying green algae bloom and has been tested on the Ohio River, correctly classifying blue-green algae in the 636-mile cyanobacteria bloom in summer 2015. The application is being tested via fixed camera monitoring stations and optimized at several locations along the Ohio River and in Lake Harsha, a 22,000-acre reservoir which supplies six million gallons per day of drinking water to the Ohio county in which it lies and is a source of many recreational activities, including swimming, boating, and fishing. The presence will be verified by other detection instruments and in vitro by agency scientists and hysteresis techniques will be used to drinking water (pressures) and a precursor on a per day (night/day) activity of the monitoring stations. Further, the APP is being extended to classify harmful algae microscopically at the genus level using a convolutional neural network approach.

Matrix-assisted laser desorption/ionization-time of flight mass spectrometry application for rapid screening of microcystins occurrence in northern Taiwan tap-water reservoirs

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Microcystins (MCs) are the most common hepatotoxins and tumour promoters produced by freshwater cyanobacteria. Due to the damaging the liver through inhibition of protein phosphatases 1 and 2A, they pose a serious health threat to humans and animals, and even inducing death. MC-LR and MC-YR are probably the most concern and toxic microcystins. They are also widely distributed and detected in the freshwater system worldwide. In this study, matrix-assisted laser desorption/ionization–time of flight mass spectrometry (MALDI-TOF-MS) technique was developed for the rapid screening of these 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 (less than 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 monitoring multi-class HAB odor compounds in water

C. Avagianos, M. Pisia, 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 sulfur compounds. Such compounds have detrimental effects to the aesthetic quality of water, making drinking water unacceptable by consumers and damaging recreational and tourism enterprizes 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 appropriate monitoring for early-warning and control of off-off 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 used for screening and optimization of these two Cs in two HAB stations and optimized at the aqueous environment. In this method, the APP is being extended to classify harmful algae microscopically at the genus level using a convolutional neural network approach.

Snelly HABs: response-surface optimized HS-SPME/GC/MS method for monitoring multi-class HAB odor compounds in water
easily computed for classes of compounds. The most significant factor was extraction temperature, especially for volatile early-eluting compounds where fine-tuning of temperature is essential to achieve the required sensitivity. The optimized automated HS-SPME-GC/MS method is proved to be a valuable tool for high-throughput, efficient and sensitive non-targeted screening of HAB odorous compounds, while sensitivity is further enhanced when certain classes of compounds are targeted, e.g. when sensory pre-evaluation of samples is applied. Acknowledgments: The authors thank CYANOCOST – COST Action ES 1105 www.cyanocost.net

THI163
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 microcosmos in periphyton formation. The community distribution is affected by water quality, flow regime, climate, and geology. During the past decades, there has been a noticeable increase of cyanobacterial blooms, dominating in many freshwater bodies worldwide. Some cyanobacteria species are known to produce toxic secondary metabolites called cyanotoxins, which vary in structure and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water supply and recreation at wetlands. The most widespread cyanotoxins are microcystin (MCs) variants MC-LR, RR, YR, with MC-LR being the most toxic one. For this reasons, the World Health Organization appointed a guideline of 1 μg/L in drinking water for total MC-LR. In order to monitor levels of cyanotoxins and prevent both human poisoning and wildlife damage, suitable analytical methods need to be developed. This work presents the development of a sensitive, fast, and robust method of analysis and detection on high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample pre-treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5 μm) using methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the potential presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanobacteria such as microcystins, nodularin, cylindrospermopsin, and anatoxin-a. The developed method was applied for the study and characterization of cyanotoxins concentrations in Catalonia freshwater reservoirs. Keywords: cyanotoxins, microcystins, high-resolution mass spectrometry.

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THI164
Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters
L. deiana. Water Research Institute National Research Council / National Water Research Institute; A. Barra Caraciolo. National Research Council / Water Research Institute; P. Gremni, National Research Council of Italy (CNR) / Water Research Institute; c. fajarud, Faculdad de Veterinaria, Complutense University Avenida Puerta de Hierro s/n, 28040 Madrid, Spain; M. Martin-Fernandez, UCM / Biochemistry and Molecular Biology; l. medlin, Marine Biological Association of the UK, The Citadel, Plymouth PL 2PB, UK. G. Mengs, Natural Biotec SL; m. saccci, Council for Agricultural Research and Economics (CREA), Agriculture and Environment Research Center (AA), Via di Corticella 133, 40128 Bologna, Italy; m. lettieri, European Commission, DG Joint Research Centre, Directorate D SWITCHABLE RESOURCES FOR WATER and Marine Resources TP 121, Via E.Ferrmi, 2749, 21027 Ipra (VA), Italy. Harmful cyanobacterial blooms have been increasing in freshwater ecosystems in recent decades, mainly because of eutrophication and climate change. In some cases, some cyanobacterial species can produce toxins and this phenomenon can have a negative impact and pose a risk for ecosystem and human health. Of the 15 known cyanobacteria genera, more than 40 species produce toxins, which are natural compounds showing different chemical and toxicological characteristics. Cyanobacterial toxins are responsible for both acute and chronic poisoning in animals and humans. Among the main classes of cyanotoxins, microcystins are among the most frequently found in the environment. These toxins are accumulated mainly in the liver, but also in the intestine and kidneys and can be very dangerous for both animal and human health (Lucernini and Ottaviani, 2011). Fast and sensitive methods to identify unequivocally Microcystis aeruginosa and Planktothrix agardhii are very useful to discriminate these species with respect to the other non-toxic cyanobacteria. For this purpose, we designed, developed and validated some oligonucleotide probes (GP1:Plankso302, PKAgD03, MicAerD03) for FISH (Fluorescence In-Situ Hybridization) analysis to detect these species in freshwater samples. The FISH probes were designed using the ARB software with the Silva database in the framework of the MicroCoKit project. We tested different fixative methods to minimise the natural autofluorescence from chlorophyll-a (Groben and Medlin, 2005).to visualize Microcystis aeruginosa and Planktothrix agardhii under a laser confocal microscope. Firstly, the FISH probes designed have been tested on pure cultures of M. aeruginosa and P. agardhii species, then the probes were successfully applied to natural samples collected from surface waters. Keywords: Microcystis aeruginosa; Planktothrix agardhii; FISH probes; algal bloom References Groben R. and Medlin L., 2005. In situ hybridization of phytoplankton using fluorescently labeled RNA probes. Methods in enzymology, 399:101-120. M. Lucernini, LU, M. Ottaviani, E. ML, 2011. Cyanobacterial toxins in water for human consumption: Guidelines for risk management. “National Group for cyanobacteria risk management in water for human consumption”, vol. 2, VIII, p. 67 Rapporti ISTITAN 11/35 Pt. 2

THI165
Ad качеству EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water
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Natural toxins constitute a potential risk to water supplies in Europe. Only a few cyanotoxins toxicokinetic and toxicodynamic models are available. In this work, we present the development of the aquatic ecotoxicity models for cyanotoxins that has been identified as human health hazards. The target evaluation of samples is applied. Acknowledgement: This work has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 722493.

References

THI166
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 need comprehensive and methodical tools to study and manage. Due to the complexity of natural toxins from various kingdoms, those produced by aquatic organisms have a direct entry into our water resources. More frequent and intense surface water blooms of cyanobacteria have triggered particular scientific interest in their secondary metabolites as potential aquatic toxins. The variety of cyanopeptides is well documented since the 1990s and the growing publication record reflects an increasing scientific awareness and understanding. Cyanopeptides can be found in a wide range of natural structures 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 cyanopeptides 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
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The carcinogen ptaquiloside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus Pteridium (Bracken fern) and Pseudobrachyglottis, where a part of the fern. PTA is suspected of causing Human gastric cancer. PTA is a nor-sesquiterpine glycoside and is not sorbed by soils to a great extent (logKow of approx. -0.5). Hence, PTA can leach from Bracken stands. Leaching is most prominent during rain but baseline levels are found in streams in Bracken infested areas. Soil contamination and contamination of upper aquifers has been observed on a number of occasions. PTA may contaminate groundwater resources. Dissipation of PTA under environmental conditions is governed by a number of factors: Enzymatic activity; pH (hydrolysis); irreversible sorption/reactions; and sorption to clay minerals. Bacterial activity and hydrolysis are the most important mechanisms causing dissipation of PTA. The purpose of this study was to describe the underlying mechanisms for the hydrolysis of PTA and formation of reaction products under near-sterile alkaline conditions as found in calcareous aquifers. PTA (4,700ppb) was deglycosidated using 0.1010/10.1 M NaOH and 3 different 0.025M buffer systems (approx. pH 7-12, NaHPO4/Na2HPO4/H3BO3; pH regulated with 0.1M NaOH). Dissipation of PTA and formation of reaction products were monitored up to 200hrs at 25°C, PTA and the main reaction product pterosin B (PTB) was quantified by LC-MS using SIM- and TIC-modes. Formation of other reaction products was analysed sequentially by using the relative area distribution of the main mass trace. Chemical rate constants are reported for degradation of PTA and species formation. Dissipation of PTA were pH dependent as previously observed. Addition of 0.01-1.0M NaOH results in immediate degradation of PTA and formation of a small amount of PTB plus two more reaction products. The concentration of PTB remained constant over time. PTB is the endproduct of hydrolysis in pure solutions. One reaction products was identified as the bracken dienone (BDE), a ultimate carcinogenic. BDE is formed immediately while the unknown is formed from BDE. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

TH168 Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins
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The octanol-water partitioning coefficient (Kow) remains one of the key parameters in environmental fate and risk assessment of organic chemicals for regulatory purposes.[1] Based on predicted Koc values, many natural toxins are expected to be mobile in the aquatic environment. If such toxins are not retained well in soils, they may move long distances before leaching to surface waters or downstream areas. Natural toxins, with physicochemical and structural complexity due to large numbers of various functional groups, current estimation models for Koc, and other phase distribution coefficients show limited applicability.[2] Thus, experimentally determined physicochemical property data are still of great value to regulatory organizations defining thresholds for potential environmental contaminants. In this study, Koc values are experimentally evaluated by both indirect and direct approaches based on well-established OECD methods modified for application in natural toxic analysis. A multi-step molecular size and functional group specific calibration procedure is applied in indirect evaluation of natural toxin partition properties based on chromatographic retention. Direct analysis of partitioning behavior is performed in a miniaturized shake flask system in standard HPLC vials. As HPLC based methods, both approaches show the capability to be largely automated for more efficient, less error-prone analysis and thus allow the reliable determination of Koc for the potential aquatic contaminants relevant range of log Koc from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoflavonoids as reference compounds in addition to representatives of the plant kingdom. In regards to predicted toxicity, persistence and mobility as well as plant occurrence, specific natural alkaloid subclasses such as pyrrolizidine alkaloids from Senecio spp. or quinolizidine alkaloids from Lupinus spp. are investigated in more detail. As an indicator for the partitioning of natural toxins from aqueous media to organic matrices, Koc values can be seen as first proxy estimating natural toxin mobility in the aquatic environment. Thus, experimental data will help in prioritizing of toxics for further research activities, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NaToxAg. [1] ECTOC; Technical Report No. 123, 2013 [2] Schenzel, et al.; Environ Sci Technol 2012.

TH169 Phytotoxins as aquatic micropollutants: a procedure for prioritization
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Phytotoxins are natural toxins produced by plants with widely varying molecular structures and toxic effects. Despite possibly high concentrations of natural toxins in vegetation, crops and freshwater, they are not yet commonly perceived as environmental contaminants of possible concern. This far, environmental exposure and effect studies have only been conducted for a very limited number of phytotoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytotoxins those that actually present a serious risk for the aquatic environment. For this purpose, we ranked 1586 phytotoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytotoxins. Toxicity was included as descriptor of the effect and 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 ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used as a proxy for previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC %: 0.1-7.4, pH 3.3-7.3). 0.25g of dry soil were equilibrated with 9ml 0.01M CaCl2 over-night. 1ml of pterosin B solution in 0.01M CaCl2 was added resulting in a Ceq of 0-10 mg L-1 (n=5-20). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI (SIM; 100µL injections; range 0-100 µg L-1; r2 > 0.999). Ceq were calculated as Ctotal / Ceq. Irreversible sorption and microbial degradation were considered in the model based on previous studies. Pterosin B sorb strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g-1 for the soils tested corresponding to a Koc values of 300-2,500 mL kg-1. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic matter. As Koc values can vary substantially, depending on soil type and properties like soil pH and mineralogy, sorption 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 the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work, we used the model code DAISY. A soil swelling-water retention model has been used. Modelling of natural toxin fate presents several challenges compared with xenobiotics: many and partly continuous sources, variable and poorly studied physicochemical properties of the toxins, highly variable temporal and spatial rates of transfer of the toxins from the source plant to soils, - often linked to specific events. This work focused on ptaquiloside (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The carcinogenic toxin is produced by bracken fern (Pteridium aquilimum) that usually forms dense stands. The PTA content in bracken is up to 9800 μg/g dry material. 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. Maximum PTA concentration in the leachate at a depth of 2 m were 2.5 and 1 μg l⁻¹ in a sandy loam and sandy soil, respectively. These could be "dietary" herbivores are exposed to the leachate 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. The model presents several uncertainties such as the toxin production in the biomass, seasonal variation in toxin concentrations and in particular, the transfer rates from plant to soil. Spraying is not an ideal "dosing" function and might overestimate the leaching, hence the results must be taken with caution.

TH172
Genotoxic insight into biosynthetic pathways 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 serious problems in aquatic ecosystems. One group of the recently discovered cyanobacterial toxic compounds are endocrine disruptors compounds retinoids. It has been documented that cyanobacteria are potent producers of retinoids and they are able to produce these compounds into their surrounding environment. However, our understanding how are retinoids 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 their role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic apparatus of retinoids in animals and provides an evolutionary comparison of all ALDH and CYP from publicly available genomes of cyanobacteria to well-characterized ALDH and CYP from human and mouse, which are involved in the biosynthesis of retinoids. This comprehensive phylogenetic study describes evolutionary similarity of cyanobacterial ALDH to human and mouse ALDH from family 1. This fact points out to a similar function of these enzymes in the biosynthetic machinery of retinoids. Based on these results, the most related cyanobacterial ALDHs (to human) were selected from different cyanobacterial genomes and heterologously expressed in direct cloning-proficient E. coli strain GB05-dir. Effectivity of expression reflected as the amount of produced retinoids was assessed by in vitro bioassay on cell line P19/A15 with endogenous expression of retinoid receptors stably transfected with reporter luciferase gene under the control of retinoic acid responsive element (RARE) markers (transient transfections). The concentration 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).

TH173
Emerging treatment methods for the removal of cyanotoxins from drinking water with focus on Advanced Oxidation Processes
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Cyanobacteria form blooms in freshwaters due to environmental pollution and can produce taste and odour compounds, but also substances that have been shown to be toxic to animals, humans and other organisms. Numerous events of cyanotoxin-associated poisonings of pets, livestock, birds, wildlife and humans, and in some cases even sublethal occurrence, occurred – and still occur – globally. These mainly waterborne secondary metabolites can adversely affect the quality of water intended for drinking and recreational purposes. So far, most countries have not yet enforced strict regulations regarding maximum tolerable cyanotoxin levels in drinking water. Some countries adapted the WHO provisional guideline value of 1 μg/l for microcystin-LR or amended it for country-specific regulatory values. Due to their diversity, fluctuating environmental occurrence and concentration, conventional drinking water treatment can result in insufficient removal of cyanotoxins. Advanced Oxidation Processes (AOPs) are emerging treatment methods that have been shown to be very promising for the removal of organic pollutants in general, also providing a potential for the removal of cyanotoxins. AOPs promote the in situ formation of highly reactive radicals, mainly hydroxyl radicals, and other mechanisms. Hydroxyl radicals are non-selective and randomly attacking oxidants, usually reacting with rate constants orders of magnitude higher than for other oxidants. So far, most research focuses on treatment of microcystins, but other toxin classes such as nodularins, saxitoxins, cylindrospermopsins and anatoxins have also been shown to be susceptible to be removed by AOP treatment. The most often reported AOPs for the removal of cyanotoxins include ozonation, (photo)-fenton oxidation, direct and catalyst-enhanced photocatalysis, and combinations of these or with hydrogen peroxide. Lesser studied, but still very promising AOPs for the removal of cyanotoxins from drinking water are sonolytic and hydrodynamic cavitation, electrochemical oxidation, radiolysis and other novel approaches such as those based on non-thermal plasmas. The present paper summarizes pros and cons of AOP technologies for the removal of cyanotoxins from drinking water and presents the to experimental (and more toxic) forms characterizing the potential and novel AOPs for the removal of less explored cyanobacterial metabolites and their mixtures.

TH174
An overview of the effects and bioaccumulation of ciguatoxins in fish
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Ciguatera Fish Poisoning (CFP), the most common non-bacterial seafood intoxication caused by consumption of fish containing the ciguatoxins (CTXs), a family of bioactive marine polyether toxins (Figure 1) known as ciguatoxins (CTXs), that target voltage gated sodium (Na+) and potassium (K+) channels. CTXs enter the food web through consumption of Gambierdiscus spp. dinoflagellates by herbivorous fish. It is well established that the algal CTXs undergo biotransformation in fish organisms (oxidative metabolism) as they pass from the gill into the marine food web. The detailed mechanism of formation of highly reactive radicals, mainly hydroxyl radicals, and other mechanisms. Hydroxyl radicals are non-selective and randomly attacking oxidants, usually reacting with rate constants orders of magnitude higher than for other oxidants. So far, most research focuses on treatment of microcystins, but other toxin classes such as nodularins, saxitoxins, cylindrospermopsins and anatoxins have also been shown to be susceptible to be removed by AOP treatment. The most often reported AOPs for the removal of cyanotoxins include ozonation, (photo)-fenton oxidation, direct and catalyst-enhanced photocatalysis, and combinations of these or with hydrogen peroxide. Lesser studied, but still very promising AOPs for the removal of cyanotoxins from drinking water are sonolytic and hydrodynamic cavitation, electrochemical oxidation, radiolysis and other novel approaches such as those based on non-thermal plasmas. The present paper summarizes pros and cons of AOP technologies for the removal of cyanotoxins from drinking water and presents the to experimental (and more toxic) forms characterizing the potential and novel AOPs for the removal of less explored cyanobacterial metabolites and their mixtures.

TH175
AFLATOXIN CONTAMINATION IN IMPORTED NUTS FOR DIRECT HUMAN CONSUMPTION: THREE YEARS (2013-2015) OF OFFICIAL CONTROL RESULTS IN ITALY
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Aflatoxins (AFs) are the most toxic group of mycotoxin and secondary metabolites of various species of Aspergillus that can occur in all agricultural commodities under appropriated field or storage conditions. These molecules can cause important health problems and have high potential toxic effects. A validated Enzyme Linked Immuno Assay (ELISA) to monitoring the presence of aflatoxin
B1 (AFB1) and total aflatoxin (AFT), as a screening test, was used in order to analyze imported nuts, from non-European countries, intended for direct human consumption. The percentage of AFTs positive samples (only pistachios and almonds), taken during the three years from 2013 to 2015, under the national programs of official control, amounted to 9% for B1 and 10.5% for AFT, and were confirmed by HPLC (High Performance Liquid Chromatography). The results demonstrated that AFB1 isolated from Turkish pistachios and AFT isolated from Turkish almonds, and that ELISA is a sensitive screening method to monitoring residue levels. The aflatoxin levels in pistachios exceeded even more than five times the maximum permitted levels set by European Commission in Reg 165/2010 and referred to the edible part of the tree nuts. The higher incidence of AFBs in imported shelled pistachios is probably due mostly to an easier aflatoxin contamination following the fact that the pistachios are stored in high moist conditions, and more resistant to the A. flavus colonization. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in mycotoxin field, due to the great utility of low-cost, rapid and reliable methods of analysis.

TH176
Impact of climate change drivers on toxin contamination and genotoxicity in Mytilus galloprovincialis: combined effects of warming, acidification and harmful algal blooms.
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Mytilus galloprovincialis under current environmental conditions and at conditions simulating scenarios of climate change, namely warming, acidification and the combination of these two factors were exposed to paralytic shellfish poisoning (PSP) toxin-producing *Gymnodinium catenatum*. Shellfish toxicity derived from accumulation of algal toxins was assessed in mussels at the four treatments as well as the damage at DNA level via the comet assay. Mussels were acclimated for 21 days and then exposed to *G. catenatum*, during 5 days (uptake), followed by 10 days with non-toxic diet (elimination). The analyses of PSP toxins in the mussels were carried out by Liquid Chromatography with Fluorescence detection. The highest PSP content was observed at day 5 in mussels in the actual conditions (1493.8 ± 202.4 µg STXeq. kg⁻¹), which exceeded the international seafood safety limits (800 µg STXeq. kg⁻¹). Significantly lower PSP content was observed in mussels under climate change scenarios. The lowest levels (661.9 ± 22.8 µg STXeq. kg⁻¹) were found in warm-acclimated mussels, followed by acidification (761.2 ± 62.3 µg STXeq. kg⁻¹). However, interaction of both parameters did not reveal an additive effect. Lower toxin elimination was observed in warm-acclimated mussels. Genotoxicity was assessed in gills and hepatopancreas of mussels sampled at the end of each period. In mussels not exposed to toxic algae, the comet assay revealed highest damage levels in mussels under combined effects of warming and acidification at the end of the experiment (i.e after 36 days). When mussels were exposed to *G. catenatum*, DNA damage in both gills and in hepatopancreas significantly increased at an earlier stage, i.e just after the uptake period. The treatments representing the acidification scenario and the interaction with warming with acidification revealed higher DNA damage than the actual conditions, highlighting a synergistic impact. DNA damage decreased in all treatments at the end of the elimination period, although reduction was subtle in mussels under interaction of warming and acidification. This is the first study assessing the impact of the combined effect of warming, acidification and biotoxins in shellfish. In conclusion, it was provided evidences that changes of global conditions may lead to lower PSP contents, but also to slower elimination rates and to a synergistic effect on DNA damage implying possible consequences for the mussels populations.

TH177
Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems
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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 most cytotoxic cyanobacterial microcystins (MCs) effects on organisms is overall quite well documented. However, the neurotoxin β-methylamino-L-alanine (BMAA), suspected to be a causative agent in the human neurodegenerative disease amyotrophic lateral sclerosis (SLA), is less studied. The bioaccumulation of BMAA has recently been demonstrated with highly selective analytical methods in various marine organisms (zooplankton, mussel, oyster, fish), but rarely in freshwater organisms. Bivalves such as species such as cyanobacteria or diatoms, both known to produce BMAA, and can be used as sentinel organisms to reveal the environmental contamination. A dual approach, in the laboratory and in situ, is used to evaluate the pertinence of the bivalves Anodonta anodonta, Dreissena polymorpha and *Mytilus edulis* as bioindicators of the contamination of fresh and estuarine waters by MCs and BMAA. The laboratory approach consist in the evaluation of the kinetics of BMAA and MCs accumulation and detoxification in bivalves at various times and concentrations of exposure. The in situ approach consist in the evaluation of the MCs and BMAA accumulation in caged bivalves along a river continuum from with strong freshwater bodies to estuarine coastal areas used for mussel aquacultures. First results show MC and BMAA accumulation in laboratory-exposed *D. polymorpha* and *A. anodonta*, with varying kinetics. Freshwater and marine bivalves also accumulated MCs in situ and a MC transfer from fresh to estuarine waters occurred, highlighted by an accumulation in the marine bivalve *M. edulis*. The results of this project will facilitate the long-term tracking of the contamination of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecodiversity 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] Successfully, TTX was isolated from other marine and terrestrial animals, as xanthid crab, trumpet shellfish, blue-ringed octopus, gastropods, starfish, and frogs. The wide distribution of TTX in genetically unrelated organisms has made TTX origin for long time controversial, with different kind of bacteria being identified as TTX-producing organisms [2].

Even *Alexandrium tamarense* – one of the paralytic shellfish poisoning toxins (PST) producing organisms – was proposed as potential biogenetic source of TTX [3]. Although fatal human poisonings following consumption of TTX-contaminated seafood have been reported so far only in Japan, the accumulation of TTX in fish, oysters and mussels collected in Europe (Spain, Portugal, UK, Greece) has been recently reported. So, in the frame of a collaborative study on evaluation of PST-related risk in the Mediterranean area, mussels collected in the Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophilic interaction liquid chromatography coupled with both high resolution 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 g/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 g/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.

The aim of this study was to investigate the profiles of volatile and odorous compounds in natural freshwaters of Greece as well as in cyanobacteria. T&O include terpenoids, ionones, amines, carbonylic and sulfurous compounds, as well as alkenes, alkenes, and alkenes. The other species found in CYN- and ANA- species included trimethyamine (fishy), dimethyl- and dimethyl-sulfide (septic), methanethiol (septic), b-cyclocitrinal (tobacco), a- and b-ironones (floral). Interestingly, results showed that in surface water bodies of Greece geosmin and MIB have a minor role, while other T&O compounds having characteristic odor (e.g. fishy, swampy) may be more important. Based on the findings of T&O profiles of cyanobacteria strains. The diversity and odor profile of cyanobacterial samples were developed. It is concluded that non-targeted HS-SPME/GC/MS analysis is an effective and efficient technique for wide-range screening of cyanobacterial T&O compounds in water. Volatile and odorous metabolite profiles of cyanobacterial strains can be useful in interpreting T&O incidents in natural surface waters and water reservoirs. To better understand and anticipate T&O incidents, monitoring should be extended to compounds beyond geosmin and MIB.

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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 FAs have important communication and signaling roles within and between cells. Fatty acid profile showed to be a sensitive and highly informative parameter to address effects of marine macroalgae toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH184 Impacts of _Asparagopsis armata_ on marine invertebrates: behavioral and biochemical responses**  
C.O. Silva, Polytechnic Institute of Leiria; C.E. Silva, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria  
The introduction of non-native seaweeds outside their native 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 seaweeds, vertebrates, and invertebrates leading to severe consequences for coastal ecosystems. The main objective of this study was to evaluate the potential impact of _A. armata_ on marine invertebrates by exposing the common prawn _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. Affers of macroalgal exudates was assessed by toxicity tests and the intensity of toxic effects were measured by body mass loss. 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 for biomarker compounds associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurototoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for _G. umbilicalis_ and the avoidance behavior for _P. serratus_. The biomarker responses analysed on invertebrates showed an impact on their physiological status after exposure to this alga exudate, with both species suffering from disruptions in their neuronal and energy metabolism functions, as well as from oxidative stress inducing damage in their macromolecules. Behavioural responses were also highly sensitive to _Asparagopsis_ exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of potential health risks linked to _CYN_-producing blooms. Exposure to _CYN_ occurs primarily orally, causing hepatotoxic effects. However, extrahaemoplastic manifestations of _CYN_ toxicity have also been reported and adverse respiratory conditions have been frequently linked to cyanobacterial blooms. Detection of cyanobacterial toxins in aerosols and dust particles raises the question of potential associated hazard of human exposure via inhalation. The susceptibility and vulnerability of human bronchial epithelia to _CYN_ were investigated in vitro. To assess inhalation toxicity on airway epithelia, monolayers of immortalized human bronchial epithelial cells (HBE1 and 16HBE14o) were exposed to a concentration range of 0.1-5 μM _CYN_. Cytotoxic endpoints were assessed as morphologic alterations, resazurin reduction capacity, esterase activity, membrane integrity and by real-time cell analysis. Both cell lines were sensitive to _CYN_. Depending on the endpoint assessed, EC50 values ranged between 0.8-2.1 μM (HBE1) and 1.6-4.8 μM (16HBE14o). To evaluate alterations of other cellular events by sub-cytotoxic concentrations of _CYN_, phosphorylation of regulatory switches, mitogen-activated protein kinases (MAPKs) ERK and p38, was evaluated. After prolonged exposure (4-8 h), stress-activated MAPK p38 was hyperphosphorylated in both cell lines, while elevated phosphorylation levels of ERK following _CYN_ treatment were detected only in 16HBE14o- cells. This study suggests possible hazards of _CYN_ inhalation, which might affect the integrity of airway epithelia and epithelial cell signalling, including chronic inflammation due to increased p38 hyperphosphorylation. Further research of _CYN_-induced toxicity and underlying mechanisms is needed, as well as more data on environmental concentrations of _CYN_ in aerosols and exposure assessment. The research was supported by the Czech Science Foundation Grant No. G17-25279Y and from H2020-MSCA-ITN-2016 Project No.722493 NaToxAQ.

**TH185 Assessing consumption risks through cadmium-contaminated shellfish amplified by ocean acidification**  
W. Chen, Kangshen University / Dept Biological Science and Environmental Biology; H. Lin, National Taiwan University; S. Chen, Chung Shan Medical University / Public Health  
The purpose of this study is to assess the human health risk of Taiwan population through consumption of cadmium-contaminated hard clam and oyster amplified by ocean acidification. This study employed forecasted ocean surface pH from the coupled model project planned projected emission scenarios representative concentration pathways 8.5, and Cd distribution as 0.001 – 2 μg L⁻¹ in Taiwan coast to estimate potential Cd accumulation of shellfish. A gender-specific physiologically-based pharmacokinetic model was developed to assess urinary and blood Cd concentration via daily shellfish consumption. The dose-response function was used to account for the prevalence of renal dysfunction and osteoporosis in response to human accumulated Cd in urine and blood. Results showed that median Cd accumulations under current and 2100 ocean acidification scenario were, respectively, 0.0009 and 0.0010 μg g⁻¹ for hard clam, whereas 0.0186 and 0.0210 μg g⁻¹ were estimated for the oyster. The urinary Cd concentration in female had potential 80% higher for ocean acidification scenario than that for non-ocean acidification. However, results revealed that exceedance risks of renal dysfunction and osteoporosis for gender-specific consumption only and whole groups under 2100 ocean acidification were no significant different with that of current non-ocean acidification scenario. This study concluded that ocean acidification was not likely to increase synergistically the renal dysfunction and osteoporosis of human health risk through shellfish consumption.

**TH186 Cyanobacterial toxins - a threat to the human respiratory tract?**  
B. Kabščková, Masaryk University, Faculty of Science; P. Laboha, Masaryk University / Research Centre for Toxic Compounds in the Environment RECETOX; J. Hildebrandt, Universität Greifswald / Animal Physiology and Biochemistry; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX  
Cyanotoxins such as microcystin- and anatoxin-producing blooms, pose an increasing threat to the human respiratory tract. Microcystin (CYN) is a highly toxic secondary metabolite produced by numerous cyanobacterial species. The respiratory system is a primary route of human exposure, and inhalation is frequently a prominent route of human intake of _CYN_. Microcystin intoxication can lead to health threat. Microcystin (CYN) toxicity may affect different organs and systems, including the lung, kidney, and gastrointestinal tract. Furthermore, it has been shown that _CYN_ has the capacity to alter alveolar epithelial cell permeability and thereby induce pulmonary edema. However, the effective concentration of _CYN_ required to induce pulmonary edema is not known. In the present study, we investigated effects of _CYN_ in human bronchial epithelial cell lines (HBE1, 16HBE14o) under conditions of acute and chronic exposure in vitro. To do so, we investigated effects of _CYN_ on the integrity of airway epithelia and epithelial cell signalling, including chronic inflammation due to increased p38 hyperphosphorylation. Furthermore, research of _CYN_-induced toxicity and underlying mechanisms is needed, as well as more data on environmental concentrations of _CYN_ in aerosols and exposure assessment. The research was supported by the Czech Science Foundation Grant No. G17-25279Y and from H2020-MSCA-ITN-2016 Project No.722493 NaToxAQ.

**TH187 Effects of microcystin-LR and cyanobacterial LPS in human airway in vitro models**  
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Intensified occurrence of toxic cyanobacterial blooms is becoming a major human health threat. Microcystin-LR (MCLR) is probably the most frequent and abundant cyanotoxin detected in the environment, known to induce primarily hepatotoxic effects. In addition, MCLR is believed to induce other effects, also on lungs and respiratory system following both inhalational exposure as well as oral or intraperitoneal administration of the toxin. Therefore, we investigated effects of MCLR in human bronchial epithelial cell lines (HBE1, 16HBE14o, BEAS-2B). Cyanobacterial lipopolysaccharides (LPS) represent another bioactive component of cyanobacterial biomass, which is likely to expose human beings simultaneously with MCLR, thus we studied also effects of LPS isolated from a culture of cyanobacterium _Microcystis aeruginosa_ PCC7806. Dose- and time-dependent formation of MCLR-protein adducts was observed in the exposed human bronchial cells. Several genes from OATP family previously implicated in the cell uptake of MCLR were found to be expressed in HBE1 and/or 16HBE14o- cells. Nevertheless, MCLR (up to 20 μM and 48 h) did not induce significant cytotoxic effects. MCLR targets protein phosphatases (PP1/PP2A), which are the major regulators of MAPKs ERK and p38. Although protein adducts with the molecular weight corresponding to MCLR-PP2A complex were detected, MCLR did not alter phosphorylation of MAPKs ERK1/2 and p38 in bronchial cell lines. Short
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercellular communication in bronchial cell lines. Regardless MCLR cell uptake, the toxin was relatively less cytotoxic to human bronchial epithelial cells when compared to the effects of other cyanotoxins (e.g. cylindrospermopsin), or in comparison with other cell types (e.g. hepatic or neural cells). Further experiments should focus on more detailed characterization of MCLR uptake and on long term effects of MCLR and LPS on inflammation-related endpoints. Inhalation toxicity of other hazards such as cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also be investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-23279Y and H2020-MSCA-ITN-2016 Project No.722493 NaToxq.

TH188
Estrogene and retinoid-like activity in stagnant waters
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classical in vitro and in vivo assays are used to assess effects on the development, reproduction or apoptosis. However, more recent data suggest that still other compounds with retinoid receptor-mediated modes of action are present. Our study highlights the ability of co-occurring endocrine-disrupting compounds to alter hormone signalling and development in aquatic organisms.
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, pyrophosphoryl and chloroplastic photosynthesis, and tetr updoid backbone biosynthesis-related pathways, and the induction of thiocysteine, 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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Developments in the use of bioassays for chemical and environmental risk assessment (P)

TH194 Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida) P. Irate, E. Guidolin, University of Padua, Department of Biology; F. Manea, Regional Agency for the Environment, ARPA Veneto, Verona / Lab. 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 / Lab. Operative Service - Verona; L. Tallandini, University of Padova / Department of Biology The aim of this work was to perform with the Sediment dwelling invertebrate Dendrobaena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (lysosomal and mitochondrial stability), and at tissue level (GPX and MTs), following the exposure to two perfluorinated alkyl acids (PFOA and PFBS) for short (72 h) and long (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/unAs 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/unAn 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 premature data don’t show significant differences between control and treated organisms regarding the GPX activity. A significant MT total decrease was detected after PFOA exposure, both at 14 and 28 days while PFBS exposure only at 14 days. As for MT, because it has been reported that PFSAs 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/unOur 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.

TH195 Toxicity of Per- and Polyfluoroalkyl substances on Chironomus dilutus for use in a relative toxicity model C.J. McCarthy, CH2M / Environmental Services; M. Stanaway, B. Muckey, Test America; C. Salice, Towson University / Environmental Science & Science Dept.; D. Wright, CH2M Per- and polyfluoroalkyl substances (PFASs), including perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) are commonly elevated in soil and groundwater. High detection frequency and concentration has resulted in identification of PFASs as compounds of interest and as emerging contaminants due to their regulatory uncertainty. Published toxicological research to date relates to PFOS and PFOA only and for a limited number of organisms. The lack of robust and defensible ecotoxicity data on other PFASs hinders risk assessment and leads to unsupported risk management decisions. Given this gap in understanding of the additional compounds, the Strategic Environmental Research and Development Program (SERDP) is funding research of these additional PFAS and classes of organisms. This discussion will summarize the first phase of a SERDP research grant to address these needs. Tests were conducted with a common aquatic test species to identify patterns of relative toxicity between the PFASs. Chironomus dilutus tests included a 96-hour reference toxicant test, a 10-day range finding test, and a 20-day definitive bioassay. For shorter duration Chironomus tests, the main endpoint of interest was survival while for longer-duration tests (20 days), the more sensitive growth endpoint was measured. Opportunistic measurements of depuration were also included to enhance the understanding of potential toxicity to these compounds. Test results will ultimately be used in conjunction with concurrent tests being conducted with avian and reptilian model species to the same chemicals to develop a relative toxicity model. Endpoints measures from the aquatic species tests will be used to identify clear patterns of relative toxicity of the tested PFASs. Results will inform and prioritize PFAS testing on avian and reptilian species. In addition, the relative potency patterns observed after aquatic testing will be reassessed upon completion of the upper trophic level exposure studies. Once all phases of toxicity testing are complete, the results will be used to help develop a
interactions. A change in the dimer knowledge has not been previously reported, may be allosteric interactions of the co-triphenyl phosphate), and the OP diester DPHP (diphenyl phosphate), to (tris(1,3-tetrabromo-tetrahydroxybenzene (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Debrominated photodegradates of TeDB-DiPhOBz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4'-OH-2,2',4'-tetrabromo-DiPhOBz. Chemically related methoxylated tetra- 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 hormonemia of 2,2',4'-DiPhOBz. Three strains of S. oryzae – 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 thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive. In silico and in vitro studies of dihalogenated soil 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 TH. Overall, the results indicated both species- and structure-related differences in binding affinities of these ligands, and suggest there is potential for these xenogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

Thyroxine to Human Transthyretin In Vitro
Organophosphate Triesters and Selected Metabolites Enhance the Binding of

organic phosphate triesters and selected metabolites enhance the binding of
thyroxine to human transthyretin in vitro

Tetrabromo-1,4-diphenyloxybenzene (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Debrominated photodegradates of TeDB-DiPhOBz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4'-OH-2,2',4'-tetrabromo-DiPhOBz. Chemically related methoxylated tetra- 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 hormonemia of 2,2',4'-DiPhOBz. Three strains of S. oryzae – 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 thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive. In silico and in vitro studies of dihalogenated soil 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 TH. Overall, the results indicated both species- and structure-related differences in binding affinities of these ligands, and suggest there is potential for these xenogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

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 report. In South Korea, Sitophilus oryzae has been developed phosphine resistance after the severe use of phosphine. In this study, how S. oryzae survived under the recommended dose of phosphine and we assessed the biochemical and molecular mechanisms for referring phosphine resistance. Three strains of S. oryzae were prepared as control groups (C), medium-resistant group (MR), and strong resistant groups (R) for this study. One of target sites of phosphine is cytochrome c oxidase (COX) and we analyzed the enzyme activities within the three strains. The highest COX activities were found in R groups with about 1.5-fold increase when compared to the controls. IC50 values on the COX activity by ethyl formate, one of COX inhibitors, was 2.82, 7.71 and 16.55μM for C, MR and R strains. Lineweaver-Burk plot for COX using ethyl formate exhibited different modes from R strain to C strains. And six genes cat, jhip, voltage, casp, wnt7, wnt11 were analyzed using RT-PCR for comparing gene expression and cat gene was dramatically down-regulated in the R strain. jhip gene expressing juvenile hormone inducible protein was differentially expressed in the two phosphine-resistant strains, while it was also up-regulated in C strain, but it was not so big different. Three biomarker enzymes such as acetylcholinesterase, glutathione S-transferase, and carboxylesterase activities were also determined within the three strains. Only glutathione S-transferase activity decreased in the R strain. Taken together, phosphine resistance in S. oryzae may be related to the changes in COX enzyme and up-regulation of jhip gene expressing juvenile hormone inducible protein.

Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS

S. Baik, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kim, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe / Environmental Safety Group

Glutathione is a important non-protein compound and existed in both internal and external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) of glutathione is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, using high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very potentential for a better understanding of the biological effects of these xenogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS

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Glutathione is a important non-protein compound and existed in both internal and external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) of glutathione is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, using high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very potentential for a better understanding of the biological effects of these xenogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.
50mM, sensitivities of GSH and GSSG were increased from 0.0034 to 0.0072 and 0.028 to 0.046, respectively. Detection limits of both GSH and GSSG were also significantly lowered as using higher concentration of ammonium acetate. This indicates that producing ammonium adducts followed by dissociating ammonium ions from adducts to protonate GSH and GSSG is important mechanism for protonation of these compounds with using ammonium acetate as a mobile phase additive. This enhanced detection sensitivity was due to ZEL (Z) to investigate the recovery of both GSH and GSSG and achieved more than 100% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZEL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZFL exposed to different concentrations of a target chemical as well as 6 mg/L of H₂O₂, a negative control. The lowest concentration of GSSG in this work was 5.0 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 long time ago, contaminants are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly consumed organisms like bivalves. Given that it is unrealistic to assess every possible combination of chemical substances accumulated by organisms, the major challenge now is to develop systematic ways of addressing these chemical mixtures, and to identify priority mixtures of potential concern. For this purpose, the profiling of the xenometabolome, or range of xenobiotics and their metabolites in an organism exposed to environmental contaminants, seems to be the way forward. In the present work, for the profiling of the xenometabolome, a fast analytical method has been developed for the extraction and identification of priority contaminants in bivalves from Ebro Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebro Delta and possible sources of contamination. Taking into account the information, a mixture of components representative of the different contaminant sources identified in the area was selected. This mixture including pesticides, plasticizers, antibiotics, preservatives, stimulants, and pharmaceuticals was used for a recovery study with three different bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the targets. The purifications 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 (PVP) 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 eco toxicological bioassays (Vibrio Fischeri, Daphnia magna and Vicia faba), microbiological analysis (Salmonella spp, Staphylococcus spp, Clostridium spp, and Campylobacter uprigin and virological analysis for Enterovirus, HAV and HEV, Norovirus NoGI and NoGII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41. The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The eco toxicological analysis (a set of the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and original vision of the qualitative state of the ecosystem. In conclusion these results highlighted the different levels of alteration and the potential need for the primary prevention and restoration, confirming that an ecosystem approach plays a key role in the ecological and human health risk assessments.

TH204 INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT
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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 information in order to feed up and perform consistent handling of relevant data. The NIVA RAdb compile available experimental and predicted (computational) effect data that range from molecular and cellular responses characterising the mode of action (MOA), typically derived from high-throughput and high-content (in vitro) bioassays, to (apical) adverse data derived from whole organism bioassays of potential regulatory relevance. These effect data are assembled within the context of Adverse Outcome Paths (AOPs) by anchoring data to initial cellular responses referred to as molecular initiating events (MIE), to downstream key events (KE) at the cellular/organ level and finally to adverse outcomes (AO) at the individual or organism level. The resulting multi-level assemblies of data can be used in hazard assessment to identify the MOA of one or more stressors, to link molecular responses to higher organisation level effects and to identify potential stressors among large assemblies of pollutants that can give rise to a given AO. The NIVA RAdb also support risk assessment by calculating risk quotients (RQs) of single pollutants and mixtures of these on basis of exposure (typically measured or predicted environmental concentrations) and effect data (typically NOEC, ECx, PNEC or EQS values) and can identify risk drivers (most toxic chemicals), relevant toxic endpoints (i.e. MIE, KE and AO) and susceptible species for a given exposure scenario. Recent developments including integration of non-chemical stressors such as ionizing and non-ionizing radiation,examples on uses on specific exposure scenarios will be presented to show the utility of the databases and the tools developed. Acknowledgements: RCN projects 221455-EDRISK (www.niva.no/edrisk), 268294 MixRisk (www.niva.no/mixrisk), 223268 CEERAD (www.mmbu.no/en/services/centers/ceerad) and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).

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 pollutants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs on marine organisms. OBJECTIVES: The influence of marine bivalve Mytilus posed by environmentally relevant concentrations of microplastic polystyrene (PS-MPs) and MPs based on bioassay results from related published literature. METHODS: We used Hill-based dose-response model to simulate the effects of PS-MPs on the lysosomal destabilization and phagocytosis in bivalves. The predicted no-effect concentrations (PNECs) causing 1% inhibition of immune function were also estimated. We developed a risk-biased 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, implicating that phagocytosis is a more sensitive endpoint for immune responses in bivalves. In addition, our results demonstrated that the North Pacific Ocean appeared to be the greatest risks among global oceans. CONCLUSIONS: The strict thresholds estimated by applying a environmental risk assessment framework could be recommended as a criteria for environmental management of PS-MPs or MPs. Potential effects of PS-MPs/MPs on marine organisms at higher trophic levels should also be taken into consideration. Keywords: Polystyrene microplastics; Bivalve; Environmental risk assessment; Predicted no-effect concentration; Predicted environmental concentration; Hazard quotient

TH207
Innovative Design of Nationwide Dutch Water Quality Monitoring
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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 these locations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality. Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is however important to use 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 and water quality of surface waters by monitoring the presence of 45 priority substances. However, these substances are often banned and their concentration in surface waters is strongly decreased, frequently to levels below the limits of detection. Simultaneously, industries have switched to a myriad of alternative compounds that have serious impacts on water quality, most of which are not listed as priority substances. Consequently, a large portion of the observed toxic effects of surface waters cannot be attributed to compounds measured by the water authorities. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy, applied in a nationwide water quality assessment campaign in The Netherlands. The smart monitoring strategy involves 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 daphnid test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in vitro bioassays were conducted: (i) activated 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 - estuarine biota as indicators of drinking water quality
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EU commission Water Framework Directive considers employment of passive sampling and use of effect-based tools in the monitoring of aquatic pollution. A combination of both approaches was used for monitoring of two rivers differing significantly in pollution levels. The Bosna, moderate-sized river in Bosnia-Herzegovina, which is burdened by untreated wastewaters, was sampled by semipermeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampler device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance reference compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or determined from the collected chemicals. Afterwards, the samples 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 (BEQs) of respective model compounds in water. The BEQs 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 (BEQs). The concentrations of bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQs. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQs was comparable with the BEQs levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the complementary assessment of the biological potentials of the 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 harpacticoid copepod species Nitocra spinipes using passive sampler extracts
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The use of passive sampling as a tool in environmental monitoring has gained wide acceptance within the past decades. More recently the possibilities of combining passive sampling and biotesting gained higher attention and researchers focus on reconstituting environmentally realistic contaminant mixtures in aquatic biotests. 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 integration samplers (e.g. Speedisk™) 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 to study the interaction between passive sampling and biotesting with realistic contaminant mixtures in terms of qualitative chemical composition. In the current study we extracted Speedisk™ passive samplers that were deployed for 8 weeks in two Belgian harbours and one location next to one of the harbours to spike a 7-day larval development test with the harpacticoid copepod Nitocra spinipes following ISO 18220. In order to fractionate the compounds on the Speedisks™ we followed two different procedures: a sequential and a parallel extraction approach using three solvents: acetoneitrile, ethyl acetate and dichromomethane. We exposed 80 larvae divided into 8 replicates in a fully randomized setup including controls and solvent controls to each of the Speedisk™ extracts and counted larvae and copepodites after 7 and 14 days. In order to fractionate the compounds on the Speedisks™ we followed two different procedures: a sequential and a parallel extraction approach using three solvents: acetoneitrile, ethyl acetate and dichromomethane. We exposed 80 larvae divided into 8 replicates in a fully randomized setup including controls and solvent controls to each of the Speedisk™ extracts and counted larvae and copepodites after 7 and 14 days.
5, 6 and 7 days to calculate the larval development ratio. Results showed no statistically significant developmental effects for all tested extracts. The tested concentrations after solvent spiking in our test system were slightly below environmentally realistic contaminant concentration levels. Overall the larvae showed to be unaffected by the exposure to the SpeediSK™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of *N. spinipes*.

**TH211**

Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures.

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The passive dosing approach is currently focused on hydrophobic organic substances. Dosing phases such as polydimethylsiloxane (PDMS) silicone are suitable for this task, but also limit the approach to specifically this group of substances. However, metabolism, volatilization and sorption – particularly medium sorption – are also highly relevant for polar substances. Therefore, a requirement for the passive dosing of these substances also exists. To overcome the current limitations of silicone, the applicability of Oasis HLB for dosing polar and non-polar substances was tested in a neutral red assay. The findings show a high affinity towards Oasis HLB. The passive dosing approach 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 mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

**TH212**

Passive dosing strategy for in vitro test systems: static concentration generator and continuous release

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The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. This is especially critical in screening in vitro test systems, and becomes highly challenging when dealing with hydrophobic (logKow> 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro bioassays and tests with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartment of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous enrichment. Specific handling tools and concentrating models were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH213**

Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach

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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 objectives of this study is to identify endocrine compounds responsible for the observed toxic effects in Danube river water by using non-target screening. Water sample from Danube River were extracted on site using large volume solid phase extraction (LVSPE) and was pre-screened on genetically modified bioassays for agonistic and antagonist hormonal activity for progestrone and glucocortico receptors (PR and GR). The extracts were analyzed by a combination of LC-HRMS. In addition to the cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C-18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioassays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using aninopropyl) column with gradient elution with methanol:water (30:70) with 0.1% formic acid. One to two minute fractions (total 28 fractions) were collected and biological analysis of these sub-fractions revealed again one active fraction with reduced potency as compared to F18 (parent fraction). For unraveling the compounds responsible for gestagenic and corticoid activity, non-target screening is being performed by using LC-HRMS.

**TH214**

Mixture Risk - Development of an effect-based chemical risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants

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Environmental contamination is usually comprised of a mixture of pollutants, each of them bearing the potential of causing different toxic responses towards humans and wildlife. Recent risk assessments still generally rely on chemical analyses only; however, such investigations do not provide information regarding the interactions between chemicals including their integrated toxicity. The limited knowledge of the risks associated with mixture toxicity is the starting point for this study, and is part of the EnFocus 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 vetebrate 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 effects of PFAS *in vitro* test systems, and becomes highly challenging when dealing with hydrophobic (logKow> 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the *in vitro* bioassays and tests with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartment of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous enrichment. Specific handling tools and concentrating models were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH215**

Analyzing chemical pollutants in water samples from an urban river and wastewater effluent in Hyderabad (India) and their ecotoxicological effects using effect-directed analysis (EDA)

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In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of...
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) in order 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 toxicological risk by 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 alga Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticeasseastrogen 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 river and its ecotoxicological effects.

TH216 Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays

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The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluated pesticides in surface water in catchments affected by agricultural land use. For this purpose five small streams were sampled from the beginning of March to the end of August using half-day composite samples and an analytical method covering 213 active substances. The chemical analysis was complemented with several biological investigations. Measured concentrations of pesticides were used to determine the risk of pesticide mixtures. Using acute and chronic effect-based water quality criteria (QC), we calculated risk quotients (RQ). In a second step RQs of individual compounds were summed to provide separate mixture RQmix for plants, invertebrates and fish. In all the tested water bodies a chronic mixture risk with RQmix > 1 was determined. There was a chronic mixture risk at three sites for almost the entire sampling period. Consequently this resulted in no recovery time for aquatic organisms. An acute mixture risk was determined for four streams, with two of them showing high risks with RQmix greater than 10. In addition, it was investigated to what extent the predicted mixture risk of herbicides was consistent with endpoints that are determined in the combined algae test. This test provides information on the inhibition of photosystem II (PS II) and algae growth. The resulting risk corresponded very well with the calculated mixture risk for PS II inhibitors. In one stream PS II inhibiting plant protection products dominated the mixture toxicity assessment of Lake Mondsee was carried out. Water (W) and sediment (S) samples were collected from Lake Mondsee and the reference site, Lake Irsee, on three different seasons: 1) summer 2015 (preliminary assessment of W and S samples’ toxicity), 2) spring 2016 (possible best-case scenario, since lake was frozen for the winter) and 3) summer 2016 (worst-case scenario, tourist activities peak). The WWTP inflow and outflow, plus pre-thickening (PS) and thickening (TS) sludge (TS) were also collected. The toxicity assessment for summer 2015 was made by performing 48-h population growth (r) assays with the rotifer Brachionus calyciflorus (W samples) and the 15-min luminescence inhibition assay with the bacterium Vibrio fischeri (all samples). Regarding the W samples, results showed no luminescence inhibition for V. fischeri and average r inhibition rate (%) of B. calyciflorus was below 26%. The WWTP inflow samples presented high toxicity to B. calyciflorus (EC50 > 60%). Samples of S, PS and TS were extremely/toxic to V. fischeri. The samples collected during spring 2016 and summer 2016 were analysed through a battery of assays, with species belonging to different trophic levels. In addition to the two above mentioned tests: the 72-h growth inhibition test with Raphidocelis subcapitata and the feeding inhibition test with Daphnia magna, the rotifer H. incongruens was used for the 6-day mortality and growth assessment with Heterocapsa incongruens for S, PS and TS samples. Regarding spring 2016, the average r inhibition rate (%) of B. calyciflorus was lower than 30% for most of the W samples and average did not surpass 12%. The Microtox® tests showed high toxicity only for all W, S, PS and TS samples. Samples collected in the summer 2016, showed similar results for the growth inhibition for R. subcapitata and the feeding inhibition test with H. incongruens. Of B. calyciflorus and the 6-day mortality and growth assessment with H. incongruens showed some variation. No evidences of the influence of the WWTP present at lake Mondsee were retrieved, since W and S samples from both Lakes Mondsee and Irsee showed similar toxicity. Further chemical analysis is necessary to clarify the high toxicity observed in the sediments.

TH219 Availability of estrogens applied onto 96-well plates in the LYSE

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Vermeiren, Ecotox Centre Eawag-EPLEF / Aquatic Ecotoxicology. D. Obstreich, Swiss Centre for Applied Ecotoxicology EAWAG - EPFL. I. Werner, Ecotox Centre Eawag-EPLEF / Department of Anatomy Physiology and Cell Biology. E. Simon, Centre Ecotocs / 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 start an assay and the assay is subsequently evaluated, usually in a bioassay. However, there is scant information on the kinetics of the redissolving behaviour of test substances on 96-well plates. Furthermore, a redissolving step can be circumvented by adding samples and standards directly to the assay, either dissolved in water or medium (or DMSO). In this study we compared the availability of four estrogenic compounds (E2, E1, E2 and BPA) on 96-well plates in the lyticase-based yeast estrogen screen assay (LYES; this test was recently adopted as an ISO standard). Two-fold dilution series of compounds were added directly to the wells via medium (aqueous; i.e. as suggested in the LYES ISO protocol) or using ethanol (lanthanide) 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 in control groups were equal; 2) control group (p = 0.01). The major concern about nuclear anomalies is the potential for them to cause deformities in the newborn fish during the exposure. However, there was a decrease in the number of larvae with skeleton malformations at the post-fertilization to pluteus stage (72 h) from 90 days to waterborne sodium dodecyl sulfate (0.3 and 0.6 mg/L). During the exposure time, newborn fish was fixed and destined for further evaluation. 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, E2 and BPA were performed in parallel to the bioassay. These data are currently being evaluated.

TH221

Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment

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Commercial objects made of plastics are composed of two different components with dissimilar ecotoxicological properties, namely the polymer matrix and the chemical additives used to provide the final physical and chemical properties demanded by the consumers. Most conventional polymers are made of innocuous monomers (olefins, terphthalates), they are inert under environmental conditions and, according to standard ecotoxicological bioassays using early life stages (ELS), do not pose a toxicoecological risk to 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 sub lethal toxicity for the reproductive and endocrine systems of aquatic organisms. Those potential effects are difficult to test in laboratory since they may result of very 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.

TH222

EFFECTS OF POTASSIUM BROMATE ON THE EMBRYOLOGICAL DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758)

A. Arslan, University Ege / Hydrobiology; DZ. Aysar, Le Etablissement Scolaires Tsvifik Fikret; G. Kenanoglu, Turkish Education Foundation Inan, Turkey; priyate hign school; M.A. Karaslan, University of Ege; S. tez, University Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than air. Potassium bromate bleaches dough, which makes for the fluffy, soft walled bubbles as the bread rises. The product is fluffy, soft and unnaturally white. In this investigation, the embryotoxic, spermotoxic effects of Potassium bromate analyzed during the development of the sea urchin Arbacia lixula from the post-fertilization to pluteus stage (72-h). Moreover, effects of Potassium bromate on fertilization success were observed. Sea urchin sperms and embryos were exposed to Potassium bromate at different concentrations during 90 days to waterborne sodium dodecyl sulfate (0.3 and 0.6 mg/L). After redissolving, medium was transferred to new well plates. Furthermore, a redissolving step can be circumvented by adding samples and standards directly to the assay, either dissolved in water or medium (or DMSO). In this study we compared the availability of four estrogenic compounds (E2, E1, E2 and BPA) on 96-well plates in the lyticase-based yeast estrogen screen assay (LYES; this test was recently adopted as an ISO standard). Two-fold dilution series of compounds were added directly to the wells via medium (aqueous; i.e. as suggested in the LYES ISO protocol) or using ethanol (lanthanide) 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 in control groups were equal; 2) control group (p = 0.01). The major concern about nuclear anomalies is the potential for them to cause deformities in the newborn fish during the exposure. However, there was a decrease in the number of larvae with skeleton malformations at the post-fertilization to pluteus stage (72 h) from 90 days to waterborne sodium dodecyl sulfate (0.3 and 0.6 mg/L). During the exposure time, newborn fish was fixed and destined for further evaluation. 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, E2 and BPA were performed in parallel to the bioassay. These data are currently being evaluated.

TH223

DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758)

A. Arslan, University Ege / Hydrobiology; DZ. Aysar, Le Etablissement Scolaires Tsvifik Fikret; G. Kenanoglu, Turkish Education Foundation Inan, Turkey; private high school; M.A. Karaslan, University of Ege; S. tez, University Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than air. Potassium bromate bleaches dough, which makes for the fluffy, soft walled bubbles as the bread rises. The product is fluffy, soft and unnaturally white. In this investigation, the embryotoxic, spermotoxic effects of Potassium bromate analyzed during the development of the sea urchin Arbacia lixula from the post-fertilization to pluteus stage (72-h). Moreover, effects of Potassium bromate on fertilization success were observed. Sea urchin sperms and embryos were exposed to Potassium bromate at different concentrations during 90 days to waterborne sodium dodecyl sulfate (0.3 and 0.6 mg/L). During the exposure time, newborn fish was fixed and destined for further evaluation. 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, E2 and BPA were performed in parallel to the bioassay. These data are currently being evaluated.

TH224

DETERMINATION OF IZMIR BAY POLLUTION BY USING GENETIC BIOMARKERS IN THE MUSSEL (MYTILUS GALLOPROVINCIALIS)

Izmir Bay, which is surrounded by many agricultural and industrialized cities like İzmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were affected very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980, since all the city smell very badly. Micronuclei (MN) tests is a system of microscopic testing used to detect the possible DNA changes in DNA fragments such as micronuclei in the cytoplasm of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (Mytilus galloprovincialis). According to our results MN frequency of 10 stations varied between % 39.33 - % 5.6 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 vertebrates, invertebrates, plants, and humans. Recently, several studies reported that daphnids of species which reproduce by parthenogenesis may generate male offspring in response to EDCs. In addition, it was demonstrated that variation of water temperature is able to change reproduction, growth, and survival of aquatic organisms and population number. This study aims to evaluate the effect of thermal stress on endocrine disrupting effect of EDCs using *Daphnia magna*. Short-term screening (STS) assay was employed 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 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. Iturri, O. Jaka, C. Martí, A. Alzuide, 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 algae growth inhibition test for the evaluation of aquatic toxicity. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for new fast and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 algae growth inhibition test. The miniaturized test is carried out in 96 well plates and the biomass measurement is performed on a plate reader. The methodology makes possible to test ten concentrations of a compound and a negative control on the same plate. The biomass measurement by fluorescence 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 SEEBALANCE®*

P. Salinger, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenewald, P. Koehls, BASF SE / CDS/S

Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed by the SDGs (Sustainable Development Goals). For this reason, social aspects also have an increasing impact on marketing and management decision-making processes.

In The SEEBALANCE® methodology, measures the ecological and economic consequences of alternate products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

**TH227**

*Piloting 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.rrri-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world innovation 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, LORéal Research & Innovation / LORÉAL; P. Arsac, N. Zaraouei, LORÉAL; A. Wahelet, Solvay SA / LCA; J. Viot, F. Laurent, Solvay SA; M. Vuillat, S. Causee, EVEA

Sustainable Guar Initiative (SGI) is a three-year long integrated program aiming at developing sustainable guar production within the Bikaner district in Rajasthan, India. This desert district is one of the largest producers of guar and guar gum in India. SGI was set up by Solvay, L’Oreal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices, in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (LCA) has been commissioned, comparing the guar gum 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 Diangaruna furthermore “Integrating Smallholders with the Handbook for Product Social Impact Assessments” has been completed with some developments, related to: (1) Goal and scope: better identification of relevant stakeholders and social aspects, (2) Inventory: improvement of data quality among the social aspects, stakeholders or life cycle steps and (3) Performance assessment: common rating system enabling aggregation related to inventory from multiple sources.

Besides environmental LCA, the poster will focus on social LCA. Methodological challenges encountered will be presented and solutions to tackle them will be detailed as long with other limits related to these new developments.

**TH229**

*How can the social pillar be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study*

P. Falcone, E. Imbert, A. Tani, V. Tartiu, P. Morone, Unitelma Sapienza University of Rome

**Abstract**

Along with environmental and economic assessment, social sustainability of the bioeconomy have become a growing challenge, with important effects on the market uptake of bio-based products. In recent years, social and socioeconomic aspects have progressively been included in both the discourses and sustainability analyses concerning the bioeconomy. Yet, when it comes to bio-based products the situation still lags behind (Siebert et al. 2017[1]), given that bio-based products involve longer and more complex value chains (Bell et al. 2014[2]) that make the assessment of social and socio-economic impacts extremely challenging. Furthermore, the success of a sustainable bioeconomy depends on stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of ‘what 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 the social dimension of the transition towards bio-based products, by identifying and validating the main social impact categories pertaining to the bio-based products realm. In doing so, we employ a robust three-step methodological framework encompassing: impact categories identification, stakeholders mapping, and social impact categories validation. In order to operationalize the methodological framework, empirical data is gathered by means of in-depth literature review, stakeholders’ interviews, and focus groups. By providing empirical evidence on the social dimension, which incorporates different visions of the stakeholders involved in the bio-based value chains, our study paves the way for further developments concerning the integration of social assessments within bioeconomy context. **Keywords:** bio-based products, social assessment, stakeholders analysis - bio-based products - BRIDGE [3] by Siebert A., Sallab J., Sieber et al, Thránab D., (2017) Social life cycle assessment indicators and indicators to monitor the social implications of wood-based products. Journal of Cleaner Production, Available online 9 March 2017 [2] Bell, G., et al., (2014). IEA Bioenergy Task42 Biorefining. Wageningen: IEA Bioenergy.

**TH230**

*Metholodical considerations for applying social LCA to modelled future European energy systems in the REFLEX project*

N. Brown, KTH royal Institute of Technology / Sustainable Development, Environmental Science and Technology; E. Ekener, KTH royal Institute of Technology; M. Fuss, KIT Karlsruhe Institute of Technology / Institute for Technology Assessment and Systems Analysis ITAS; L. Xu, KIT Karlsruhe Institute of Technology

A methodology has been developed for the social assessment from a life cycle perspective of supply chains for future energy systems for the European Union
(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 handful 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 models is defined as the entire life cycle, from extraction of the raw materials, through 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 possibly shift. This is true for the energy system, if doing so it is necessary to be clear about how such results should and should not 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. Güereca, 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 shortage of safe water, lack of education and professional development, and aging of the labour force. The objective of this research was to carry out an assessment of damages to human welfare of the workers, through a holistic and systemic approach to assess the impacts of each of the processes of the water system in relation to working conditions. The evaluation of the social impacts of the water system was based on methodological guidelines of S-LCA edited by USEPASETAC LCI and other instruments of social impact assessment; however, if considered five stages of the water system: water abstraction and treatment, distribution, storage, water waste collection and wastewater treatment. The evaluation used the method of impact assessment with a normalized scale between 0 and 1, divided into five ranges of social performance: Without information, Bad, Medium, Good and Very Good. The results were that: Water abstraction was considered as a very good process to determine supply. Distribution. The Storage was the stage with the lowest value of social performance with a level of Medium. While, in the stages of the wastewater management, the stage of Wastewater collection obtained a performance of Medium and the stage of Wastewater Treatment, with a performance of Good. Any stage of the system has reached a Very good level in social performance. In conclusion according to the methodology used, which adopts a scale of 0 to 1, where 0 is the worst and 1 the best; it determines a score of 0.6 for all the analysed system, which places the system assessed in Good social performance, but is identified as priority needs to be solved. Mainly for the stage of water treatment, it is necessary to improve the facilities in order to reduce the risks to health. The welfare of workers requires attention on these points to get closer to the definition of decent work.

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

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. Orrù, 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 proposal 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. Diethylene glycol) used in oil and gas platform activities. This approach allows to determine specific concentration limits eligible for seaward 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 Diethylene glycol showed that the concentration considered (500 mg/l for constant/frequent release and 5900 mg/l for intermittent release) are below the limits for the discharge of these additives as per REACH. These limits have been included by the Ministry of Environment as a binding condition for granting the authorisation of discharge to the platform manager. Session: 3.12

Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries. Authors: S. Santoro - National Research Council (CNR) - Institute of Atmospheric Pollution Research Italian Ministry of the Environment, Land and Sea Silvia Giardina – Italian Ministry of the Environment, Land and Sea – General Directorate for environmental assessments and authorisations Maria Antonietta Orri – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.

TH233

Multidisciplinary approach for discussing the rice crop specific needs in Southern Europe in the view of the Plant Protection Products assessment: conclusions from an ad hoc workshop


In Europe and in the context of Regulation (EC) 1107/2009 for placing into the market of plant protection products rice as a crop is an anomaly and has created several difficulties in its evaluation. For regulators, there is a need for comprehension of the unique agronomic practices, application techniques, water management and environmental concerns, both from an ecotoxicology and environmental fate perspective considering the majority of rice cultivated within the Europe is grown in paddy fields. This gap in knowledge caused issues in the evaluation of rice as a representative use in the process of European authorization of active substances for plant protection products and raised questions over the suitability of environmental indicator species and risk assessments within the context necessary. Rice is a major crop in many Southern Zone Countries and the difficulties gaining an understanding of rice practices, compounded by uncertainty with changing regulatory requirements and a lack of transparency in evaluation procedures has hampered the process of active substances approval. Such a complex framework could dissuade active substance renewal by agrochemical manufacturers 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/Africa, 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 adoption of 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. Pampinan, International Research Institute of Stavanger; S.J. Brooks, NIVA
The applicability of the assessment entity concept in the REACH registration of complex mixtures. A case study for fragrance substances. K. Jenner; Givaudan; Global Regulatory Affairs & Product Safety; G. Kreutzer, Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA The assessment entity (AE) concept was developed by ECHA together with industry for the registration of complex mixtures. The tool was introduced in EUCLID 6 and aims to assist users in documenting complex assessment cases in a transparent and systematic way. The assessment entities (AEs) may be imported in Chesar 3 for the purpose of exposure assessment. The relevance and applicability of the AE concept to multi-constituent substances is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer hazard assessment, a 10% mixture was used. However, to assess environmental exposure and risk, a constituent block approach was used because the substance consists of components with different environmental fate properties (e.g. water solubility, log Kow, adsorption coefficient) and ecotoxicology profiles (e.g. acute EC50/LC50 values). The use of whole substance testing versus constituent data is explored. The adaptation of standard tests, such as the traditional whole substance assay, was not pursued. Instead, the traditional whole substance assay was used to show how the different HPLC partitioning characteristics of the components and the use of two analytical detection methods was exploited to obtain water solubility information for the individual blocks from a test performed on the whole substance. The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity. TH237 Canada's Approach to Determining Causes of Impairment at Federal Contaminated Sites M.H. Henning, D. Pelletier, Ramboll EH; M.T. Sorensen, Ramboll / Senior Science Advisor Canada's Federal Contaminated Sites Action Plan (FCSAP) was developed to reduce risks to human health and the environment from—and to reduce the financial liabilities associated with—the legacy of activities performed since 1995. The new requirements have been applied for the first time in the 2017 Water Column Monitoring program. This holistic approach shows a significant improvement in the scientific outcomes of the monitoring, in a cost-efficient way. The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern North Sea and Egersundbanken (reference area) and in addition the near platform effect (Statoil A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted risks. The immediate impact was measured to be on the reduced the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to: harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off; - provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged. TH235 DAPHNE: a supporting tool for pesticides risk assessors and stakeholders A. Linguadoca, F. Galimberti, S. Ubbiali, ICPS - International Centre for Pesticides and Health Risk Prevention / Public Health; L. Menabelli, ICPS - International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS - International Centre for Pesticides and Health Risk Prevention / Public Health DAPHNE (DAteS and PHenoLogistical Estimation) is a tool created to contribute supporting the Environmental Risk Assessment (ERA) of pesticides. The rationale behind its development is based on correlating crop phenological stages (BBCH) to specific dates for representative geographic areas is often a crucial step both for the exposure and (higher tier) effects assessment. However, currently there is no source of information clearly addressing this issue at the national, Zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These interpolation curves are then used to be combined into the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to: - harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off; - provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.
The 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 initial alia biological oxygen demand, hydraulic retention time, and temperature. The modelled the chemical fate in industrial STPs (iTreat, Straïa 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 rates from the parametrized iTreat model. The simulation results were also compared to the non-parametrized model of iTreat and to the municipal models of Simple Treat 4.0 and Simple Treat 3.1. Overall, the iTreat model was successfully adapted to model chemical fate and behavior in an industrial, site specific STP. The elimination rates of the parametrized iTreat model were generally in better agreement to the measured elimination rates than for all other models investigated. The biodegradation rate constant of substances turned out as 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 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.

**TH240**

Combination of remote sensing and coarse statistical data for determination of precise spatial distribution of a pesticide load on soils at a national scale

**V. Kodeev,** Czech Hydrometeorological Institute / Section of water quality; **L. Brodsky,** Mapradix Ltd.; **T. Herza,** Hydrosoft Veleslavin Ltd.

Objective of the Study In order to calculate an annual pesticide load over a certain area, one needs detailed data on pesticides’ application that are hard to find in a real world. One way is to collect desired data from the farmers, but this is feasible just in relatively small areas. Due to missing detailed data, we computed more precise pesticide load and used established method to estimate the spatial distribution of the total load. Firstly, we calculated the number of spraying of pesticides on every single Czech Republic districts 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 rows to 12 classes) grids of 100 m cell size (later 14 classes, 25 m cell size) were derived from remote sensing images; the crops were linked to plant protection products (PPP) and active substances. Then redistribution of pesticide usage from districts to grid cells was carried out using established link between a crop, PPPs and respective active substances. Results The grid of pesticide usage on perennial crops is produced before the end of spring every year in order to provide data needed for monitoring of pesticides that starts regularly in April. The grid of pesticide usage on all the other crop classes is produced regularly in November. The results are published on WWW and annually updated in order to provide water managers with information necessary for a meaningful design of pesticide monitoring in the Czech Republic. Conclusion The product provides more detailed information on a spatial load of pesticides than other publicly available data on pesticide usage and it is very welcome by interested water managers. Further enhancements are planned in the future as new remote sensing sensors become available.

**TH241**

A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.

**A. Rutier,** 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 Université Bordeaux / UMR 5805 EPOC; **L. Penuet,** CNRS / UMR EPOC LPTC; **N. Delorme,** H. Queau, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; **O. Geffard,** Irstea / UR MALY Laboratoire Ecotoxicologie; **M. P. Babut,** Irstea / Water Toxicokinetic models are used to describe how organisms bioaccumulate chemicals or other substances according to uptake and elimination processes. They provide a theoretical framework for understanding phenomena, testing hypotheses, and predicting some outputs of interest. In these models, the absorption process can result from dissolved or trophic routes. The elimination process includes excretion, biotransformation and dilution by growth. To date, models exist to describe the accumulation of persistent organic pollutants (i.e. highly metabolized organic pollutants) in various aquatic organisms. However, taking into account biotransformation remains problematic despite its potential importance. It is a key process that can limit the bioaccumulation of parent compounds while generating potentially hazardous metabolites. It varies considerably among species and contaminants. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model taking into account biotransformation, by considering simultaneously accumulation and depuration data. The poster present the first results about this experiment. We will discuss about the posterior distributions obtained for each parameter and the fit of the model to the data.

**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 Université Bordeaux / UMR 5805 EPOC; **L. Penuet,** CNRS / UMR EPOC LPTC; **N. Delorme,** L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; **O. Geffard,** Irstea / UR MALY Laboratoire Ecotoxicologie; **M. P. Babut,** Irstea / Water Toxicokinetic models are used to describe how organisms bioaccumulate chemicals or other substances according to uptake and elimination processes. The absorption process can involve both dissolved or trophic route. The diet of aquatic organisms is known to be an important route of bioaccumulation of contaminants. The elimination process includes excretion, metabolism and dilution by growth. To date, there are few models focusing on persistent organic contaminants. Furthermore, estimating models’ parameters is generally done through a frequentist approach in two steps: first by estimating parameter(s) related to depuration, then estimating parameter(s) related to accumulation. The problem by doing this is that depuration during the accumulation phase is neglected, while this process occurs in the two phases. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model together by considering simultaneously accumulation and depuration data. The posterior distribution obtained for all parameter will enable a more accurate assessment of uncertainties. We illustrate our approach with the freshwater benthic invertebrate Gammarus fossarum exposed for 7 days to a sediment spiked with PCB153 and transferred to a clean media for 7 more days. The PCB153 concentrations in Gammarus fossarum increased from an initial concentration of 0.32 to 12.36 ng g^-1 (wet weight) at the end of accumulation step. When gammarids were transferred into a clean media, the PCB153 concentration in organisms decreased to 6.41 ng g^-1 (wet weight) at day 14. The bioaccumulation model assuming first-order kinetics was fitted to the data using Bayesian inference. The inference process quickly converged and thin posterior distributions were obtained for each parameter, meaning that data brough enough information to estimate precisely each parameter. The median model predictions and their 95% credible intervals showed a good fit of the model to the data.

**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; **S. Mach, University of Michigan / Department of Environmental Health Sciences. 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 chemical classes. Using data from a national longitudinal study, we will identify populations at high risk for exposure. We used the National Health and Nutrition Examination Survey (NHANES) datasets to collect information on chemical biomarker measurements and demographic traits for the years 1999-2014 (n = 74,942), focusing on 229 chemical biomarkers from 16 different classes of chemicals. Poverty income ratio (PIR) was used as a surrogate variable for socioeconomic status, while cotinine levels was used as a proxy for smoking habits. We evaluated the association of each individual biomarker and various demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.
Our findings show that race/ethnicity, gender, and socioeconomic status can be statistically significant predictors of chemical exposure. More specifically, parabens, which are chemicals used in personal care products (PCPs), and 2,4- and 2,4,5-Dichlorophenol, which can be a products of photo-degradation of tricosan, a common antibacterial and antifungal agent, were observed to elevated in African Americans when compared to White Americans. In addition, higher levels of parabens was observed in Toronto, while men had showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be from women using cosmetic PCPs more frequent and in larger amounts, and men using insect repellent slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and tricosan, which could possibly be explained by more accessibility to PCPs. In this study, we have identified inherent and demographic traits associated with elevated biomarker concentrations. We hypothesize that this is due to use patterns of consumer product, particularly PCPs. This could support research findings emphasizing the importance of near-field chemical exposures.

TH244

Occupational exposure to flame retardants among Canadian e-waste dismantlers
L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; V.H. Arrandale, Cancer Care Ontario; M.L. Diamond, University of Toronto / Department of Earth Sciences

The amount of e-waste produced globally is growing dramatically. National number suggest in PM 10, PM 2.5, and particle matter in the air the world across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/y. One hazard associated with e-waste dismantling is flame retardants (FRs) which are added to electronic and electrical products to meet flammability standards. Little is known about exposure of workers to FRs in e-waste dismantling facilities in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations and profiles of selected FRs in indoor air and FRs in 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-As). A Micro-Orifice Uniform Deposition impactor (MOUDI) was used to obtain particle size distribution of air samples. Post-deployment, samples were extracted and analysed for 12 target FRs, including novel brominated flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs) and organophosphate esters (POEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samples were the novel and known BDE-209, accounting for ~70-98% of all target compounds. The median air concentrations of ∑POEs 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 phosphate (TPhP) and other replacement FRs were more abundant than PBDEs in indoor air and FRs in e-waste dismantling facility. Levels of FRs in air collected from this Canadian e-waste recycling facility suggest opportunities for inhalation exposure to flame retardants among e-waste dismantlers in Southern Ontario, Canada.

TH245

Global approaches to environmental exposure - assessment of e-wastes
D. Purchase, Middlesex University / Department of Natural Sciences, Faulty of Science and Technology; L. 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 / Vernadskii Institute; C. Ekberg, Chalmers University of Technology / Division of Environmental Monitoring; A. Serpe, University of Cagliari / Department of Civil Engineering, Environmental and Architecture; K. Surati, Department of Women's Chemistry, Faculty of Women; R. Luque, University of Córdoba / Chemistry; O. Fedotov, Russian Academy of Sciences / Vernadskii Institute; D. Purchase, Middlesex 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 Chemistry and Architectural Heritage; K. Surati, Sardar Patel University / Department of Chemistry; B.P. Wilson, Aalto University / Department of Chemical and Metallurgical Engineering.

Except for e-waste, global e-waste, and electronic waste is complicated by illegal waste shipments and further exacerbated by weak legislation. The current methods for the measurement of free cyanide concentrations and profiles of selected FRs in indoor air and dust at an e-waste dismantling facility. Levels of FRs in air collected from this Canadian e-waste recycling facility suggest opportunities for inhalation exposure to flame retardants among e-waste dismantlers in Southern Ontario, Canada.

TH246

Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard
S. Onno, Italian National Research Council; G. Innerneber, A. Schmid, C. Roschat, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE, M. in water, but its minor Mg2+/Ca2+ with absorption detection is far below than needed. In Italy quality vines are sometimes grown in small fields on steep slopes where spray-gun application of pesticides is used, a technique that is very costly and labor intensive. A possible alternative is the use of a fixed spraying system, and first researches are in progress. A fixed spraying system prototype was built in a vineyard at Laimburg Research Centre and a trial was performed with the aim of measuring the deposition pattern of droplets on the row and between rows with water sensitive papers, also in comparison with a precise low-drift air-blast sprayer. Results show that a fixed spraying system has the potential to apply plant protection products without generating drift problems, with a performance similar to a low-drift sprayer, becoming an opportunity for vineyards on very steep slopes.

TH247

Sensitive Arsenic Speciation by Capillary Electrophoresis Using UV Absorbance Detection with On-Line Sample Preconcentration Techniques
H. Lee, J. Kwon, Seoul National University; D. Chung, Seoul National University / Chemistry

The World Health Organization (WHO) guideline states that the total arsenic concentration in drinking water must not exceed 10 ppb. However, arsenic toxicity varies significantly, with inorganic arsenic species being more toxic than organic species. Arsenic speciation is therefore important for the evaluation of health risks from arsenic-contaminated drinking water. Capillary electrophoresis (CE) provides the necessary high performance separation for the determination of arsenic species including inorganic arsenic species. CE-based technology is sensitive to a wide range of arsenic species, and its detection limit can be as low as 1 ppb. Using a coated capillary, several on-line sample preconcentration techniques such as large volume sample stacking with an electroosmotic flow pump, field amplified sample injection (FASI), transient injection using phosphate and sodium dihydrogen phosphate buffer, and solid phase extraction have been developed. Arsenic speciation will be successfully performed via a multidisciplinary, transboundary approach that involves all stakeholders that include amongst others: manufacturers, scientists, economists, policy makers, waste professionals and consumers. The e-waste project "The Environmental and Health Challenges of E-waste and its Management: an Emerging 21st Century Global Concern" (#2014-031-3-4000), supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of the new e-waste area: chemical analysis of contaminants, policy and governance, environmental and health impacts, development and advances in treatment technologies including e-waste valorisation. This presentation makes use of studies from the world to highlight the following: i) discrepancies in the provision and enforcement of regulations between developed and emerging countries; ii) complexity in the analysis of e-waste contaminants in environmental and biological samples; and iii) lack of harmonisation of tools or indices to assess risk in environment and health, particularly in soil. It proposed that a harmonised approach should be taken to use appropriate speciation analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.
Application of equilibrium and kinetic passive sampling method to quantify integrative chemical profile in a small river and the outflow of WTTP Y. Jeong, D. Stumm, T. Bader, T. Bauer, S. Hekman, H. Kwon, H. Jeon, KIS, South Korea; S. Blumenstein, E. Fünfrocken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Monitoring water quality is challenging as most of the organic contaminants present at trace levels and chemical profile is fluctuating. Current legislative requirement of water quality monitoring, with levels mainly below the limit of detection (LOD, 1/3 of the LOQ), and downstream sampling points where free cyanide concentrations were at least 50% higher, possibly due to degraded plant biomass in the water. This first measurements revealed that background concentrations of free cyanide in the test surface waters can be below the proposed EQS of 0.5 µg/L. However, the analysis of further parameters (e.g. geographical regions, seasonality) is necessary to create a reliable database on the range of free cyanide background levels as basis for EQS implementation.

Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals

I. Bordeaux; C. Miege, A. Daval, M. Gregson, Irsnea Lyon; N. Mazzella, Irsnea Bordeaux / UR EABX

The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations”. For the passive sampling of moderately hydrophobic organic contaminants, the Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels let in contact for 30 minutes. The concentration in each gel disk was determined over the time, allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Then, obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.47 µm) to obtain the sampling rates, and to validate the diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.


Tebuconazol…contaminations and typical agricultural activities (corn, sunflower and wheat crops) for some sub-watersheds. Similarly, the presence of Norflurazon and Dimetomorph was correlated with vineyards, which is consistent with their use. Additionally, cartographic projections of the contamination levels for the 6 sampling period highlighted seasonal variations which are characteristic of some side uses.
application group. Although both basipetal movement (downward from leaf application site) via phloem and acropetal movement (upward from both leaf and root application sites) via xylem were observed, results indicate the movement of radioactive residues is much faster through xylem. Select tissue samples were extracted and analyzed by HPLC-RAM, which shows that the majority of translocated radioactive residues by phloem was metabolites of the active ingredient. A complete evaluation of translocation during a conventional plant mass balance study can provide valuable information to better assess the potential effects of plant protection products on pollinating insects.

TH253
An Examination of Microbial Biomass in Sediments and the Impact of Seasonal Variation
K. Malekani, Smithers Viscient / Environmental Fate and Metabolism; S.P. McLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, Smithers Viscient / Environmental Fate Metabolism

Microbial biomass is an important measure of the health and viability of a sediment just as it is for soils. It is also a parameter used to assess viability of the ecosystem. Studying the seasonal variation of microbial biomass in sediments is typically determined by fumigation/extraction procedure prior to test initiation (post-handling/pre-treatment), near test initiation and near test termination. The current presentation will focus on the initial microbial biomass as an indication of health and viability of sediments at the time of their collection. A collection of initial sediment microbial biomass values has been summarized and presented based on their time of collection during the year. An example used is a sediment (Taunton) and one sandy sediment (Weweantic) collected during all four seasons, over a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Wewaentic 2017 Taunton Wewaentic Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Summer 0.63 0.22 Summer 0.51 0.41 Fall 0.40 0.22 Fall 0.60 0.71 late summer Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and % OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

TH254
Use of scanning electron microscope (SEM) in evaluation of hypopharyngeal glands development in Honey bees (Apis mellifera L.)

The hypopharyngeal glands (HGP) of Honeybees consist of many acini connected with a collecting duct, arranged in the form of long paired cords lying on the both sides of the head. They played important role in maintaining healthy colonies i.e. through production of “milk” containing proteinic substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with four different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 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 2.5 % 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.

TH255
Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis
D. Thal, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Blye, Environmental Standards Inc.

The analysis of polychlorinated dibeno-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in environmental media, foods and tissues by high resolution gas chromatography-high resolution mass spectrometry (HRMS) is frequently used as the reference methodology against which other candidate analytical approaches are compared. Official methods for HNS analysis technology, especially recently calibrated standards for recovery correction have been established in the EU, the USA, Japan and other nations for decades and international standards for such methods have been established by ISO (Standards 13914 and 18073, for example). To identify achievable best practices and to understand differences in precision, accuracy and qualitative certainty for data produced from wide-ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.

TH256
New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants.
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giexy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre

Research development over the past few years has been stimulated by breakthroughs in mass spectrometry and instrumentation that 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 homologues and congeners even in an extract of used motor oil. Reanalysis of fish tissues previously analyzed by a magnetic sector instrument demonstrate accurate of identifications and quantifications and provide valid 20°C methods. Analyses were also conducted to determine the potential for a “multiplex” analysis of various POPs where the resolving power (>120,000 FWHM) of the MS system was able to eliminate potential interferences from a variety of “non-target” organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extract preparation and clean-up. In addition, the relatively simple auto-tuning and mass calibration algorithms available for the advanced mass spectrometry systems greatly simplify these otherwise challenging analyses.

TH257
Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment
M. Baniewicz, D. Doran, E. Ogburn, Mossakowska Medical Research Centre; R. Strzalkowski, Mossakowska Medical Research Centre; N. Lemańska, Institute of Industrial Organic Chemistry, Branch Pecznica / Department of Toxicological Studies; E. Kulec, Institute of Industrial Organic Chemistry, Branch Psczyna / Department of Toxicological Studies

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 impact of HNS. To achieve this, the researchers conducted a study 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.

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SETAC Europe 28th Annual Meeting Abstract Book
Acetylcholinesterase inhibition has been used as a biomarker of the effects of organophosphate and carbamate compounds. AChE is present in most animals and is responsible for the rapid hydrolytic degradation of the neurotransmitter acetylcholine (ACh). The inhibition of AChE has two main effects. The first is to regulate the nervous transmission by reducing the concentration of ACh. When AChE is inactivated by an organophosphor or carbamate ester, the enzyme is no longer able to hydrolyse ACh and the concentration of ACh remains high. Continuous stimulation of the muscle or nerve then occurs, resulting in tetany and eventually paralysis and death. The ICES/IoC International workshop on Biological Effects of Contaminants, that took place in Bremerhaven, Germany during March 1990, provided an opportunity to test AChE inhibition as an index of marine contamination. An official ICES Technique in Marine Environmental Sciences (TIMES No.22 Biological effects of contaminants: Cholinesterase inhibition by organophosphate and carbamate compounds) is available and recommended for contaminant monitoring programmes in the marine environment.

This method was published to improve and standardise the comparability between results from different laboratories and/or countries. However, the method has not been updated since 1998 and does not provide enough details on different marine species, preparation and handling of samples or storage conditions. The search continues for new monitoring tools, improvement and harmonisation of existing methods, which may be used as specific markers for contaminant effects on the safety of management. From a regulatory point of view, we are working to define the cationic surfactant samples. They can also be toxic to fish, which constrains the concentrations that can be exposed to. We are currently working to define the cationic surfactant exposure. They display a partitioning behaviour that is similar to biomolecules, have a tendency to sorb extensively to surfaces, making it difficult to generate and obtain precise, consistent and comparable results across the national and international laboratories and therefore provide a real evaluation of the status of the marine environment.
produced from guideline values (Canadian soil quality guideline and EU REACH PNEC values) and a ratio based on the average concentrations in a contaminated site (Sudbury) for each metal. Each mixture was tested with 11 doses in toxic units estimated from Folsomia candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing metal contamination. These community dose response curves allow for an estimation of microarthropod community EC values, which provide valuable insight on the adequacy of current guideline values and in developing site-specific risk assessments and remedial goals with community endpoints. Produced EC values from this simplified community experiment are currently under validation in a terrestrial model ecosystem experiment, for these same mixtures.

TH264 Alteration of stress-related and thyroid hormone related genes in zebrafish larvae after the administrations of lead acetate, and mixtures of lead acetate and BDE-209
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The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, ccx, cat, gr, gst) and thyroid-related genes (trt, trf, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The full dose of both lead acetate (UA) and the combination of UA and BDE-209 were used to investigate the effect of mixtures to lead toxicity on larvae. Results showed that both exposure to both metals increased oxidative stress, and the effect was more pronounced with the mixture than with the lead acetate alone. With BDE-209 at low concentrations (50-100 μM), the effect of lead was only partially observed, and the maximum expression of the genes was higher when tested with lead acetate alone. However, when the mixture was tested at high concentrations (500-1000 μM), the general expression of the genes was significantly decreased, and the expression of the genes was lower than in the single metal treatments. This indicates that the mixture treatments could have reduced the overall toxic effect of lead acetate on the larvae, possibly through a mechanism of detoxification or the synthesis of enzymes that are induced by oxidative stress.

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 nature, organisms are exposed to a mixture of these elements. LNs are expected to have cumulative toxic effects on natural cycles have already been observed. Most of the available data on LN toxicity focuses on the effect of single elements; however, they are commonly found as a group in nature. The concentration of LNs is 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 elements. Our results showed that both the concentration and the combination of LNs at toxic levels increased oxidative stress and light LNs, respectively, on seven aquatic species belonging to different trophic levels. From the seven organisms studied, A. fisheri, R. subcapitata, C. vulgaris, B. calcitrophicus, H. incongruens, D. magna and D. rerio were identified as potential oxidative stress agents and potential toxicity factors were observed only in five; and the inhibitory LN concentrations were significantly decreased during all tests and the major decline took place at the beginning of the tests, but the extent of the decrease varied across test media. Thermodynamic speciation calculation highlighted important differences: in distilled water and 1% NaCl, LNs were predicted to occur mainly as free ions; in more complex media, LNs appeared as free forms and with complexes. The most toxic metal with MIC of 0.15g/100ml while Mercury was the least toxic of these metals. The isolates of bacterial resistance to these metals with MICs ranging from 0.15g/100ml to 0.25g/100ml were isolated from different locations at the Mambilla artisanal mining site, Nigeria. The resistance to these metals was observed in bacteria from soil samples obtained from different locations at the Mambilla artisanal mining site. The isolates 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 antibiotic resistance. Staphylococcus aureus is the most common bacteria isolated from the industrial sector of the Mambilla plateau has been on the increase in recent years. Therefore, the present study was aimed at characterizing and determining resistance to lead, mercury and copper by selected bacterial strains isolated in soil from Mambilla plateau artisanal mine and to explore their bioremediation capacity. Bacterial isolates were isolated from soil samples obtained from different locations at the Mambilla artisanal mining site. The isolates were identified as Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus sp, Enterobacter aerogenes and Pseudomonas aeruginosa. The isolates were selected and grown on nutrient agar plates incorporated with heavy metals namely Lead, Mercury, and Copper. These isolates showed multiple antibiotic resistance. The most toxic metal with MIC of 0.15g/100ml while Mercury was the least toxic of these metals. The isolates were identified as Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli. The isolates were identified as Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli. The isolates were identified as Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli. The isolates were identified as Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli.
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 stressors can be so high as to make the way in which aquatic environments 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 by explorative biometric and biomonitoring surveys of fish, macroinvertebrates, and Flora (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 stress metal concentrations in the different ecological compartments (water, sediment and biota). The results, together with general water quality parameters (pH, conductivity, temperature, DOC and macronutrients) will identify whether the ecological quality is primarily governed by chemical or biological factors, or a combination of the two. The outcomes of our research will provide mechanistic insights into the determinants of ecological quality and facilitate development of a more differentiated basis for the setting of EQS.

**TH269**

**Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio**

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The aquatic environment is continuously under threat because it is the final receptor to a large variety of anthropogenic substances. 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 cellular defence mechanisms, oxidative stress and physiological parameters. Preliminary results indicate that metal accumulation induced expression of metal binding and stress proteins, and metal specific compensatory effects were seen in genes related to ionoregulation and oxidative stress. Further analysis will determine whether antagonistic, additive or synergistic effects occurred.

**TH270**

**Silver nanoparticles exposure inhibits glycans synthesis and induces cytotoxicity in human cell line**

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Silver nanoparticles (SNPs) are used in industrial products worldwide. Hence, there are many reports about environmental pollution risks. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycans are one of the targets of silver nanocolloids (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycans function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. In this study, we employed four different SNPs including SNCs to compare their different toxicities using three different human cell lines. The another SNCs was coated with sulfur and diameter was 20 nm. Another one’s coating material and diameter are unknown. Of SNCs, one SNCs was non-coated and its diameter was ca. 30 nm. The other SNCs was coated with nitrogen and diameter is ca. 20 nm. We used three kinds of human cell lines; lung cancer-derived A549, epidermal-derived HaCaT, and monocyte-derived THP-1 because we supposed SNPs have a chance to contact to alveolus of lungs, epidermis and blood. To evaluate cytotoxicity, each cells were exposed to SNPs or SNCs (10 μg/mL) and incubated for 24 hours, and then we measured survival rate, membrane damage, inflammatory response, ROS accumulation, caspase-3 induction, intracellular ion concentration, and gene expression. In results, SNPs suppressed survival rates. SNPs and SNCs exposures exhibited membrane disturbance and inflammatory response. However, ROS accumulation and caspase-3 induction were observed in only SNCs exposure. Measurement of concentration of intracellular silver found that higher silver concentration in SNCs exposure rather than SNPs exposure. Finally, to investigate effects of SNP/SNC exposure on glycans, we measured glycan-relative genes (ALG2, BAGAL2T and GNS) expressions. Tested gene expression levels were all suppressed by SNPs and SNCs exposures. Since this study demonstrated that SNPs inhibited 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 the exposure of aquatic environment may lead to mixture forms of by biological system. In this study, the acute toxicity tests using Daphnia magna were conducted for examining the single- and mixture toxicity. The methodological approaches for mixture toxicity (Mixture I – 5:5; Mixture II – 7:3 and Mixture III – 3:7) were conducted as three binary mixtures of AgNO3 and ZnO based on the estimated toxicity data (i.e., EC50 values) of single substance. To compare with control response and mixture results, the mode of action in mixtures, the effects of mixture were analyzed using the MIXTOX models. The EC50 values of AgNO3 and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-2.2066 mg/L), respectively. Among the 3 mixtures, Mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of all mixture of AgNO3 and ZnO, the concentration of AgNO3 indicated an increased toxicity when the mixture effect was caused mainly by ZnO, and the positive b values of both models indicate 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?**

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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 major concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution.

**TH273**

**Simplify: reasonable approaches to Mixtox assessment for plant protection products**

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As regulatory implementation of risk assessment of mixtures has increased and several guidance documents describe the process. Our suggestions here deal with mixtures of PPP that require an environmental risk assessment (ERA) for cumulative exposure. Depending on the regulatory context, this may include PPP with multi active substances, relevant co-formulants, adjuvants, safeners or metabolites. While publications on mixture toxicity understandably tend to focus 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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Pesticides are widely used throughout the world in many agricultural and domestic activities. By their presence in the environment, they can have an impact on non-target organisms. Moreover, due to the persistence of some products and the formation of active metabolites, more or less complex mixtures of pesticides can be found in the environment. Thus, the aim of this study was to evaluate the effects of one herbicide (S-metolachlor and his two metabolites) and an insecticide (imidaclopride) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their groups in the aquatic systems. The sublethal effects of each active substance and the mixture were assessed. The concentrations in this study for the detoxification processes of each pesticide were chosen. The results showed that the acute and chronic effects of pesticide mixtures are low compared to the separate substances, then the mixtures for 5 days (zebrafish) or 2 days (oyster). The malformations, the locomotion activity and target gene expression levels were assessed to understand the mechanisms of possible sublethal toxicity of the selected pesticides. According to our results, no malformations and no effect on locomotion activity for the tested concentrations were observed for zebrafish. On the contrary, the effects on the malformations and the locomotion activity of the oyster larvae is already induced at low concentrations of the selected pesticides. The first results of the gene expression show an overexpression of some of the selected genes of zebrafish (12S, TR-beta – known to be related to the thyroid disruption) caused by one of the metabolites. In conclusion, an indication of a novel mode of action of the chronic pesticide toxicity has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH275
Including multistress in risk assessment of pesticides. Current state of knowledge, based on a literature review and evaluation of tank mixture applications in a spraying schedule for strawberries
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PPPs are part of a crop protection programme and thus should be evaluated in this intensively cultivated crop with sequential applications of products and mixtures of plant protection products (PPPs). An evaluation of tank mixture applications in a spraying schedule for strawberries was performed based on a realistic application schedule and spray drift on surface water in 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 of the problems were herbicides (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.

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 modelling strategy to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMo model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in doubling the concentration ensuring the uniform distribution of the plants subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, we should not accept that the acute and chronic risks of pesticides residues in sour cherries are low. Sour cherrys 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 to control different pests, weeds 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 modelling strategy to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMo model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in doubling the concentration ensuring the uniform distribution of the plants subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, we should not accept that the acute and chronic risks of pesticides residues in sour cherries are low. Sour cherrys 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.
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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A large 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 the mixture classification is not sufficient as it only applies for a minority of substances and further hazardous substances may be missed. All substances with ecotoxicity data need to be considered together with information on uses and exposure. The methods for an assessment of mixtures including component-based approaches, whole mixture testing, identification of main drivers and tiered assessment strategies are in general available. These need to be transparently addressed, so that further calculations by other downstream users are possible. The quality and availability of hazard and exposure data is central and data (eventually considering an anonymization of CBI) needs to be communicated between registrants and downstream user in the supply-chain to reach the respective “mixture evaluator”, i.e. the formulator. Communication formats (e.g. extended SDS + SUMI) as well as central data bases seem promising and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies.

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, & UVCVs. Amongst these substance type, several families of natural products presented challenge to testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals can fall under multiple categories: natural, synthetic, monococonstituent, multiconstituent or considered as UVCVs. One group of fragrances that fell under the title of multiconstituent/UVCV 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) solid/semi-solid, extremely viscous resins, with a frozen honey-like texture. We tested hypotheses and performed ecotoxicology and e-fate studies on all the different classes of these substances (gums, resinoids, concretes and everything in between) to optimize our testing strategies for such compounds: we will necessitate avoidance of some 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. Devillier, 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 methodology is defined for a chemical, the detection and quantification of concentrations on the measured concentration should be applied for these mixtures? This presentation is intending to discuss these issues and to bring some elements of response based on case studies.

TH282
Deriving USEtox human non-cancer toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program
F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, M. Fuart-Gatnik, M. Pavan, S-IN Soluzioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

The problem of substances that is defined include footprint (PEF/OEFO) 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 relies the model on input data 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-TSD50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ESRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels. The product challenges that is defined include footprint 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. NOAEL), 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.

TH283
Deriving USEtox aquatic freshwater toxicity Effect factor from OpenFoodTox database (EFSA) using R-Studio program
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The USEtox requires the most up to-date input data for a chemical. Focusing on aquatic freshwater toxicity effect factors (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 relies the model on input data 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-TSD50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ESRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels. The product challenges that is defined include footprint 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. NOAEL), 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 and Chronic species geometric means with standard deviation. Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TH284 Bioassays for assessing effects of overall mixture from food contact materials K. Martinovic, F. D. Mezger, J. Crookston / Math, Science and Technology; E.M. Curran, University of St. Thomas / Biology; A.C. Mehinto, Southern California Coastal Water Research Project / Toxicology; N. Vinas, US Army Engineer Research and Development Center; A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; E.M. Curran, University of St. Thomas; C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; M.L. Ferrey, Minnesota Pollution Control Agency / Environmental Outcomes

Determining ecological risks associated with exposures to complex chemical mixtures in the environment is challenging. Bioeffect-based monitoring tools that can measure integrated biological activity of mixtures have been proposed as one of the most promising ways to assess the impact of chemical mixtures on ecosystems. This approach is based on the use of bioassays that measure the effects of chemical mixtures on biological organisms, such as plants or microorganisms. The results of these bioassays can then be used to calculate an index of toxicity, which can be used to prioritize mixtures for further study.


Inspired by methods and tools developed in the field of life cycle analysis (LCA), we assess the risk to human health from chronic ingestion of FCCs, basic information on migrating chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCCs, especially the non-intentionally added substances (NIAS), as some or most NIAS typically remain unknown, depending on the type of FCA. Furthermore, the current approach to chemical risk assessment is focused on single substances, while it is known that migrating FCCs migrate simultaneously, forming the ‘overall migrant’ and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCCs is to assess biological effects of the overall migrate. In addition to assessing mixture toxicity this approach also includes effect-evaluation for unknown NIAS which otherwise remain unassessed.

We review this approach, discuss benefits and disadvantages, and highlight future research needs.

TH286 Solution-focused application of mixture modelling and chemical footprints M.C. Zigg, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTARES; A. van Wezel, KWR Watercyle Research Institute / Chemical Water Quality and Health; D. De Zwart, DIz Ecotox / Centre for Sustainability Environment and Health; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; L. Posthuma, RIVM / Centre for Sustainability Environment and Health

Status reports of the Water Framework Directive direct 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 10k chemicals and their mixtures, are the causal agents. In the FP7-project Solutions, a modelling train is developed with the purpose to support derivation of water quality management plans that provide best value for money regarding chemicals and their mixtures, i.e., help to identify the largest potential risk reduction per euro spent. Thereby, the challenge is to focus on those chemicals that matter most, which can result in prioritization to sites (where are largest impacts to be expected), to times (when are largest impacts to be expected, e.g., crop-growing season & pesticides), to affected species groups (which species (groups) are most sensitive to the present impact) and to compound (which chemical (groups) contribute most to local impacts). Collaboration with the FP7-project MARS (on multiple-stress effects on ecological status) forms a multi-stress, multi-chemical inventory. In SOLUTIONS, the modeling train will result in complex chemical footprints (ChFs). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current presentation, ChFs are evaluated in terms of the net contributions to predicted mixture impact of emissions in one region, e.g., a sub-catchment, on the mixture risk pressure in the total river downstream, including the estuary. Hence, it extends the potential transfer of risk from one region to another, only considering 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.
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, NOA). Rat toxicity 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 iodamid (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signaling. Collectively, these results indicate that fish transcriptomics may be a convenient tool to study biological communities’ responses. We exposed twenty-four artificial streams to a range of WWTP effluent concentrations, from no effluent to pure effluent and under controlled conditions of light and water flow during 34 days, followed for 22 days of recovery under no effluent conditions. We analysed river biofilm inhabiting in sediments and cobbles surface because of its major role in ecosystem functioning. To assess impact and recovery we measured Chlorophyll-a content, Chlorophyll-a fluorescence measurements, extracellular enzyme activities (APA and LAP), algal community and metabolism at weekly scale. Pollution load associated to the WWTP effluent was characterized analyzing physical-chemical parameters (pH, dissolved oxygen, conductivity and temperature), nutrients, organic matter, heavy metals and microcontaminants in the water phase. Our preliminary results indicate a complex response of stream ecosystem functioning in front of the WWTP effluent. We notice changes on the ecosystem balance and the final return to equilibrium. Acknowledgements - The research leading to these results has received funding from the European Commission’s 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Gloebaqua

TH292

Risk assessment of chemical mixtures in the Erft river basin

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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 Exposure (TUE) was used to determine assigned 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...
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 WWTW effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered as a potential indicator for the presence of sunscreen in coastal surface waters. UVB-absorbers occurred 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, Bisprofen and Dichlofenac as substances with a possible risk for the aquatic organisms. In waterbodies strongly influenced by WWTW discharges Dichlofenac and Bisprofen 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 general 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 Cremoza aquifers. For that, four priority contaminants identified in the two aquifers were chosen as model chemicals and synthetic water was built to mimic the natural water composition from the Bologna and Cremoza 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 203). In the Daphnia studies the model was able to predict the effects of the binary mixtures used 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
Mixture effects of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
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In coastal ecosystems, surfactant mixtures are not present on their own but in mixtures. A chemical monitoring survey detected more than 60 organic chemicals along the west coast of Sweden in 2012, many of which exceeded their environmental thresholds. A total of 33 chemicals was found to co-occur in the water column of the coast of Stensungsd, 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 concentration (toxicity). 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 endpoints at different concentrations of 0.20 µmol/L (SDS) and 0.32 µmol/L (DBP), respectively. The prediction of structural endpoints as well as time-course experiments are currently (Nov. 2017) ongoing and will be presented on the poster.

TH295
Analysis of the Mixture Toxicity Burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef.
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The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2000km along the coastline of north-eastern Australia. A total of thirty-five major river basins discharge to the GBR and many transport large loads of pesticides, suspended sediments, nutrients from agricultural land. Over the past 6 years an extensive program has been conducted by the Queensland Government to monitor concentrations of 51 pesticides and their breakdown products in 17 rivers that discharge to the GBR. To explore the potential impact of these pesticides on the Great Barrier Reef, water quality conditions in the rivers and to the GBR we analysed the risk posed by the individual pesticides and their mixtures. Australia currently does not have water quality guidelines for 17 of the 38 pesticides detected. For those, we calculated ecotoxicity thresholds using a simplified version of the Australian methodology for determining water quality guideline values, based on species-sensitivity distributions. In all rivers, multiple pesticides were routinely detected and the mixture concentrations exceeded their level of reporting. All rivers had at least one sample where the combined toxicity was greater than 1 toxic unit (TU), i.e. exposure situations where the total pesticide concentration exceeded acceptable levels. In a number of rivers more than 50% of samples had a combined toxicity greater than 1 TU. Average TU’s per river ranged from 13.47 to 0.10, with substantial fluctuations over the seasons but without clear trends between years. The patterns indicate that specific events such as severity of wet/dry seasons and cyclone events impact the combined toxicity found. We also found land use patterns affected the combined toxicity in the river ecosystems. In each of the rivers, 90% of the expected mixture toxicity was caused by only between 2 and 6 pesticides, although the individual pesticides that dominated the combined toxicity differed between rivers.

TH296
Physiological and transcriptomic responses in the tropical coral Stylophora pistillata to inorganic sunscreen exposure.
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Between 16000 and 25000 tons of sunscreen are used annually in tropical countries with tourism linked to coral reef areas considered to be one of fastest growing tourism sector worldwide. Sunscreens are complex mixture of UV filters, emollients, and emulsifiers, and at least 25% of the cream is washed off from the 5-10% of the tourist beaches. Organic UV filters have been documented to cause bleaching both in the coral's symbiotic algae Symbiodinium indicating that sunscreen toxicity is likely driven by the oil phase and not the sunscreen itself and it is independent of the tested concentrations of the UV-filter nTiO2 in the cream. Thus in the present study the tropical coral Stylophora pistillata, a common model coral species, was exposed to increasing concentrations of custom-made sunscreen formulations with and without the UV filter nTiO2 to characterize the responses of the chemical mixture either containing or not nanoparticles in it. A series of short-term (5 days) experiments was carried out to compare the effects of these sunscreens on corals, by studying coral photophysiology, coral respiration, symbiont density and chlorophyll content. The expression of genes involved in thermal stress (HSP70), carbon acquisition (intra- and extracellular carbonic anhydrase) and calcium and ATP exchange (CA-ATPase) were also analysed to characterize Stylophora pistillata transcriptomic response to sunscreen exposure. Results from this work will be presented and compared to other studies carried out with organic sunscreens. Results from the present studies are essential to understand how the exposure to inorganic sunscreens affects reef-building corals, and they will contribute to the development of effective conservation programs and support eco-tourism.
Economies.

TH297 Effect of antibiotic mixtures on the growth of Anabaena flos-aquae
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Antibiotics can be released to the environment, following use in both human and veterinary medicine. As a wide range of antibiotics active ingredients are in use, the natural environment will be likely exposed to mixtures of these compounds. The environmental risks of these mixtures are however poorly understood. In this study, the toxicity of single and mixture of six major human antibiotics from different classes; amoxicillin (AMO), oxytetracycline (OXY), clarithromycin (CLA), meropenem (MER), ciprofloxacin (CIP), cephalaxin (CEP) to the blue green algae, Anabaena flos-aquae was assessed. All antibiotics showed high toxicity to the cyanobacteria with EC50 concentration ranging from 0.001 to 0.08 mg/L (CLA, AMO, OXY, CEP, CIP, 0.001 mg/L, respectively), while edamycin and oxytetracycline (OXY, 0.006 mg/L, MER, 0.02 mg/L and AMO, 0.03 mg/L). Use of these toxicity data along with predictions of water surface concentrations, using simple models, resulted in risk characterisation ratio values of 30.2, 2.5, 2.4, 1.9, 1.4 and 0.2 for AMO, OXY, CLA, MER, CIP and CEP respectively, suggesting that five of the six compounds may be adversely affecting the aquatic environment. The mixture toxicities studies are ongoing but the study data available; these will be used to evaluate the concentration addition (CA) and independent action (IA) for estimating the mixture toxicity. The best performing model will then be used alongside exposure modelling approaches to explore the risks of mixture for different scenarios.

TH298 Exposure to mixtures of Persistent Organic Pollutants (POPs) can inhibit the transactivation activities of Aryl hydrocarbon Receptor (AhR) in vitro
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Exposure to mixtures of Persistent Organic Pollutants (POPs) can inhibit the transactivation activities of Aryl hydrocarbon Receptor (AhR) function. AhR is a key receptor involved in an organism’s response to POPs as xenobiotics. In this study, three different luciferase reporter cell lines (rat hepatoma H4IIIE, human mammary gland carcinoma T47-D and human hepatoma Hep G2) were used to screen AhR transactivation activities (i.e. agonistic and antagonistic) of 29 compounds listed as POPs under the 2001 Stockholm Convention. Their mixture, prepared according to the nominal final concentrations found in human blood, was also tested for the same AhR transactivation activities. We show that these compounds have species- and tissue-specific effects and that the rat cells DR (Dioxin responsive)-H4IIIE are more sensitive than the two human cell lines (DR-T4-D and DR-Hep G2). Only 6 out of them showed AhR agonistic activities. PBDE-153, PBDE-154, PCB-138, and PCB-118 were able to activate the AhR in H4IIIE cells only, γ-HCH was active in DR-T4-D only, while PBDE-99 was found to be an AhR agonist in both cell lines. No agonistic effect was seen for DR-Hep G2. In contrast, 19 out of the 29 compounds showed AhR antagonistic activities in DR-H4IIIE, while 10 and 6 compounds displayed AhR antagonistic activities in DR-T4-D and DR-Hep G2 cells, respectively. Not surprisingly, the mixture of the 29 compounds also showed an AhR antagonistic action in all cell lines. In the rat hepatoma H4IIIE, AhR inhibition was observed with concentrations of the POP mixture corresponding to 75 times the blood level and above, which could be plausibly reached in humans after a food contamination incident. The IC50 for the POP mixture was 262.6 ± 104.6 times the background blood level, which corresponds to an interpolated antagonistic equivalent of 0.165 μM BDE-47, while only 0.0047 μM BDE-47 presents in the mixture at the IC50. In addition, the isobole coefficient of the mixture is 0.3 (-1) according to additive mixture effect model. This indicates that AhR antagonistic activities are significantly enhanced in real mixtures.

TH299 Ecotoxicity of biofuel-mixture DnBE and 1-Octanol on aquatic organisms
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The worldwide demand for fuels is increasing, but currently used fuels are based on fossil resources. A possible alternative for diesel is the biofuel mixture of 1-Octanol (1-Oct) (80%) and Dn-butyl ether (DnBE) (20%). These fuels are based on the raw material lignocellulosic and -neutral. However, potential effects of this mixture include toxicity, endocrine disruption, especially for aquatic organisms. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction between the two substances. Acute embryo toxicity and developmental effects were investigated in the fish embryo toxicity test (FET) with Danio rerio (OECD 236). The acute immobilization assay (OECD 202) was performed in order to determine the LC50 of the test mixture. To interpret the results for possible interactions between the two substances, the investigation of DnBE and 1-Octanol as single substances was necessary. In the acute immobilization test, the LC50 values were 14.7 mg/L for 1-octanol and 17.3 mg/L for DnBe. Both biofuels led to teratogenic and lethal effects in the FET (LC50, DnBE: 24.7 mg/L; LC50, 1-Octanol: 11.3 mg/L). Especially in the study of DnBe was a low hatching rate, while edemas were often observed at the pericardium of the developing larvae. Testing the mixture in the FET revealed a LC50 of 14.7 mg/L. The acute immobilization test resulted in 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. DnBe showed a higher toxicity on D. magna than the tested mixture. For the comprehensive ecotoxicological assessment of the mixture and these 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 a part of the Research and Training Program “Towards biomarkers from “farming” by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.
Inherently to the use of the insecticide abamectin and the fungicide difenoconazole, the main objective of this research was to evaluate the effect generated in Danio rerio embryos exposed to pesticide mixtures and evaluate the effects produced by the interaction of these compounds. For this, Danio rerio embryos were exposed for 96h to the binary mixtures of abamectin and difenoconazole following the recommendations of OECD TG 236. The concentrations used were 0.5; 1.1; 2.4; 5.3 and 11.7 mg L\(^{-1}\) of abamectin and 0.2; 0.5; 1.0; 2.3 and 5.0 mg L\(^{-1}\) of difenoconazole. The factorial design was used to evaluate 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 totalizing an n = 15. Survival data were recorded every 24 hours and the results were analyzed in the Minitab software. Results indicate that, for each compound, the binary mixtures of abamectin and difenoconazole promotes in Danio rerio embryos the antagonistic effect in the lower concentrations, but in higher concentrations the produced effect is synergic. This means that, at lower concentrations the interaction of abamectin + difenoconazole seems to decrease the toxicity of pesticides to Danio rerio embryos, but the toxicity of the compounds is potentiated at higher concentrations of the mixture. Similar results were obtained in other studies with compounds mixtures, 

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

TH302

Cocktail-effect of persistent organic pollutants on selected bioreporter-systems and zebrafish embryos

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There is an ever-increasing number of chemicals including pharmaceuticals and industrial pollutants that are released into the aquatic environment, leading to the exposure of fish and other aquatic organisms. Moreover, at the present time, environmental risk assessment is mainly based on chemical analysis, only. However, "compound-by-compound" based assessments seriously run the risk of underestimating the risk of chemicals as the true exposure scenario for humans and wildlife is known to be far more complex. Under regular environmental conditions, organisms can be exposed to multiple chemicals associated with different risks and specific effects, e.g. teratogenicity, immune toxicity and suppression, genotoxicity, and endocrine disruption. Moreover, it has been repeatedly demonstrated that pollutants and the underlying toxic responses may interact and generate effects that are different from the toxicity of the individual chemicals. Thus, understanding the effects of similar mixtures of chemicals that are generally referred to as "cocktail effects", represent one of today's greatest challenges in environmental but also in human toxicology. The aim of the present study is to investigate embryotoxic and teratogenic but also mechanism-specific effects using zebrafish embryos. They will be exposed to selected priority pollutants and their mixtures (e.g. polychlorinated biphenyls, heavy metals, polycyclic aromatic compounds). These chemicals represent highly relevant chemicals which can be found in great levels in the environment. First results indicate that beside biological interactions heavy metals may alter the toxicity of organic pollutants. This study is part of the EnForce project (https://www.oru.se/enforce), which aims at the development of an effect-based risk assessment in cooperation with different stakeholders and several industrial partners.

TH304

Environmental impact assessment of carbon fibers reinforced composites pyrolysis process


The end-of-life management of carbon fibers reinforced composites (CFRCs) has been investigated by comparing the environmental sustainability of Curti S.p.A. company’s pyrolysis process with waste-to-energy (WtE) and landfill disposal. The determination of environmental loads was carried out through the Life Cycle Assessment (LCA) methodology, modelizing and analyzing each scenario through Goal and Scope Definition, inventory analysis and Impact Assessment. CFRCs are highly engineered materials, with high caloric power and excellent mechanical properties. From their recovery, it is possible to obtain a secondary raw material that can be used in application requiring lower performance than originals, or the recovery of thermal/electrical energy. The market still offers few CFRC recovery technologies. Therefore the most developed ones have been chosen to compare with landfill disposal, even though nowadays it would be avoided, for waste with a LHV>13 MJ kg\(^{-1}\). The pyrolysis process involves a first pyrolysis and a subsequent gasification of the waste within the same reactor. This system allows the quantitative recovery of carbon fibers (CF) contained in the initial composite and generates hot gaseous compounds that are burnt and released into the atmosphere. Since the plant is at a pilot scale, a heat recovery system has not been designed yet for the combustion of fumes. Considering the impact assessment results, pyrolysis has proved to be the most sustainable treatment due to the quantitative recovery of carbon fibers, which avoids the consumption of material and energy deriving from the production of virgin carbon fibers. The worst scenario is WtE, mostly because of the damage generated by emissions in air and water. The impact of landfill disposal is intermediate, due to the good stability of CFRCs: a slow degradation, their disposal in landfills does not cause an high impact, except for land occupation. The LCA study made it possible to carry out a preliminary assessment supporting the pyrolysis pilot plant design, to identify critical aspects and strengths of each scenario. [1] Legislative Decree n°36 of 13 January 2003; Implementation of Directive 1999/31/EC on landfill of waste, Official Journal of the Italian Republic, 2003. [2] Legislative Decree n°205 of 3 December 2010; provisions implementing Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, Official Journal, 2010.

TH305

Critical raw materials in a new building integrated photovoltaic system

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REELCOOP, an EU-FP7 funded project which stands for Renewable ELEcricity COOPeration (www.reelcoop.com), aims to develop and test novel prototypes of renewable electricity generation technologies. One of the prototypes is a solar photovoltaic (PV) ventilated façade (6kW) and involves the development of c-Si solar cells, as well as the study of the ventilation effect in PV façades. PV solar panels have particular metals or rare earths that are potentially included in the category of ‘critical raw materials (CRMs)’. This work aims to identify the potential CRMs in this prototype and to define several ways to improve the sustainability from a life-cycle approach, including aspects like substitution or recycling of these materials.

TH306

Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment

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Most Life Cycle Assessments (LCAs) performed in the pharmaceutical sector have been done on chemically synthesized drugs, leaving biopharmaceuticals aside. The fact that sustainability assessments of biopharmaceutical products and technologies have been rarely done is probably a consequence of the major challenge that building a robust Life Cycle Inventory (LCI) represents for the upstream and downstream processes of biologics. However, the low number of LCAs performed on biopharmaceuticals does not reflect the current reality of the pharmaceutical sector, as its market is rapidly growing at an annual rate of around 9%. Therefore, this study focuses in performing a resource based LCA to measure the environmental impact of a biological Active Pharmaceutical Ingredient (API). A resource-based methodology has been used to address the task that aims to shed light on supply and efficient use of resources. The API investigated is infliximab, a monoclonal antibody that treats autoimmune diseases. An Exergetic Life Cycle Assessment (ELCA) was conducted, using the Cumulative Exergy Extracted from the Natural Environment (CEEENE) method. First results show that the unit operations with the highest impact are: i) The first chromatographic process for purification (Direct Product Capture), since it requires the highest quantity of buffers which are produced using chemicals as well as complex organic compounds such as amino acids. ii) Fermentation, as similar complex components are required for its medium, which are also produced through biotechnological processes. Furthermore, fermentation is the process that takes the longest (several days), leveraging the Heating Ventilation and Air Conditioning (HVAC) system to achieve the clean room conditions needed for the production of biologics. HVAC has shown to be the utility with the highest impact, consuming a significant percentage of the total electricity used in the plant. Performing an LCA on a biologic mainly using primary data has proven to be a possible task. However, challenges such as the data unavailability of biotechnologies used to produce the nutrients needed throughout the process, as well as the further integration of these technologies into databases should be addressed.

TH307

LCA methodology: a case study of the industrial production of terephthalic acid from renewable sources

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The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved for the traditional way with those of three bio-based routes. The aim of the study is to identify which of the selected pathways has the lowest environmental load. Below the four routes selected are briefly described: Traditional way: p-xylene is obtained from catalytic reforming of crude oil as part of extracted BTX (benzene, toluene and xylene isomers); GEVO’s process: isobutanol from the fermentation of biomass is converted into hydrocarbons, iso-octene and p-xylene; 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 this study is to provide an assessment of continuous micro/milli-flow technologies applied to Engineered Nanoparticles (ENPs) production, benchmarking them against the conventional batch productions. As the quantity of ENPs produced and their applications are steeply growing, an increasing attention is being paid to the quality of the product and the efficiency of the synthesis. Continuous micro/milli-flow (CF) synthesis is considered to be the natural evolution of the currently most diffused conventional batch synthesis, as it intensifies the production in terms of productivity, energy and chemicals use, product quality and functionalisation. Given the importance and potentiality of the transition, an evaluation of these new technologies is needed. Life Cycle Assessment is the chosen methodology for addressing this objective, as it looks deep into the sustainability, efficiency and environmental impact of the system considered, in order to identify the key parameters for a deliberate green process design. The application of the LCA methodology to ENPs production presents many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed; lysozyme, TiO2 and Au. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.

TH310 LCA of nanomaterials production for the emerging technology: the case of printing batteries T. 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 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 24 continuous electricity production, electricity and heat generation, heat for distributed in concentrated solar plants. Nonetheless, the overall 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: Photonic 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. A detailed work process looking for high performance materials but environmentally friendly. Some improvements are being made such as: use of aluminium instead of silver in the mirror reflective coating, to meet the European requirements for use of non-critical materials; the reduction of materials weight; and the increase in materials robustness. The expected results are to: Obtain a complete environmental profile of IN-POWER CSP architecture. Calculate the environmental impacts associated to: new polymeric materials for mirrors; higher absorber coating; high thermal storage capacity materials; polymeric composite for CSP structure. Evaluate the benefits of IN-POWER materials compared with reference materials. Evaluate the benefits of IN-POWER CSP architecture compared with current mature Parabolic Trough Collector technology.

**TH312**

Environmental impact and social influence of an Advanced Adiabatic Compressed Air Energy Storage (AA-CAES) located in Eisenerz, Austria. The case of RICAS2020 PROJECT.

A. Clare, Leitat Technological Center / Sustainability Division; G. Ferrer, Leitat Technological Center / Quantitatii Change / Research and Social impact benefits and 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 low 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) develop new innovative materials; (ii) generate a worldwide challenge for high performance component but environmentally friendly. Some of the main results will be presented, such as the sensitivity analysis showed that electricity used for the production of glass has a high impact on the environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 construction stages (in the excavation and, concrete structure) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

**TH313**

Upgrading wastewater treatment technologies in the framework of current renewable energy policies - an environmental assessment

A. Petit-Boix, University of Freiburg / Chair of Societal Transition and Circular Economy; M. Rufí, Salix, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology (ICTA); G. Villalba, X. Gabarrull, J. Riera and, last but not least, in the process analysis stage for understanding the potential improvement of an existing process. It consists in the construction of the Cavern and, in the construction of the TES. A life cycle assessment (LCA) has been evolved to assess the environmental impacts of the innovative materials in 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) develop new innovative materials; (ii) generate a worldwide challenge for high performance component but environmentally friendly. Some of the main results will be presented, such as the sensitivity analysis showed that electricity used for the production of glass has a high impact on the environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 construction stages (in the excavation and, concrete structure) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

**TH314**

Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for greenhouse glass

N. Tsou, CML Leiden University / CML; J. Quist, Delft University of Technology / Technology, Policy, and Management; A. Wypkema, M. Mourad, TNO / Materials Solutions; V. Prado, CML Leiden University

Technology that can increase crop productivity and sustainable development but at the same time 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 innovative materials in 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) develop new innovative materials; (ii) generate a worldwide challenge for high performance component but environmentally friendly. Some of the main results will be presented, such as the sensitivity analysis showed that electricity used for the production of glass has a high impact on the environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 construction stages (in the excavation and, concrete structure) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

**TH315**

Combine process simulation analysis with Life Cycle Assessment in photovoltaic polyethylene rigid foam production

A. Bordignon, M. Ferrmeglia, Universita` di trieste; A. Bortoluzzi, S. Rondinini, C. Locatelli, A. Vertova, Universita` 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 construction of the Cavern and, in the construction of the TES. A life cycle assessment (LCA) has been evolved to assess the environmental impacts of the innovative materials in 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) develop new innovative materials; (ii) generate a worldwide challenge for high performance component but environmentally friendly. Some of the main results will be presented, such as the sensitivity analysis showed that electricity used for the production of glass has a high impact on the environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 construction stages (in the excavation and, concrete structure) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

**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.
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 with 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 phototreatment utilisation are reducing CO₂ emissions and establishing an alternative carbon source, this study compares the CO₂-based and fossil-based methanol production systems with respect to global warming and fossil resource depletion. The CO₂-based methanol production system consists of the following three stages: CO₂ source including CO₂ capture, electricity compensation, and CO₂ utilisation for methanol production. The fossil-based methanol production system serves as benchmark and is divided into electricity generation and fossil-based methanol production. The main functions of the CO₂-based and fossil-based systems are production of methanol, and supply of electricity to the UK electricity grid. To quantify the main functions, we choose 14.3 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 intermediate and steps are considered, compared to the corresponding fossil-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

**TH317**
Linking failed swim bladder inflation of larval Japanese medaka (Oryzias latipes) after embryonic exposure to 17α-ethinylestradiol, levonorgestrel and diclofenac, to disrupted greifenkin/Wnt signalling

Z.P. Pandelides, University of Ontario Institute of Technology; M. Overturf, University of Louisiana at Monroe / Biology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guichard, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science

Embryotoxicity testing is a high throughput alternative to using the whole fish model. Previous studies in the laboratory have demonstrated that embryonic exposure to pharmaceutical compounds capable of disrupting the endocrine system such as 17α-ethinylestradiol, levonorgestrel, and diclofenac, both alone and in mixtures, can impair swim bladder inflation of Japanese medaka (Oryzias latipes). Failure of swim bladder inflation can have serious long-term effects on fish population dynamics and can be linked with reduced ability to avoid predation. Dermal embryotoxic 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 IWR 1 and lithium exposed from 36-101 hours post fertilization on gene expression of medaka embryos was determined. The effects of embryonic exposure to the three pharmaceutical compounds on whole embryo gene expression were then established and compared. It was measured that these pharmaceutical compounds significantly inhibited the expression of genes related to the formation of the three layers of the swim bladder (epithelial, mesenchyme, and outer mesothelium). Both levonorgestrel and 17α-ethinylestradiol also significantly downregulated the expression of lefl and ctf7l (β-catenin/Wnt transcription factors), but not the expression of the Wnt ligand wnt5b. Thus demonstrating that these compounds may be altering swim bladder inflation through a disruption of β-catenin/Wnt signalling during early embryo development.

**TH318**
Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor

L. Xie, NIVA - Norwegian Institute for Water Research; T. Gomes, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; A.K. Solhaug, Norwegian University of Life Sciences; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Moe, NIVA Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

*Lemma minor* is an aquatic plant commonly used in laboratory phytotoxicity testing due to its rapid reproduction capacity, resource-effective exposure format and central function in the aquatic ecosystem. Several standard methods have already been adopted by international standardisation organisations using this species as an ecotoxicological model. Although being highly useful for regulatory purposes focusing on traditional adverse endpoints, these test systems provide limited information about the toxic mechanisms and modes of action (MoA) and rarely address complex environmental issues such as exposure to multiple stressors. The present study aimed to use selected functional assays in *L. minor* after exposure to 3,5-dichlorophenol (3,5-DCP) as a model to characterize the toxic mechanisms causing growth inhibition and lethality in primary cultures. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophyll 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 relation well studied in vertebrates, especially mammalian species. However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs based on a combination of literature survey and in silico predictions; evaluate the knowledge gaps in the AOPs using the forecast species Daphnia magna. An extensive literature survey to collect existing knowledge on ROS-mediated reproductive effects in aquatic invertebrates, and metals, ironizing and non-ironizing 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 damage, DNA, protein 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.

**TH339**
Development of an Adverse Outcome Pathway for oxidative stressor-mediated reproductive effects in aquatic invertebrates

Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; L. Xie, NIVA - Norwegian Institute for Water Research; Y. Lee, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; G. Caldwell, Newcastle University; K. Tollefsen, Norwegian Institute for Water Research

Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous antioxidant defenses. Environmental chemical contaminants present in the aquatic environment such as 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 relation well studied in vertebrates, especially mammalian species. However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs based on a combination of literature survey and in silico predictions; evaluate the knowledge gaps in the AOPs using the forecast species Daphnia magna. An extensive literature survey to collect existing knowledge on ROS-mediated reproductive effects in aquatic invertebrates, and metals, ironizing and non-ironizing 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 damage, DNA, protein 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.
insecticides, have the potential to perturbate the functionality of calcium channels. Among the different types of calcium channels, the L-type calcium channel (LTCC) is responsible for the excitation-contraction coupling of skeletal, smooth, and cardiac muscle. Chemicals that unintentionally block this channel in cardiac cells may impair heart function and health, leading to various cardiac pathologies and predisposing individuals to heart failure. Advancing our understanding of the mechanisms underlying these adverse effects is of paramount importance if we want to develop effective strategies able to accurately predict the cardiac risk posed by chronic exposure to those chemicals. In this presentation, we describe the development of an Adverse Outcome Pathway (AOP) that outlines the series of causally related key events triggered by the blockade of LTCC, and that can ultimately lead to cardiac adverse effects. We discuss the integration of in silico, in vitro, and in vivo evidence to support the AOP development, as well as the application of computational and network biology approaches that may accelerate the identification of relevant key events. Considering the multifaceted role of LTCC in different components of the cardiovascular system other than the heart, we also discuss the importance of applying AOP network considerations to guide a reliable and fit-for-purpose AOP development. This AOP will represent a valuable knowledge base able to guide the identification of key events that are highly predictive of in vivo toxicity, and that can be measured in vitro without relying on animal testing. The knowledge base will also be used as platform to drive future development projects aimed at incorporating additional layers of complexity in the model, and at driving the transition towards a fully quantitative AOP able to effectively support regulatory decision-making and risk assessment.

TH321 Quantification of AOP by Bayesian network modelling: linking 3,5-DCP exposure to adverse outcomes in Lemma minor
J. Moe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; W. G. Landis, Western Washington University / Institute of Renewable Energy; L. Xie, NIVA; Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment
AOPs have gained international recognition as a systematic approach for capturing existing toxicological knowledge to transparently link mechanistic data to toxicity endpoints. Nevertheless, most AOPs are qualitative and not directly suitable for quantitative risk assessment. Quantitative AOPs (qAOP) should define the relationships underlying transition from one KE to the next sufficiently well to allow quantitative prediction of the probability or severity of the AO occurring for a given activation of the MIE. We have started developing a Bayesian Network (BN) model to quantify a recently proposed AOP, which links the mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol (DCP) to adverse outcomes in the aquatic plant Lemma minor. The BN model is based on data from a laboratory experiment exposing L minor to DCP in 8 concentrations with 3 replicates. The measured response variables include OXPHOS (oxidative phosphorylation), ROS (reactive oxygen species), ETR (electron transfer rate), Fv/Fm (maximum quantum yield of photosystem II), LPO (lipid peroxidation) and number of fronds (leaves). The proposed AOPs a network consisting of three chains with the same chemical stressor (DCP) and AO (fronds number). All AOP components are defined in the BN as nodes with discrete states. Each node is quantified by a probability distribution across these states. The causal links (Key Event Relationships) are quantified as conditional probability tables (CPTs), which determine the probability distribution of a child node conditionally on the probability distribution of the parent node(s). The CPTs are calculated directly from the data in this BN version. The BN was run by changing DCP concentration and inspecting the changes in all subsequent nodes. Qualitatively, the model predictions were as expected: increasing the DCP concentration caused reduced OXPHOS, reduced ETR and reduced fronds number. For example, when DCP was increased from 1 to 2 mg/L, the probability of fronds number being in the lowest (worst) state 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.

TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effectcopia
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 PPAR interaction as Molecular Initiation Event (MIE), Collagen activation, Inflammation and EMT-Fibrosis activation as Key Events (KEs), and Cytoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelial cell (Beas2B). Beas2B cell was exposed to CMT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis of the KEs was performed using Effectopedia platform of AOP-KB. For further study, we are planning to do various dose- and time response test (using qPCR and ELISA) for each potential KEs, so that we can integrate data for building qAOP model with the network between MIE-KEs-AO. Acknowledgement: This work was supported by a grant from the Korean Ministry of Environment through ‘Environmental Health R&D Program’ (201700137001).

TH323 Exploring Potential of Knowledge Databases for Adverse Outcome Pathway Discovery
C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; D. Martinovic-Weigelt, University of St. Thomas / Biology
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-billion 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 increased by building 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 discharge of untreated sewage into the river. Significant biological effects of untreated sewage were previously observed through an in vitro study. To study neurotoxic effects more in details and in realistic ecological context, we conducted fish caging experiment. Common carp (Cyprinus carpio (L.), Cyprinidae) has been selected for the experiment, as one of the most common species in the Middle Danube, genetically well described and economically important. Ten fish per cage were exposed in cages for nine days at three sites on the Danube River: upstream from sewerage discharge – reference site, 230 m and 7 km downstream from the discharge and at one site on Sava River (downstream from industrial wastewater discharge near the city of Sabac). After the exposure period, brains were isolated and prepared for gene expression and enzyme activity analyses. The expression of genes encoding for five enzymes was studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (receptor for the inhibitory neurotransmitter GABA and various drugs), synaptotagmin 10 (integral membrane protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelination of axons and neuroprotection). The activity of acetylcholine esterase, enzyme that terminates action potential transmission in chemical synapses of cholinergic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin3a and tachykinin 3b, GABA a1 receptor and synaptotagmin 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream from the sewage discharge, but this gene expression was significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603437.

MOPC02
Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreocephalus niloticus as model
A. Marcato, Sao Paulo State University - UNESP / Department of Biology; C.P. de Souza, Sao Paulo State University - UNESP / Biology; J. Evangelista Correia, Unesp - Institute of Biology / Biology; C.S. Fontanetti, Sao Paulo State University - UNESP / Biology

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 organic matter, and also because it promotes improvement in soil fertility, favoring the availability of some elements for the plants. However, the amount of vinasse used in the fertirrigation should not impair the soil, since the dosages should be directed to the specific characteristics of each soil. When used in unbalanced proportions can impair to the soils and the plants, in addition to being able to reach water resources. Considering studies that prove the toxicity of vinasse in nature, the use of treatment systems has become quite interesting. The integration of systems such as natural attenuation, filtration and phytoremediation increase the effectiveness of the treatment, since they are highly effective biogeochemical systems to treat waste water from different sources. Aquatic macrophytes, which not only accumulate pollutants directly in their tissues but also produce detoxification enzymes in the root rhizosphere, 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 pollutants potential of vinasse, since the animals did not present histological changes.

MOPC03
Assessing toxic effects in the fish Violet Goby (Gobioides broussonnetii - Gobiidae) from one of the most productive estuaries in Brazil.
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The Estuarine-Lagoon Complex of Cananéia (São Paulo, Southeast Brazil) is among the most productive areas in the South Atlantic. The Ribeira de Iguape River (RIR) is the major freshwater contributor of the estuary. It carries different classes of contaminants from former mining activities, agricultural areas and urban centers through an artificial channel. The disordered human occupation, presence of boats and the disposal of waste and sewage are also sources of pollution throughout this system. The Violet Goby (Gobioides broussonnetii - 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. broussonnetii the studied area. Fishes were sampled near Cananéia, Subaúma and Iguape in winter (2016) and summer (2017). The animals were anesthetized, euthanized and the blood, brain, muscle, liver and kidney were collected for the biochemical and genetic biomarkers analysis. The muscle AChE activities showed similar results among the points and seasons, while hepatic and renal Gpx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxicity in Cananéia and Subaúma points 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 stimulating this stress. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of contaminants may interfere in the observed responses. Nevertheless, an anthropic 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 biomonitors
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The Aachen-Soers WWTP is a large-scale ozonation plant aimed to achieve a good chemical and biological state of all surface waters until 2015. However, the good biological state is only reached by around 20 % of the German surface water bodies. One reason might be the release of a variety of anthropogenic contaminants by waste water treatment plants (WWTPs) into these water bodies. Additionally, these substances are not sufficiently eliminated via conventional waste water cleaning processes. Nevertheless, these chemicals can have adverse effects on the river biota. The implementation of a further treatment step into WWTP could reduce this burden. There are advanced treatment processes, as the ozonation. At the “Aachen Soers” WWTP a large-scale ozonation plant was installed at the end of 2017. Regular operation will start by approximately March 2018. The “Aachen Soers” WWTP is located near the city of Aachen (North-Rhine-Westphalia, Germany) and releases its effluent to the Stream Wurm. At medium and low water levels the stream runs around 70 % treated waste water. To elucidate the impact of the additional waste water treatment on this river the status quo was recorded before the implementation of this treatment step. After the installation of the ozonation the WWTP as well as the Wurm will be monitored for two years. Beside numerous in vitro and in vivo experiments also in situ caging experiments with juvenile rainbow trout (Oncorhyncus mykiss) were performed upstream and downstream the WWTP. The goal was to evaluate the impact of the WWTP outlet on the river. Further, the impact of the upstream burden was part of the study. Several biomarkers were investigated on different organs of the fish. Detoxification enzymes were investigated in liver tissue and acetylcholinesterase was measured in brain tissue. Furthermore, micronuclei formations counted in blood smears get information on genotoxic effects. To gain information on endocrine effects Vitellogenin levels were measured in blood plasma and mucus to compare the conventional invasive method with a new non-invasive method. Fish were caged.
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, larger numbers of chemicals, particularly pesticides, have been identified with anti-androgenic and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic life stages we developed the Rapid Androgen Disruption Adverse outcome Reporter (RADAR) assay. Extracts of Danube River water from sites upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia was analysed. Comparison of our results to previously published data from four in vitro assays carried out on the same extracts indicated that the effect observed in vivo was two orders of magnitude higher than the in vitro effect, suggesting additional mechanism(s) of action present in vivo in addition to androgen receptor activation indicated by the in vitro assays. Application of the RADAR assay for effect-directed analysis was demonstrated for the rapid in vivo confirmation of a number of pesticides, that were initially 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.

Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae ( Oncorhynchus mykiss) and liver cell line RTL-W1

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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 increasingly found in the environment and a resulting great need to be addressed. Raman microspectroscopy (RM) is a versatile tool for MP analytics.[2] Optimization and automation of RM measurements as well as automation of spectral data evaluation are of high importance for monitoring programs and enable quantitative results. We advanced RM-based analysis by optimizing measurement parameters, measurement automation and reduction of data. First, a filter holder was constructed that flattens the filter surface. This filter holder is superior compared to filters deposited on, or glued to, glass slides. However, a flat filter surface is only a first step for successful measurements. For an automated particle recognition we also optimized the contrast between particles and filter. To this end, a variety of polymers (e.g. PE, PP, PS) with different sizes (10^-6 to 10^-7 μm) and forms (spheres and irregular shapes) were analyzed on different filter materials (e.g. PC, gold coated PC, nitrocellulose, etc.) under different modes of illumination (bright and dark field, fluorescence mode). We found that reflecting filter materials combined with dark field illumination yield superior contrast. Finally, we tested these optimized parameters with samples of different complexity (incl. environmental samples) and three RM methods (non-, semi- and fully automated in regard of particle recognition and RAMAN measurements). Samples with a low loading are accessible via an automated approach, whereas the analysis of more loaded samples is better done with manual particle recognition.[3] The results brought forward in this work aim to catalyse advances towards automated methods for a better assessment of environmental risks arising from MP. In the future, the challenges lie in developing automated methods for various samples, especially for very complex samples as resulting from environmental samples.

Preparation of model small microplastics and nanoplastics

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Pollution with plastic debris and plastic fragments has recently been recognized as a major water quality problem in fresh and marine water systems. Degradation of plastic debris in the marine environment leads to the formation of microplastics (<5 mm) and potentially nanoplastics (<1 μm). Recent investigations show that the microplastics can interact with the marine biota. The impact of the interaction on the exposed organism depends on the nature and size of the particles. To acquire more knowledge on these impacts and to optimize analytical procedures, model particles of different sizes and nature of polymers are necessary. However, in the smallest range (<10 μm), particles of only a few types of polymers are currently available. For this reason, most toxicity tests were realised using PS beads whereas polyethylene (PE) and polypropylene (PP) fragments are by far the most common in the aquatic environments. In addition, commercial micro and nanobeads have surfactants at their surface which may enhance their toxicities. Here, we present a simple methodology that allows one to prepare small microplastics of PE with sizes between 0.7 μm to 3 μm. These particles were obtained by dissolving PE pellets in toluene at high temperatures, that were afterwards dispersed in water by 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 (Tween60, Tween80 and a biosurfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed. These...
particles are currently used to optimize strategies of identification by Raman microspectroscopy 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, emplacement of MP-particles, biofouling, and degradation of MP-particles are factors affecting the sorption of humic material, respectively.

The composition and structure of humic substances are not yet fully elucidated due to their heterogeneity. Humic substances contain a high number of electron donors, which can interact with many natural and anthropogenic substances. Sediments composed of organic carbon and rubber crumbs were used as a vector for the sorption of humic substances, due to the sorption of humic substances to the polymer surface. The distribution of microplastic particles in marine environments and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the micro scale. This hypothesis is supported by results of our group that were obtained from different 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 10^17 kg for particles with diameters of 0.5 µm. This circumstance raises concerns as particles vspectroscopy. With imaging FTIR this is possible only down to particle sizes of 10 µm. Electron microscopy suffers from sample preparation and high mortality rates were found for different marine zooplankton species.

Environmental Technology
In Norwegian coastal communities, rubber microplastic granules (≤ 5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the compositional, degradation and ecotoxicological impacts of these rubber granules from locations in northern Norway and Svalbard. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wildlife through direct ingestion, as is the case for other persistent plastic materials and heavy metal pollutants. Furthermore, the rubber particles may act as vectors for other persistent organic pollutants and heavy metal pollutants already present in the marine environment. Arctic marine environments present special abiotic conditions for the degradation of these particles, with cold water temperatures and long periods with unlimited sunlight. During a 12 months period, rubber crumbs were placed out in the ocean in stainless steel containers and sub-sampled continuously for the measurement of persistent organic pollutants, metals and additives. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, diphensols, as well as metals were measured to establish the adsorption and leaching kinetics in seawater under in situ conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GC and SPE clean up. Chemical analyses using pyroGC/MS, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure and transport were investigated or are still under investigation to identify plastic samples. Nano-FITR 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. The detection of microplastic particles in marine environments and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the micro scale. This hypothesis is supported by results of our group that were obtained from different 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 10^17 kg for particles with diameters of 0.5 µm. This circumstance raises concerns as particles vspectroscopy. With imaging FTIR this is possible only down to particle sizes of 10 µm. Electron microscopy suffers from sample preparation and high mortality rates were found for different marine zooplankton species.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (PC)
MOPC17
Neonicotinoid insectsicide in surface waters discharging into the Great Lakes of Southern Ontario, Canada
T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre Neonicotinoid insecticides (NNIs) are a large part of the global pesticide market, as they are very effective at controlling a wide range of insect pests. In Canada, NNIs are used extensively in agricultural regions of southern Ontario to control insect pests on field and greenhouse crops, orchards, nurseries and woodlots etc. Because of their persistence and high solubility in water, there is potential for NNIs to be transported from agricultural fields into surface waters. The objective of this study was to evaluate the distribution of NNIs in surface waters located in areas of intensive agriculture in southern Ontario, Canada that discharge into the Great Lakes basin; specifically into Lake Erie, Lake Saint Clair, Lake Ontario and Lake Huron. Passive sampling with Polar Organic Chemical Integrative Samplers (POCIS) was the principal monitoring technique. To correct for the effect of environmental factors on the rates of uptake of the target NNIs into POCIS, Performance Reference Compounds (PRCs) were spiked into some of the POCIS deployed at each of the monitoring sites. POCIS were deployed for 2 weeks over two intensive deployment periods. Samples from 5 major rivers and 11 smaller creeks in the Great Lakes basin were collected at 5 major rivers and 11 smaller creeks in the Great Lakes basin.
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. Fluoroacetamid was detected at concentrations up to 1140 ng/L in watersheds discharging into Lake Ontario. Imidacloprid at concentrations up to 1731 ng/L and thiamethoxam at concentrations up to 625 ng/L were detected in the watersheds discharging into Lake Erie. Overall, these data indicate that NNIs are widely distributed in surface waters in agricultural regions in Ontario within the Great Lakes basin.

MOPC18 Occurrence and removal of antibiotics in municipal wastewater by conventional activated sludge (CAS) and membrane bioreactor (MBR) systems

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This study provided the first and comprehensive data on the occurrence and removal of twenty-one target antibiotics and antimicrobials in a full-scale conventional activated sludge and membrane bioreactor systems in the Southeast Asian region. Nineteen out of the twenty-one target compounds were ubiquitously detected in raw influent samples. Concentrations of the detected ECs in raw influent samples ranged by several orders of magnitude (e.g. from 23.8 to 43,740 ng/L) depending upon the compound and sampling date. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIP), clindamycin (CLI), azithromycin (AZT), clarithromycin (CLR), oxytetracycline (OXY), tetracyclins (TCS), vancomycin (VCM), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), tetracyclins (TIN) and erythromycin (ERY) were in the persistent in both the CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most target antibiotics and antimicrobials. The relationship between molecular characteristics of ECs (i.e. physicochemical properties and structural features) and their removal efficiencies during biological wastewater treatment was also elucidated. Excellent removal efficiencies (>90%) were often noted for compounds with the sole presence of electron donating groups (i.e. phenolic –OH), beta-lactam ring, amine –NH2, methoxy–O–CH3, phenoxo–O–CH2–, or alkyl groups). Conversely, antibiotics containing aromatic groups with the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carbonyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC19 The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation

L. Gusmaroli, G. Buttiglieri, Catalan Institute for Water Research ICRA

Micropollutants such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) have been detected in all water compartments and the European Union is therefore updating its legislation to limit the release of emerging contaminants. Numerous studies on several microorganisms and the environmental conditions (e.g. from 23.8 to 43,740 ng/L) depending upon the compound and sampling date. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIP), clindamycin (CLI), azithromycin (AZT), clarithromycin (CLR), oxytetracycline (OXY), tetracyclins (TCS), vancomycin (VCM), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), tetracyclins (TIN) and erythromycin (ERY) were in the persistent in both the CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most target antibiotics and antimicrobials. The relationship between molecular characteristics of ECs (i.e. physicochemical properties and structural features) and their removal efficiencies during biological wastewater treatment was also elucidated. Excellent removal efficiencies (>90%) were often noted for compounds with the sole presence of electron donating groups (i.e. phenolic –OH), beta-lactam ring, amine –NH2, methoxy–O–CH3, phenoxo–O–CH2–, or alkyl groups). Conversely, antibiotics containing aromatic groups with the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carbonyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC20 Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Ciprofloxacin 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 (CIPO) in the aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofilms (plasma and bile), metabolism and elimination of CIPO in gill-head bream (Sparus aurata), controlled dosing experiments for 8 days at 200 μg/L concentration were carried out. CIPO was only observed in bile, probably due to its low octanol-water partition coefficient and the zwiterionic behaviour. CIPO 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 CIPO in seawater and bile, from which 30 structures were reported for first time. Up to 20 BPs were annotated in the absence of fish. The phase I degradations suffered by CIPO 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 piperazinyl ring with (1 BP) or without (2 BPs) the loss of the primary amine formed during the cleavage. The only phase II transformation of CIPO observed was BP18 that, apart from the oxidative deamination of the piperazinyl ring, also suffered the glycine conjugation. 14 of the previously observed BPs were plus 10 new BPs were annotated in water in the presence of fish. Compared to the BPs annotated in the absence of fish, oxidative deamination and both glycine and glutamine conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPO metabolites were searched in gill-head bream liver, brain, muscle, gill, plasma and bile, BPs were only detected in bile. 5 BPs were found and none of them was detected in seawater. While defluorination and oxidative deamination gained importance in bile, neither glycine nor-glutamine conjugates were observed in bile BPs. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Ziarutta is grateful to the Spanish Minister 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 risk that these contaminants may have on local ecosystems and seafood production activities, and eventually on human health. To this end, an analytical method based on on-line solid-phase extraction-liquid chromatography–tandem mass spectrometry (SPE-LC–MS/MS) was developed and validated for analysis of over 50 pesticides, including various neonicotinoid and organophosphate insecticides, as well as herbicides pertaining to the classes of triazines, phenylureas, acetanilides, chloracanilalides, acetyl herbicides, oxadiazoles, carbamoxides, benzoazinidazines, nitriles, dipheryl ethers, and carbanmates 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
MOPC22 Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montague, University of Castilla-La Mancha; H. El-talawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martin, University of Castilla-La Mancha; K. Bester, Aarhus University / Environmental Science

Diclofenac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of using persulfate in wastewater treatment plants to remove diclofenac. The persulfate (DCEP) removal reaction was investigated using a persulfate process that was used to remove diclofenac from wastewater: a 0.56 km grid of PASs was deployed at two spatial scales: a 0.56 km grid, and a smaller grid of 34 to 46 days. The larger grid was deployed in measured from floating instrumentation the incoming UV concentration and nitrogen gas concentrations, and the smaller grid was deployed at the Kejimkujik National Park. The results showed 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 unique Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (GTA) in Canada and the Monte Amiata region in Italy to illustrate this approach to Hg source characterization. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radially diffusive barrier to control uptake kinetics. 145 PASs were used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radially diffusive barrier to control uptake kinetics. 145 PASs were deployed across the GTA in July and August 2015 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km² square comprising the former Abbadia San Salvador mercury mine and a 41.6 km² square covering the eastern slope of Mt. Amiata. Both squares were divided into a grid of 757 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 2016. The coarser spatial resolution grid was sampled for an entire year (Oct. 2015-Oct. 2016), in four seasonal deployments of approx. 3 months each. Measurements of gaseous Hg concentrations in downtown Toronto (1.77 ± 0.28 ng m⁻³) were slightly, but significantly elevated relative to other parts of the GTA (1.42 ± 0.20 ng m⁻³). Concentrations at sites close to waste/recycling (1.61 ± 0.22 ng m⁻³) and hospitals/dental facilities (1.63 ± 0.21 ng m⁻³) were significantly higher than at sites presumably distant from potential sources (1.37 ± 0.20 ng m⁻³). 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.

MOPC24 Mercury trend as a possible result of changes in cod age distribution

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Norwegian Institute for Water Research; N. Green, NIVA

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 París 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. 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)

MOPC25 Contributions from biomass burning to mercury emissions at Cape Point, South Africa

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Mercury (Hg) is known to be a persistent and toxic heavy metal that can bio-accumulate in the aquatic environment and lead to serious human health effects. Hg is released into the atmosphere from both natural and anthropogenic sources, whereby the atmospheric burden is present in a gaseous phase or in particulate matter. The importance of studying Hg emissions from biomass burning has increased due to the increasing occurrence of the Hg emission from the Inner Oslofjord (Norway) reach back to 1984. Until 2014, annual median Hg-concentrations in cod from the Inner Oslofjord displayed significant long-term (whole time series) and short-term (last 10 years) trends (when 2015 was included, the short-term trend was not significant). However, the median length of the cod sampled also increased significantly over time. This is consistent with results from beach seine surveys conducted in the Inner Oslofjord the emission of cod recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalized Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from provides a quantified assessment of the increase in Hg from 2007 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 newly finalized and will be presented.

MOPC26 Building a predictive model for methylmercury photodemethylation in freshwater ecosystems

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Photodemethylation of MeHg is thought to be one of the main processes that convert MeHg into a less biologically toxic form of mercury [4]. While previous studies highlight the importance of photodemethylation to mercury budgets, few have examined the magnitude of photodemethylation of MeHg as a function of associated dissolved organic matter (DOM). DOM absorbs specific wavelengths of solar radiation and therefore MeHg that is bound to these compounds containing photoreactive functional groups may be more readily degraded than unbound MeHg. Alternatively, DOM may shade much of the water column and inhibit photodemethylation. To address this research gap we have used measured solar controlled and solar-controlled experiments that focused primarily on the quantification of the relationships between solar radiation exposures, DOM, and MeHg within six freshwater lake systems in Kejimkujik National Park and National Historic Site in southwestern Nova Scotia. Using incident irradiation values measured from floating instrumentation the incoming UV-A could be modelled with depth in the lakes as DOM concentration changes. From these numbers we were able to apply our photodemethylation rate constants, derived from controlled experiments, to available UV-A data to predict the loss of MeHg based entirely on DOM concentration (Figure 1). In the subset of Kejimkujik National Park lakes that were studied, lakes with higher DOM lost much less MeHg through the...
photonemethylation 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 photoactivity (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 phosphorus inputs and high temperatures and thus lead to browning of freshwaters and further inhibition to the photonemethylation 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 Overview of the risks from fungicides for aquatic organisms
L.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; J.R. Rohr, University of South Florida / Department of Integrative Biology; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Agricultural Sciences and Administration; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

As fungal pests are a major threat to crop production, the application of fungicides to control fungal infestations is considereed 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, ecotoxically 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). Diverse and multifaceted fungicides like the non-fungal agricultural microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action groups that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss current risk assessment procedures for fungicides in the light of identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.

MOPC27 Metalloid inclusion membranes followed by X-ray fluorescence analysis as a new tool for mercury monitoring in natural waters at low concentration level
G. Elias, University of Girona; E. Margui, University of Girona / Department of Chemistry; S. Díez, IDAEA CSIC Barcelona; C. Fontas, University of Girona / Department of Chemistry

At present, there is a considerable interest in mercury (Hg) monitoring due to its widespread occurrence and high toxicity of most of its compounds. Due to the low concentration levels, the complexity of some natural waters and the poor stability of the metal during sample storage, methodologies overtaking this problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide elasticity. The stability, versatility and easy manufacturing make PIMs as a useful separation technique to be taken into account. In this work, PIMs have been prepared fixing cellulose tricatate as the polymer and the iodonic trioxymethylammonium thiosalicylate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were dissolved in a mixture of the carrier (EDXRF) system and were directly analyzed. A good correlation was found between Hg concentration in the natural water (0.1-10 ppb) and the peak area obtained in the analysis of the corresponding loaded PIM, and thus, it can be used as a calibration curve. Optimized conditions of the whole methodology allowed a Hg detection limit of 0.2 µg Hg L⁻¹ in a water. Moreover, no water matrix effects were observed when testing tap water, river water, sea water and ground water were found. Thus, PIMs can be seen as a global solution for Hg monitoring in all types of natural waters. Additionally, we have investigated for the first time, the possibility of using PIMs as a tool to preserve samples of Hg in environmental waters. PIMs analyzed after 6 months of Hg extraction did not differ from the results obtained the first day of analysis, which was viewed as an innovative media to extract low levels of metal from different natural waters and to preserve sample information until the determination of the metal can be performed.

MOPC28 Dissolved organic matter as a modeller of Hg bioavailability to phytoplankton
V. Vásquez, University of Geneva / Département F-A. Forel des sciences de l'environnement et de laue; T. Chonova, I. Worms, University of Geneva / Department FA Forel for Environmental and Aquatic Sciences

Mercury (Hg) is a priority toxic of global concern, which concentrates in biota and biomagnifies in the aquatic food webs. However, mercury interaction with phytoplankton, central for its incorporation in the food webs, and in particular the role of polysaccharides in Hg binding and the role of dissolved organic matter (DOM) is still to elucidate. The objective of this work is to get new insight in the role of the DOM on Hg bioavailability to phytoplankton. Since trace metal complexation by DOM is expected to reduce its bioavailability, we hypothesized that the reduction of the Hg bioavailability to Chlamydomonas reinhardtii, chosen as a model phytoplankton, will be proportional to the fraction of the Hg being complexed by DOM. To get insight into the role of DOM in Hg uptake, C. reinhardtii was exposed to two concentrations of Hg in the presence of standard Suwannee River humic acid (SRHA) and in natural water rich in DOM from Onego Lake, Russia. Water was sampled from five sites representing the DOC gradient from River Shuya to open lake. Bioavailability was quantified by determining the adsorbed and intracellular mercury concentrations by Direct mercury analyzer on freeze-dried pellets. Concentrations of Hg in the exposure media were measured with the MERX Automated Total Mercury Analytical System. Chemical speciation of Hg in the absence or presence of DOM was computed with WHAM/model VII. The results showed that adsorbed and intracellular Hg concentrations decreased as compared with exposure in the absence of SRHA only at 0.7nM IHg, when the ratio between the reduced sulfur concentration and IHg is bigger than 100. A significant increase (1.5x) of Hg uptake in C. reinhardtii exposed to 70 nM Hg in the presence of 0.5 and 5 mg L⁻¹ DOM was found. In the DOC-rich water from lake Onega, a decrease of the bioavailability with respect to exposure in the absence of DOM was found. However no specific trends in the Hg uptake by C. reinhardtii were observed over DOC concentration gradients. The effect of the other factors such as the presence and concentration of different major cations and anions, as well as mercury binding to the Al, Mn and Fe colloids has to be taken into account in addition to the role of DOM. The implications of the obtained results are discussed further with respect to the prediction of the mercury incorporation at the base of the aquatic food web.
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 fungi may be susceptible to fungicide exposure leading to changed fungal community structure and reduced fungal biomass. These effects may negatively influence the food quality for higher level consumers, e.g. invertebrate shredders. 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 cadcellly shredders: Chaetogyrus villosa 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 drainage. Fungus fungicides. A structured biodiversity was significantly lower in the treatments containing highest fungicide concentrations and always highest in the untreated control. Emergence success of C. villosa significantly decreased with increasing fungicide concentration from >60 % in the untreated controls to < 20 % in the highest fungicide treatment at maximum food availability. Minimum food availability further increased fungicide effects. Significant effects occurred at concentrations a factor of 20 to 200 below the EC50 fungicides for chronic algae ecotoxicity tests. Our study highlights that environmentally realistic fungicide exposure may propagate through 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 and run-off. To mitigate fungicide exposure and to prevent a drift of fungicides during application. Also during run-off, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining run-off water and providing sites for adsorption as well as degradation. Under field conditions, however, the vegetation density and erosion rills underlie the buffer strips’ mitigation potential. Once released into aquatic ecosystems, (constructed) wetland and vegetated systems are considered an effective tool for mitigating a downstream transport of pesticides. The efficiency of such systems depends on both the physico-chemical properties of the pesticide of interest as well as system inherent properties. The pesticides affinity to organic carbon (Koc) is one physico-chemical property driving their retention, with more hydrophobic substances being more efficiently retained. Although fungicides are usually rather hydrophilic, their peak concentrations were also shown to be reduced by such vegetated systems. The systems’ efficiency in doing so, is modulated by size related properties as well as plant density. Both parameters are increasing the retention of fungicides and thereby the probability for adsorption and degradation processes to take place. Mitigating the fungicide exposure via spray drift and runoff may thus efficiently be addressed by a combination of measures. Those measures may include the proper management of vegetated buffer strips. This mitigation measure may be supported by the implementation of vegetated systems (such as constructed wetlands) in situations where catchment characteristics suggest a high risk that cannot be controlled by buffer strips or where such buffer strips cannot be realised.

TUPC05 Towards a better exposure assessment of antifungal azoles N. Creusot, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; C. Donat, bio-ferm GmbH In the course of introduction of new fungicides, the European Commission decided to include Acreosodium pullulans in Annex I of the Directive (EU) 91/414, a data package was developed to assess the ecotoxicity of this 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 avoidance test with earthworms were available. Whereas EFSA identified data gaps, the European Commission decided to include Acreosodium pullulans in Annex I without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized the use in plant protection products in Annex I, others recommended a 30 cm distance from surface water. However, it is important to think out of the box by evaluating these products used in agriculture. It is evident that living microorganism are able to proliferate, depending on the local environmental conditions in their micro-niche (influenced by climatic factors as well as microbial population dynamics), it is hardly possible to simulate these complex conditions in laboratory trials. Therefore, a quantitative assessment does not seem to be a

TUPC06 Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems? M. Dam, CENSE & New University of Lisbon, Lisboa; T. Brock, Altaira, Wageningen University and Research Centre / Environmental Risk Assessment Team; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology In Europe, the EFSA Aquatic Guidance Document describes the procedures for the derivation of regulatory acceptable concentrations (RACs) for pesticides on the basis of tier-1 (standard test species), tier-2 (genotoxic and SSD) and tier-3 (micro/mesocosm) approaches. The consistency of this tiered approach has previously been evaluated for insectsicides. In the present study, results of different tiers are compared for fungicides. To this end, laboratory toxicity data and microcosm/mesocosm data were compiled from open data sources supplemented with data from confidential studies conducted for the industry. RACs for tiers 1, 2 and 3 were calculated following the guidelines described in the EFSA Guidance Document. This presentation will discuss i) the consistency of the tiered effect assessment approach for fungicides as proposed in the EFSA Aquatic Guidance Document; ii) the predictive value of acute and chronic laboratory toxicity estimates for observed responses in microcosm/mesocosm tests; iii) problems in using the Geometric Mean approach in the acute effect assessment for fungicides with a biocidal mode-of-action; and iv) the taxonomic groups that should be represented in species sensitivity distributions for fungicides with a biocidal mode-of-action.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (PC)

TUPC07 Ecotoxicological studies performed to assess the potential of a yeastlike fungus, Auroebasidium pullulans, and the response of evaluating authorities I. Wittmer, Plattform Wasserqualität VSA, c/o Eawag; J. Rasmussen, 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; H. Singer, Eawag / Department of Environmental Toxicology; I. Wittmer, Plattform Wasserqualität VSA; J. Hollender, Eawag / Environmental Chemistry Antifungal azoles are a class of contaminants of emerging concern since increasing evidences highlight their potential effect on aquatic organisms at different trophic levels, raising the need to evaluate the associated environmental risk. Although a few of these compounds are routinely investigated, an accurate exposure assessment of most of them is still lacking to evaluate this risk. To address this issue, we first defined a list of 60 antifungal azoles including pesticides and pharmaceuticals based on the use/consumption of these compounds in Switzerland and Germany. We then performed a retrospective suspect screening on a set of data acquired with liquid chromatography-high-resolution mass spectrometry (LC-HRMS) from a large panel of environmental samples to 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

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scientific sound, since it is not predictable in which quantities, the microorganisms might or might not be present in the environment at certain time points after application.

TUPC08
Ecological testing and risk assessment considerations for microbial active substances
E.A. McVey, J. Wassenberg, Ctg
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 the microbial active 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 are often more dependent on exposure levels than most chemical actives. Regardless of these obstacles, some logical and objective recommendations can be made, both regarding testing and risk assessment for microbial active substances. Considerations of microbial active substances in groups based on pesticide mechanism of action and/or organism group may allow development of some generic testing recommendations. Knowledge from both the biological and chemical testing and risk assessment areas should be comprehensively surveyed and utilities to advise more appropriate and adequate testing for microbial active substances.

TUPC09
Human and environmental Risk assessment for microorganisms - to what extent?
Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (SUDD) promotes a targeted use of integrated control of pests and diseases where non-chemical measures are preferred. Plant protection products with a microorganism as active substance could be a solution. Microorganisms have to be approved in Europe in order to be used as active ingredients in biopesticide products. Data requirements for pesticides based on microorganisms are available as separate part of regulation EC 283/2013 and EC 284/2013. The Regulation provides the scope of data required above and regulations. 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 that require acceptance of a substance that are not developed for microorganisms. Thus, no consistent approach is available in the different member states. This leads to uncertainties and non-acceptance of submitted data. We will discuss the current challenges in interpretation of the data requirements and propose solutions for the risk assessment of biopesticides based on microorganisms.

TUPC10
Ecotoxicological testing to support the assessment of Microbials
Biopesticides are an excellent alternative to chemical pesticides, and there is an increasing demand in testing and evaluation of these products. This poster focuses on microbial pesticides based on bacteria, fungi, viruses or protozoans as their active substances. Possible adverse effects to non-target organisms (NTO) are rather limited due to the narrow and specific host range of these microbial pest control agents. However, a complete risk assessment demands testing of NTOs, when exposure and risk cannot be fully neglected. The assessment of microbial biocontrol agents (mBCA) and microbial biological control products (mBCP) is relatively new and approved testing methods are not yet available in the same extent as they are for chemical pesticides. Not only the toxicity, but also the potential pathogenicity/infecctivity needs to be addressed. Currently, the data requirements for mBCAs and mBCPs are issue of Part B of the European regulations 283/2013 (mBCA) and 284/2013 (mBCP). Numerous data requirements listed in these annexes were transformed directly from requirements for chemical pesticides and often cannot be adapted to the biological properties of microorganisms. In order to address the data requirements in a feasible manner, the biological properties of the microorganism have to be taken into account, instead of strictly applying to current test guidelines. It is important to note, that testing is strongly influenced by physico-chemical properties of mBCAs. Microorganisms, i.e. with frequently used co-formulants, are not soluble which results in alteration of the test conditions (i.e. turbidity, O2-demand, spray layers). Furthermore, organic components of the formulated product (i.e. yeast, starch) may lead to increased fungal growth in soil or test media. Additionally, the need to test at high concentration levels, lead to negative effects of 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
M. Zetzmann, F. Kümmerich, A. Dabrunz, C. Lang, Eurofins Agroscience Ecotom GmbH / Aquatic Ecotoxicology
In the last decade the number of biopesticide registrations in the EU and US have steadily increased. In the EU biopesticides are regulated as plant protection products under regulation 1107/2009. Biopesticides cover a wide spectrum of substances including microbial pest control agents (MPCA) defined as products containing microorganisms (e.g. bacteria, fungi, protozoa, viruses). As for chemical plant protection products, regulatory authorities require an analytical verification of the doses applied in ecotoxicological tests also for MPCAs. Guidance can be derived from SANCO/3030/99 rev.4 and OPPTS 885.1400 (1996), but verification procedures need to be adapted on a case by case basis, as each microorganism possesses its own chemical properties and different growth conditions. Just as chemical methods, microbial testing methods need to be robust and reproducible for 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
R. Merkert, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science
Persistent organic pollutants (POPs) are a group of chemicals with similar chemical characteristics that are resistant to environmental degradation and biodegradation. Not only do these POPs bioaccumulate in the food chain, they are also known to cause adverse effects in fish, wildlife and humans. Although being banned in the previous century, many POPs are still present in high concentrations in Arctic areas, due to a combination of northward marine currents and their semi-volatile nature, high thermal stability and slow degradation turnover rates. As food webs in the Arctic are relatively simple, POP contamination may pose a great risk for animals at higher trophic levels, such as the polar bear (Ursus maritimus), hence the growing interest in studying bioaccumulation in the Arctic. Despite the large interest in bioaccumulation in Arctic food chains, the OMEGA model, as well as similar bioaccumulation models, are predominately validated on temperate food chains or relatively 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, lark bell, 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 the TMF. After the TMF analysis for aquatic and terrestrial food web models, TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of marine animal, such as south pola skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Antarctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranes, compexity of the food web structure, and the overestimation due to migrant 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. T. Masset, Universite Savoie Mont Blanc; M. Perga, University of Lausanne / Faculty of Geosciences and Environment; N. Cottin, Universite Savoie Mont Blanc; S. Cacheria, CISALB; C. Piot, E. Naffrechoux, Universite Savoie Mont Blanc.

Bioconcentration and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator PCB concentration and lipid content of fish filet were measured in European whitefish (n = 89) and arctic char (n = 53) 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 d15N) and the influence of trophic parameters using d13C 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±13 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 d15N) was also not correlated with intra-species contamination variations for the arctic char and was only slightly positively related to concentration variations for whitefish (p=0.04), dismissing the importance of biomagnification as PCB accumulation process. However, fish body size seemed to be a potential explanatory variable for individual’s PCB concentration discrepancies in arctic char (p=0.002) and whitefish (p<0.01). This last observation could be explained by fish/water partitioning equilibrium to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the 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. Loveless, 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, N. Johnsen, J.O. Bustnes, Norwegian Institute for Air Research / FRAM Centre Tromsø; G. Poma, G. Malarvannan, Norwegian Institute for Nature Research NINA; M. Chevreuil, EPHE / UMR METIS 7619; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC.

The trophic magnification factors have been extensively assessed for persistant organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Polycyclic aromatic hydrocarbons (PAHs) and phthalate plasticizers are continuously released in urban rivers and are rapidly metabolised and excreted by freshwater organisms, thus limiting their bioaccumulative potential. Abiotic and biotic samples, from primary producers to piscivorous fish, were collected in an urban river and analysed for PAHs, phthalates and their metabolites. Stable isotopes of nitrogen were used to determine trophic levels and to calculate trophic magnification factors (TMF) of each compound and its associated metabolite. Our results highlight a trophic dilution (TMF < 1) of all PAHs and phthalates, meaning that predators were less contaminated than their 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)

WEPC01 Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure? H. Littler, University of Exeter / Biosciences College of Life and Environmental Sciences; L.V. Laing, University of Exeter / Biological Sciences; R. Boreham, M. Griffiths, University of Exeter / Biosciences College of Life and Environmental Sciences; M. Trznel, University of Exeter / Biosciences; J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; G.C. Paull, University of Exeter; R. van Aarde, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences.

Bisphenol A (BPA) is a commercially important chemical used in the production of widely used epoxy resins and polycarbonate plastics and it is ubiquitous in the environment, resulting in widespread exposure of humans and wildlife. BPA was shown to cause reproductive effects via disruption of both the oestrogen and androgen signalling pathways. Recent studies suggest that BPA also affects epigenetic signalling pathways, including alterations in transcription of DNA 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 100 mg BPA/L for 5 days, either once (C-10, C-100) or twice (10-10, 100-100) with a 13 day period of depuration in between, and appropriate controls were maintained in parallel. The adult gonads were sampled for transcriptional analysis. Reproduction was quantified over time, and embryos from each treatment group were then exposed to a range of BPA concentrations from 0-72pg/l to measure their susceptibility to BPA exposure. There were no effects on reproductive output under our exposure conditions. However, at the transational 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 analyse the promoter DNA methylation of amh to investigate this hypothesis.

WEPC02
Zebrafish as a model to assess transgenerational effects of environmental stress via epigenetic inheritance
J. Kamstra, NMBU / BaSam
Although toxicological effects of anthropogenic stressors present in the environment are studied extensively, few studies assess the epigenetic effects of such stressors and are thus not able to assess these effects over multiple generations. It is hypothesised 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 the adult offspring, and these changes could be linked to gene pathways that are associated to those compounds, such as embryonic development and obesity. Subsequent analysis in two following generations lead to the conclusion that some regions were persistently changed. Concerning ionizing radiation, in F1 embryonic offspring from irradiated parents, many changes of DNA methylation were observed. These changes could be linked to effects that would be in the range of such DNA damage. Follow up analysis in the second and the third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP, 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

WEPC03
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?
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In this study the impact on plants of long-term (transgenerational) exposure to radiation coming from nuclear accidents like Fukushima and Chernobyl is investigated and compared with lab experiments in either a chronic, acute, multi-, or single generation exposure. Transgenerational set up in the first generation showed 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 Brassicaeae plants, Arabidopsis thaliana and Capsella bursa pastoris in CEZ and FEZ, respectively, were sampled alongside a gradient of enhanced radiation ranging from 0.5 to 50 µGy.h\(^{-1}\). Seeds from Arabidopsis thaliana were harvested in the CEZ and grown for one clean generation under lab conditions to score for multigenerational effects. In addition further lab experiments were performed on wild type plants of Arabidopsis thaliana grown under chronic exposure conditions (at 1 mGy/h) or more acutely (20 to 400 µGy/h) for 14 days in one, two or three generations. Plants were scored for the expression of photosynthesis related and oxidative stress markers as well as germination rate and root growth. In general higher differences are found in plants exposed in a multigenerational set up than in a transgenerational one. The field plants did not show any abnormalities that could be correlated with the exposure gradient although some delay in flowering was observed in plants grown from medium and high radiation levels. The level of total DNA methylation could not be linked to the gradient present in the field but rather to differences in developmental stage of the collected plants. In lab-exposed plants however global DNA methylation showed a significant increase which was both dose and generation dependent. Significant changes in transcription of methylation regulating genes were also measured in the different generations. Highest differences were present in the S1 generation but seemed to be reduced in the S2 generation. Overall the data hint towards a role of methylation in the response to radiation but its use as marker of exposure or in risk assessment needs further experimental evidence and discussion. This work was supported by European project COMET (7th PCRD EURATOM Contract Number: Fission-2012-3.4.1-604794) (www.comet-radioecology.org)generation.

WEPC04
Evolutionary toxicity: tools to understand impacts of past, present and future environmental contamination
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This research will utilize environmental reconstruction methods along with paleontological, palaeoecological, and 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 application in toxicological investigations. Additionally, we will present our preliminary research, which examines how genotypes of clonal lineages of Daphnia species from single populations, separated through generations of evolution, differ in their response to exposure of stressors. Results will provide insight into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolve in response to chemical stressors in the environment. 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 assessments and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

WEPC05
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations
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Organisms are rarely exposed to only single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecks, evolutionary adaptation of species to altered gene flow, 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 stressor exposure 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 resulted in a depression of allelic richness in native G. pulex populations. Our results suggest that the input of a mutagenic effluent from a WWTP resulted in a strong temporal decrease in population genetic structure over multiple generations. In addition, the presence of weirs disrupted the migration across the river and thus the gene flow between G. pulex upstream and downstream. This study provides strong evidence that the assessment of genetic variation including private alleles together with the contamination of mutagenic and nonmutagenic chemical pollution offers new insights into the regulation of genetic population structure and highlights the relevance of emerging anthropogenic pressures at the genetic level.

WEPC06
Histone methylation as exposure biomarker of environmental chemicals
What's your take on communication? Don't Panic! Reports on how to accurately communicating science and risk (PC)

WEPC07
Dangerous misconceptions - Consumers need help!
U. Klawecka, University of Applied Sciences

Previous surveys revealed that average consumers and even more illiterate persons are struggling with risk communication instruments for harmful substances in commodities. The majority of consumers do not understand risk communication instruments as intended by legislators or do not use them at all. In contrast, the present survey focused on ‘best-case’ consumers who are interested in the topic, have a good education or a good self-reported knowledge in chemistry. These ‘best-case’ consumers use preferentially hazard pictograms in accordance with the Regulation on Classification, Labelling and Packaging (86%), reports in the media (80%) and information printed on the products (77%) to learn about harmful substances in consumer products. Surprisingly, smartphone applications (<10%) and information by authorities (14%) were not indicated as frequently used information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%) as trustworthy. Interestingly, the respondents considered legislators (94%), consumers (75%), manufacturers (71%) and environmental and consumer organizations (61%) as responsible for risk reduction. It is alarming that many of these ‘best-case’ participants assumed that food (up to 62%), products with an environmental label (36%), 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 presentatin will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments. n

WEPC09
Roadmap for the unknown
M. Luitwieler, M.H. Wagelmans, Bioclear earth

The main environmental themes have been addressed in the last decades. Think acidification, eutrophication, eutrophication, heavy metals, endocrine disruptors, nanomaterials, biocides etc. A number of chemicals exhibited altered histone methylation – among them some chemicals showed species specificity while some of the chemicals exhibited conservation of histone methylation changes in both in vitro and in vivo systems. Taken together, our study showed histone methylation as a sensitive epigenetic biomarker for chemical screening and in turn risk assessment. Acknowledgment: This study was supported by Basic Science Research Program (2016R1D1A1B03931553) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning

WEPC10
EVOKED: enhancing the value of climate data - translating risk and uncertainty utilizing a Living Labs approach
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The impacts of climate change are broad and although much focus has been on disaster risk reduction and coastal management, climate change will also have consequences for environmental management where the transport of contaminants, organism acclimation and vulnerability communities will be important to consider for future human and ecological risk assessments. In this context it is useful for environmental scientists to be familiar with the concept of climate services which are defined as the transformation of climate-related data into products (trends, assessments, best practices) in relation to climate that may be of use for the society at any time. Since the climate service sector is relatively new, there is a need to engage knowledge providers, users, and translators to identify improvements to climate services through co-design, co-development and co-evolution. The EVOKED project aims to address this challenge by re-framing the risk and uncertainty associated with climate data into knowledge products more understandable and useful for end-users concerned with risk mitigation and adaptation. The project team will engage end-users in a Living Labs approach to ensure a user-centric innovation methodology at established case study sites in Norway, Sweden, Germany and the Netherlands. The Living Lab methodology has emerged in recent years as a form of experimental and potentially inclusive mode of urban planning. Although the scope and character can vary depending on the issue at hand, the industrial model and the core of the problem, the general idea is to involve a range of committed stakeholders in a real-life “laboratory” setting to test and develop alternative solutions for complex challenges, such as climate adaptation. The first activity for the Living Labs at each case study site will be a co-design process to encourage stakeholders to share their perceptions of risk and uncertainty. Since there are many different definitions and interpretations of risk, understanding these perceptions of risk is a prerequisite for communicating risk. Thus, EVOKED supports the development of the field of climate services to improve our capacity to manage climate-related risks.

WEPC11
Communicating monetary values of environmental impacts - case studies related to ISO DIS 14040
B. Steen, Chalmers University of Technology; K. Hallberg, AkzoNobel; P. Hanarp, Volvo Group; J. Lindberg, IVL Swedish Environmental Research Institute; E. Risse, Essity; M. Romare, IVL Swedish Environmental Research Institute; T.
The OER concept allows to produce implements the Open Educational resources (OER) concept, which started a pilot project to develop teaching and learning materials that during long time were laboratory materials. Critical Elements (TCE) and Emerging Contaminants (EC) is needed, the choice is very different due to more or less use of fossil fuel is rather insensitive to how the valuation was made with respect to the ranking of alternatives. In cases where there is a trade-off between use of fossil resources and scarce metals, the choice is very sensitive to the temporal system boundary of the impacts and affected population. A database format is proposed for documenting monetary values and related metadata.

WEPC12 Full STEAM Ahead: Merging Science and Communications to Investigate Environmental Questions
G.K. Biedenr-Fraser, Jacksonville University / Chemistry; A. Kent-Willette, Jacksonville University / Communications; M. Simmons, Jacksonville University / Biology and marine sciences

This project involved a case study and best practices surrounding successful STEAM interdisciplinary research. The collaboration was fostered through events and benefit studies. The results involve a two year research agenda. The study focused on graduate and undergraduate interdisciplinary research in the fields of Environmental Science and Communications. Specifically, the influence of changing land use along the lower St. Johns River, Fl. was investigated, and the project and resulting data were published using modern communication tools such as social media, in tandem with more typical scientific means such as presentations at professional forums. The chances will discuss the importance of the collaboration lead to grants and ultimately secured funding, successfully incorporated service learning and research opportunities for students, pursued and communicated meaningful research and managed teaching across very different disciplines.

WEPC13 Let’s go visual, a picture is worth a thousand words: How to explain Emerging Contaminants using animations
N. Ospeña-Alvarez, S. Schneider, University of Potsdam / Institute of Earth and Environmental Sciences

The development of new technologies has enhanced the use of several elements in information and communication technologies, semiconductors, electronic displays and ‘green energy’ related technologies. Platinum, indium, thallium are good examples of those kind of elements, that during long time were laboratory curiosities but that now have an important place as raw materials in high-tech products (optics, electronics, medicine). However, many of these elements are toxic (e.g. thallium) or have a high potential to cause environmental problems from accidental releases to the environment, increasing its availability in the environment. Basic research about Technology-Critical Elements (TCE) and Emerging Contaminants (EC) is needed, but also is part of the research process to transfer this knowledge to a general public. Within this framework, the University of Potsdam and GeoEd (http://geoeducation.de/) started a pilot project to develop teaching and learning materials that during long time were laboratory materials. Critical Elements, rare metals and essential elements are of huge importance, such materials, science animations, educational tools, and open online books are available online. The project aims at developing an open online access book, which is available online, 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 open online book 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 access book on Environmental Toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way, including different modules having a clear training goal and attainment level and flagged with a number of keywords. The book will also contain tools for self-study and training exercises. 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 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 approximately 30 researchers, will be involved 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 Chemistry (SETAC)?
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Leveraging more than a hundred years of experience and knowledge (Gallo 2008), modern toxicology has crystallized in a set of highly codified and standardized practices that are used by industry and regulatory agencies internationally to assess the risk of chemicals to the environment. Toxicity testing methods using whole animal studies have long provided the general framework of instrumental beliefs concerning the most appropriate way to pursue the goals of environmental toxicology. While such in vivo methods are useful for determining the acceptable levels of single chemicals in the environment, they have a number of limitations that are broadly accepted within the profession. Most significantly, conventional in vivo methods are time-consuming and require 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 and animal 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 vivo test methods. While these methods are increasingly accurate and at lower costs, they are not universally accepted for use in regulatory toxicology. Overall, there is a pressing need for stakeholders to come together to discuss how to reconcile these different perspectives on the use of animal tests and in silico models in policy decision-making. This session will provide a platform for these discussions, with presentations from experts in the field, as well as opportunities for open dialogue and debate. The goal is to foster a collaborative approach to policy development in the field of environmental toxicology, with the aim of improving the welfare and ethical treatment of test animals, while ensuring that the best available science is used to inform regulatory decisions.
Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WPEC20
Zn-Al layered double hydroxides: a promising eco-friendly engineered nanomaterial
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Layered double hydroxides (LDH), also known as anionic nanoclay, are a class of inorganic engineered nanomaterials with a plate-like structure featuring a lateral size of 20–40 nm. LDH are characterized by positively charged metal hydroxides (e.g. Zn²⁺, Al³⁺), stabilized by anions (e.g. NO₃⁻) and water molecules between layers. LDH have remarkable properties (e.g. chemical, physical, mechanical) and potential applications in environmental remediation, drug delivery, food packaging, catalysis and lithium-ion batteries. In this study, we investigated the effect of Zn-Al LDH on the growth of Paracentrotus lividus, Acartia tonsa, Artemia salina, Polychaetes, bivalves (e.g. Macoma balthica, Mytilus galloprovincialis), polychaete (e.g. Pseudotextela incisa), and the marine bacteria Vibrio fischeri, Nannochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii, Paracentrotus lividus, and Paracentrotus lividus. The results suggest that 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 (Devries et al. 2013), they are known for their ability to remove toxic metals and organic pollutants from wastewater, air, soil, and food. However, the safety and efficacy of LDH have not been fully evaluated in the environment and human health. Therefore, further studies are needed to assess the potential risks and benefits of using LDH in environmental remediation and bioremediation.

WPEC10
Hydrophilic and hydrophobic interactions in a biological system
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Hydrophilic and hydrophobic interactions are fundamental forces that govern the behavior of biological systems. In this study, we investigated the effect of hydrophilic and hydrophobic interactions on the growth of Paracentrotus lividus, Acartia tonsa, Artemia salina, Polychaetes, bivalves (e.g. Macoma balthica, Mytilus galloprovincialis), polychaete (e.g. Pseudotextela incisa), and the marine bacteria Vibrio fischeri, Nannochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii, Paracentrotus lividus, and Paracentrotus lividus. The results suggest that 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 (Devries et al. 2013), they are known for their ability to remove toxic metals and organic pollutants from wastewater, air, soil, and food. However, the safety and efficacy of LDH have not been fully evaluated in the environment and human health. Therefore, further studies are needed to assess the potential risks and benefits of using LDH in environmental remediation and bioremediation.
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 (140cm x 90cm) was prepared by overlocking the edges to prevent loss of fibres and then retrieved for analysis after washing with a standard synthetic clothing program (20°C, 600 rpm, 1 hr, 40°C). Weights inside the washing machine assured same mass for each material assessed and a consistent water flow into the machine. Effluent water was collected in a clean container and a sub-sample (1 L) passed through a 20 µm filter to collect any microfibres that pass through the filter unit. Each test fabric was first washed to study release in new clothes, and then washed a second time to determine release of microfibres after pre-washing. To improve the accuracy of the results, the two washing procedures were repeated in triplicate. A rinse cycle was run between each test wash to ensure removal of any remaining microfibres from the system. The hoes 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.

**WPEC25**

**Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)**


Nano-agrochemicals promise higher efficiency than conventional pesticides, but much has to be learned about the gain of efficiency compared to conventional products, and the risk of directly applying such new types of yield enhancers on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO₂-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO₂-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO₂-NPs used for the experiments were ~60 nm in primary particle diameter. As reference 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 SiO₂-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)₄) acting as a phytostimulant micromineral. 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. Laurenza, UN.A.F.P.A.; L. Marchelli, Barilla G. & R. Fratelli; P. Borla, Life Cycle Engineering UN.A.F.P.A; representing all the European pasta manufacturers, is the main proponent of the EU pilot on PEF for pasta production. Furthermore, four 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 product range, providing a common reference system for setting and validating the developments process of product group-specific rules (PEFCR), including the development of performance benchmarks; Testing different compliance and verification systems, to set up and validate proportionate, effective and efficient compliance and verification systems; Testing different business-to-business and business-to-consumer PEF information 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 a production and organizational culture that allows 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 PEFCR document have been established by the maximum clarity in order to increase the suitability and robustness of the LCA implemented in the PEF method for pasta sector. The main difficulties noticed during the pasta pilot were about the hotspots management, when the producers do not directly manage those processes.

**WPEC25**

**Life Cycle Assessment of applying Algal Oil in salmon aquaculture: challenges for methodology and tool development**

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Evonik DSM founded the joint venture Veramaris®, introducing a new Algal Oil based omega-3 fatty acid source for aquaculture. This intracellular oil is produced in a biotechnological manufacturing process using non-marine resources. The rationale for this development is that the capacity to generate omega-3 fatty acids through fish is not sufficient to fulfill the dietary requirements of a growing population, and that many fish species used as feed in aquaculture are either fully utilized or overfished. Until now, the only option for expanding omega-3 fatty acids reduces the dependency of salmon aquaculture on marine fatty acid production and fish stocks, by replacing marine ingredients with algal oil and crop-based ingredients. To illustrate the environmental impacts and potential tradeoffs of this new product, a Life Cycle Assessment (LCA) was performed. Indicators developed for application of LCA to fisheries were used in an LCA to assess the marine ecosystem impact of replacing fish meal and fish oil by Algal Oil in salmon feed. The analysis had to be performed in a separate calculation outside the LCA software, because the software does not include the required data and methods. The study demonstrated that the use of Algal Oil as a source of omega-3 fatty acids leads to a considerable reduction of impact on marine ecosystems of farmed salmon. This improvement is accompanied by an increase in impacts associated with agriculture. Current LCA methodologies do not allow weighting of these opposing effects. However, to make informed choices between the available options this would be required. Because the availability of natural marine resources is limited, the strong growth expected in salmon aquaculture requires innovative feed solutions decoupled from limited fish stocks to meet future requirements for omega-3 fatty acids. Veramaris® Algal Oil in combination with vegetable crops enables growth of salmon aquaculture that is independent of limited fish stocks. To support the choices discussed in this presentation, and similar choices, implementation of fishery impact assessment methods in LCA tools and development of weighting methodology is essential. Just as for other biotic impacts, there are also challenges of non-linearity and temporal and spatial variability connected to fishery-specific impacts, which are of a more local nature than global-scale life cycle impacts.

**WPEC26**

**Balancing Environmental and Health Impacts of Food Production and Consumption**

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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. On the other hand, people with low vegetable or fruit consumption may also have relatively lower environmental impacts, while having increased risk of disease. This study investigates the daily eating patterns of a European population sample to identify and compare each individual’s environmental impacts due to their food production as well as the health impacts that can be expected due to their food consumption patterns. The Global Burden of Disease has identified dietary risk factors that have been shown to contribute to increased health risks such as low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in terms 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

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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 FLW mitigation is to reduce the environmental impacts of food production. 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 corresponding European Directive 2008/98/CE), clearly states that the implementation of a DRS should be based on the analysis of its technical and economic feasibility, a set of environmental, social and human health impacts and must ensure the proper functioning of the internal market. The study presented here follows this regulatory framework, analysing the sustainability of implementing this new system, combining environmental, economic and social studies in order to get an holistic picture of its feasibility. In particular, the following methodologies were used: (1) Life Cycle Assessment (LCA) for the environmental study; (2) Classic Cost Accounting for the economic study and (3) Social Footprint and Quantification of the Integrated Social Value for the social study. All of them applied using the same data, system boundaries and modelling restrictions. The study clearly concludes that the introduction of a DRS in Spain, under the studied conditions, is not advisable. This is because: a) according to several environmental indicators, although it could achieve an improvement in the overall recycling rate, it carries a higher environmental impact, mainly due to the duplication of collecting systems and the increase demand in transportation; b) represents a 4.6-fold increase in the economic cost to society (11 times if we only consider the management of DRS containers); and c) from a stakeholders’ point of view, it will have a significant increase both in space and time needs, and it will cause a higher Social Footprint.
Accumulation.

Bioavailability.

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