



Chemical Transport via the Global Food System

Chairs: Carla Ng, Natalie Von Götz

Global chemical fate models are used to determine how a chemical moves from its point of emission and distributes among different media on a global scale. Research into bioaccumulation has shown that some of the highest concentrations can be found in biota, due to accumulation from the surrounding environment and magnification from prey to predator within food webs. Owing to such accumulation mechanisms, food is recognized as a major pathway for human exposure to chemicals. Yet the system by which the majority of human populations now obtain their food is far different from the local subsistence food webs typically used in coupled chemical fate and bioaccumulation models. Over the past thirty years, our food system has become increasingly globalized. At the same time, food trade and production have shifted from fresh foods and agricultural raw materials to more complex, processed food products. These changes have important implications for the global fate of chemicals that accumulate in foods.

Foods contain a wide variety of chemicals that can enter at any point along the value chain: during production, processing, packaging and storage. Our ability to understand how food trade impacts the global distribution of chemicals is constrained by how much we know about the entire food system, from field to fork. In this session, we will bring together expertise from all branches of SETAC to explore how chemicals are transported between countries through food trade, and which chemicals enter the system at which point along the value chain. We invite contributions from life cycle assessment, fate and exposure modeling, representatives of the food industry, food and environmental scientists and regulators.

Preliminary session type: Platform and Poster

Detection, identification and quantification of engineered (nano)materials in complex matrices

Chairs: Patrick Bauerlein, Ralf Kaegi

Engineered (nano)particles are ubiquitous in environmental matrices, however their identification and quantification is still very challenging, due to the complexity of environmental samples and the vast diversity of these particles. They differ in size and shape, and also their elemental composition is variable. Engineered (nano)particles include inorganic particles, such as nano-TiO₂ and nano-Ag, carbon based nanoparticles, such as fullerenes and carbon nanotubes and organic microplastics. Especially the analysis of carbon-based and organic particles can be an intricate problem, as there is an almost unlimited number different variations. Fullerenes can carry various functionalities, carbon nanotubes can be multi-walled or single-walled and microplastics can be made up from for instance polyethylene, polystyrene or polypropylene. Such engineered (nano)particles are already used in many consumer products, such as sunscreens, paints, mouth wash, textiles, food packing materials and food additives and may thus be released into the aquatic environment as already documented by several research reports. However, to develop a scientific understanding of i) the release patterns, ii) the transformation reactions in the environment and iii) the environmental distribution of such pollutants, analytical tools that are capable to detect, identify and quantify these particles in complex matrices are urgently needed.

Recently developed and/or substantially improved analytical techniques such as Orbitrap MS, flow cytometry, pyrolysis GC/MS, field flow fractionation (FFF) coupled mass spectrometry, dynamic and static light scattering as well as single particle ICP-MS and analytical electron microscopy have opened a new research front in analytical chemistry. Using sophisticated analytical tools and combinations thereof, engineered (nano)particles in both their pristine and transformed state after being exposed to different environmental conditions have been investigated in unprecedented detail. Due to the enormous progress recently made in this research field particles can be accurately quantified in simple matrices. The next challenge is to make these highly sophisticated techniques compatible with complex matrices, which ultimately will allow their detection and quantification in complex matrices.

This session aims to integrate contributions focussing on latest developments for nanoparticle and microplastics analysis including explicitly sample preparation techniques to provoke a discussion about most pressing research questions in that field. We invite researchers from academia, government, industry and research institutes to share their latest findings and experiences on methods used for the detection and characterisation of engineered (nano)particles in complex matrices, including food, soil, surface- and wastewater.

Preliminary session type: Platform and Poster

Exploring links between the biodegradation of chemical contaminants, the metabolic capability of microbial communities and environmental variables

Chairs: Kathrin Fenner, Russell Davenport, Gary Bending

For most organic pollutants, biodegradation is the primary process determining fate and persistence in the environment and within bioremediation systems. The capability to predict biotransformation rates and potentially recalcitrant products is therefore essential. However, it requires an understanding of how rates and pathways depend on interactions between the molecular structure of contaminants, their bioavailability, the diversity and composition of microbial consortia and the prevailing environmental conditions. Recently, there have been enormous advances in analytical chemistry and molecular biology methods that provide the potential to shed light on the linkages between trace organic chemical attenuation and the metabolic capability of the microbiome in complex environments.

The goal of this session is to bring together environmental chemists, microbiologists and engineers to share recent findings which have unraveled interactions between biotransformation rates and pathways and environmental conditions and/or microbial community characteristics, integrating understanding from terrestrial and aquatic systems, including engineered treatment systems such as activated sludge, river bank infiltration or constructed wetlands.

Topics would include:

Techniques:

- Is -omics information useful in predicting biodegradation rates and pathways?
- In situ identification and characterization of degraders
- Pollutant bioavailability to degrading organisms

(Novel) results on dependencies:

- Role of microbial diversity in determining biodegradation rates and pathways
- Dependence of biodegradation rates and pathways on chemical structure and redox conditions

Specific environmental/experimental settings:

- Biodegradation under oligotrophic conditions
- Adaptation of communities to degrade pollutants

Preliminary session type: Platform and Poster

Fate, uptake and translocation of xenobiotics in plants

Chairs: William Doucette, Carola Schriever, Marc Lamshoef

Models simulating the environmental fate and behavior of xenobiotics within natural systems such as soil and require the input of a number of chemical descriptive parameters. Within the authorization of pesticides these parameters are usually derived from established studies following approved (OECD) protocols, such as the OECD guideline No 106 for adsorption / desorption to derive K_{oc}/K_{om} values.

In recent years, the uptake of xenobiotics (e.g. plant protection products) into plants received increasing attention as the process reduces the mass available for leaching. The plant uptake factor (PUF) accounts for this process in the commonly used fate models for leaching, i.e. FOCUS PEARL, FOCUS PELMO and FOCUS MACRO. However, an approved protocol for a standardized test design for measuring PUF is not yet available from official bodies such as the OECD. It should be noted that the PUF describes the removal of chemicals from the soil pore water via plant uptake into root system and is not identical to the transpiration stream concentrations factor (TSCF).

Generally there is still little known of the detailed specific uptake and transport mechanism of xenobiotics in plants. However, in recent years new guidance documents and some scientific articles on uptake and translocation of selected pesticides have been developed or published. New analytical techniques like mass spectrometry imaging, refinements to experimental methods like the TSCF pressure chamber and results obtained with classical hydroponic systems are shedding more light on this complex and important processes. These new findings need to be presented to and discussed by stakeholders from academia, regulatory authorities, industry and consultancy.

New discoveries shall be presented considering the spatial and temporal distribution of the fate of different type of chemicals in plant parts roots, stem and leaves. Furthermore questions on how and why selected compounds are more quickly or extensively taken up by plants should be answered. The understanding of these processes is also fundamental for exposure and risk assessments and shall be covered.

Preliminary session type: Platform and Poster

Interactions between traditional, novel and green carbonaceous materials and contaminants

Chairs: Melanie Kah, Thomas Bucheli, Thilo Hofmann

Understanding interactions between carbonaceous materials and contaminants has long been a topic of interest for environmental scientists working on a broad range of problematics.

Soot particles are ubiquitous in urban and industrial area, while sorption to activated carbon is the most widely applied and accepted technologies to remediate contaminated air, water, and more recently, also soil or sediment. Over the last decade, a wide range of novel carbonaceous materials have been considered. A lot of work focussed on new generations of carbon-based materials emerging from progresses in nanotechnologies (e.g., carbon nanotubes, C60 fullerenes, graphene and graphene oxides). Meanwhile, lower-cost and possibly more sustainable materials such as biochars, with or without modification, have also received great interest in the context of remediation.

The session aims at wrapping up recent knowledge on the interactions between carbonaceous materials and contaminants, and how this may impact environmental fate and effects. We invite contributions from the laboratory up to the field scale, which will support the development of promising applications (e.g., mitigation and remediation strategies, analytical method development) as well as a more robust assessment of the impact of contaminants on human and environment health.

Preliminary session type: Platform and Poster

Mercury Fate and Biogeochemistry

Chairs: Nelson J O'Driscoll, Sara Klapstein

The global and regional distribution of mercury is of primary importance to both ecosystem and human health. The Global treaty on mercury is a topic of international importance and many governments are currently developing policy at both a national and international level to reduce mercury emissions.

Mercury in the form of methyl mercury (MeHg) is an acute neurotoxin and endocrine-disrupting chemical that biomagnifies in food webs, with the result that higher trophic-level organisms can suffer severe neurological and reproductive effects. Temperature, moisture and solar radiation are key climate variables affecting the fate of mercury in temperate and northern ecosystems through processes that alter mercury speciation. These processes are particularly significant given the current release of mercury into the atmosphere and the prospect of future increases in emissions. According to the most recent Arctic Monitoring and Assessment Program (AMAP) report on mercury, mercury emissions may increase by as much as 20% by the year 2020. This increase in mercury will be particularly damaging in ecosystems that retain atmospherically deposited mercury and efficiently convert it to bioavailable MeHg. These mercury-sensitive ecosystems may be located in remote areas with no direct industrial mercury emissions. While a higher average global temperature is expected to increase the global mercury burden through the release of natural stores, the rate of release and the mechanisms controlling the distribution, retention and bioavailability of deposited mercury in sensitive ecosystems still require much research. The session proposed here will discuss a wide range of topics including the processes that define a mercury-sensitive ecosystem. Facilitating collaborations and tools for ecological risk assessments around the world.

With the predicted rise in global atmospheric mercury emissions, mercury will continue to be a problem contaminant for the foreseeable future, causing particular damage to mercury-sensitive ecosystems around the world. This highlights the national and international importance of the proposed session and international collaboration. Key to the continued understanding and mitigation of the mercury problem is the fundamental science controlling its movement and bioaccumulation in ecosystems. This session will cover a wide range of mercury science including new analytical techniques, speciation in ecosystems, bioaccumulation in the food web, and multimedia modeling. We welcome both field and laboratory studies on selected sites to provide important site-specific information on mercury mobility, bioavailability, toxicity and ecological effects.

A similar session has been successfully held at every SETAC North America over the past 12 years with excellent attendance and at 2 previous SETAC Europe conferences. This topic is of great interest to a wide range of researchers, government agencies, and industries. This topic was proposed in combination with a general trace metals session in 2010 and was successful, however the abstracts presented were dominated by mercury specific research. At SETAC Basel in 2015 the session was run as mercury specific with excellent attendance. We feel that a mercury specific session would allow for better discussion and capacity building.

Preliminary session type: Platform and Poster

Passive water sampling of organic contaminants in large water bodies: Opportunities, challenges and innovations

Chairs: Rainer Lohmann, Derek Muir, Eddy Zeng

The advance of passive sampling has made it possible to monitor for a wide range of dissolved organic contaminants in local, regional and remote locations. Initially, major progress was made for the sampling of legacy, mostly hydrophobic, organic compounds using a range of apolar sampling membranes. Polar organic chemical integrative samplers have also been widely applied for passive sampling of polar organics. Ideally, passive sampling would be able to yield representative measurements of both hydrophobic and hydrophilic compounds. This session aims to discuss the latest development and applications of field monitoring, new passive sampling developments and theoretical approaches to assess the occurrence, temporal trends, transport/transformation processes and impact of the organic contaminants in aquatic systems (e.g. rivers and their watersheds, lakes, seas, and oceans). In particular, we are interested in presentations that convey cost-effective environmental monitoring techniques and that address challenges such as deployments in large water bodies over extended periods of time.

Preliminary session type: Platform and Poster

Persistent and mobile contaminants in the aquatic environment: how to identify, analyse and regulate a potential threat for drinking water resources

Chairs: Michael Neumann, Pim de Voogt, Thorsten Reemtsma

Chemical substances as well as their uses that fall within the scope of the REACH Regulation (EC No. 1907/2006) have to be registered by the European Chemicals Agency (ECHA) in Helsinki. Registrants are requested to ensure that their chemicals and uses provide a high level of protection to human health and the environment. The aquatic environment and more critically, drinking water resources are particularly vulnerable and require a high level of protection. In Europe, drinking water is obtained mainly from groundwater, surface water reservoirs or river bank filtration. If these environmental compartments are exposed to hazardous chemicals, drinking water can become contaminated.

In the last decade the fate and behaviour of polar and ionic organic substances has been investigated both scientifically and from a regulatory perspective. Findings point to the fact that their intrinsic hazard potential is maximised if they are persistent in the environment and simultaneously mobile in the water cycle. Once emitted, these substances can move and remain in the aquatic environment for long periods of time and the contamination is therefore irreparable. For persistent and mobile organic contaminants that reach the aquatic environment, the likelihood of them further migrating to drinking water resources is high. Their physico-chemical properties might hinder their degradation by ozone and UV or their retention via filtration using activated charcoal during water treatment processes. If the chemicals are also toxic, emissions during the production and downstream uses should be avoided.

However, for many of these substances little is known about their occurrence in the aquatic environment because analytical determination is often difficult. Their hydrophilic character hampers efficient extraction and no generally applicable analytical methods are available. There is a need for closing these significant analytic and knowledge gaps.

The aim of this session is to stimulate the exchange between water monitoring and analytical specialists on the one hand and hazard assessment, risk mitigation and regulation on the other. We encourage contributions that propose substance properties and criteria for the identification and prioritisation of persistent and mobile organic chemicals. The session is a platform for monitoring approaches and target or non-target screenings in the aquatic environment and drinking water resources. We aim to clarify the question regarding whether there is a need to improve the protection of drinking water resources through the improvement and enforcement of chemical regulations (e.g. REACH).

Preliminary session type: Platform and Poster