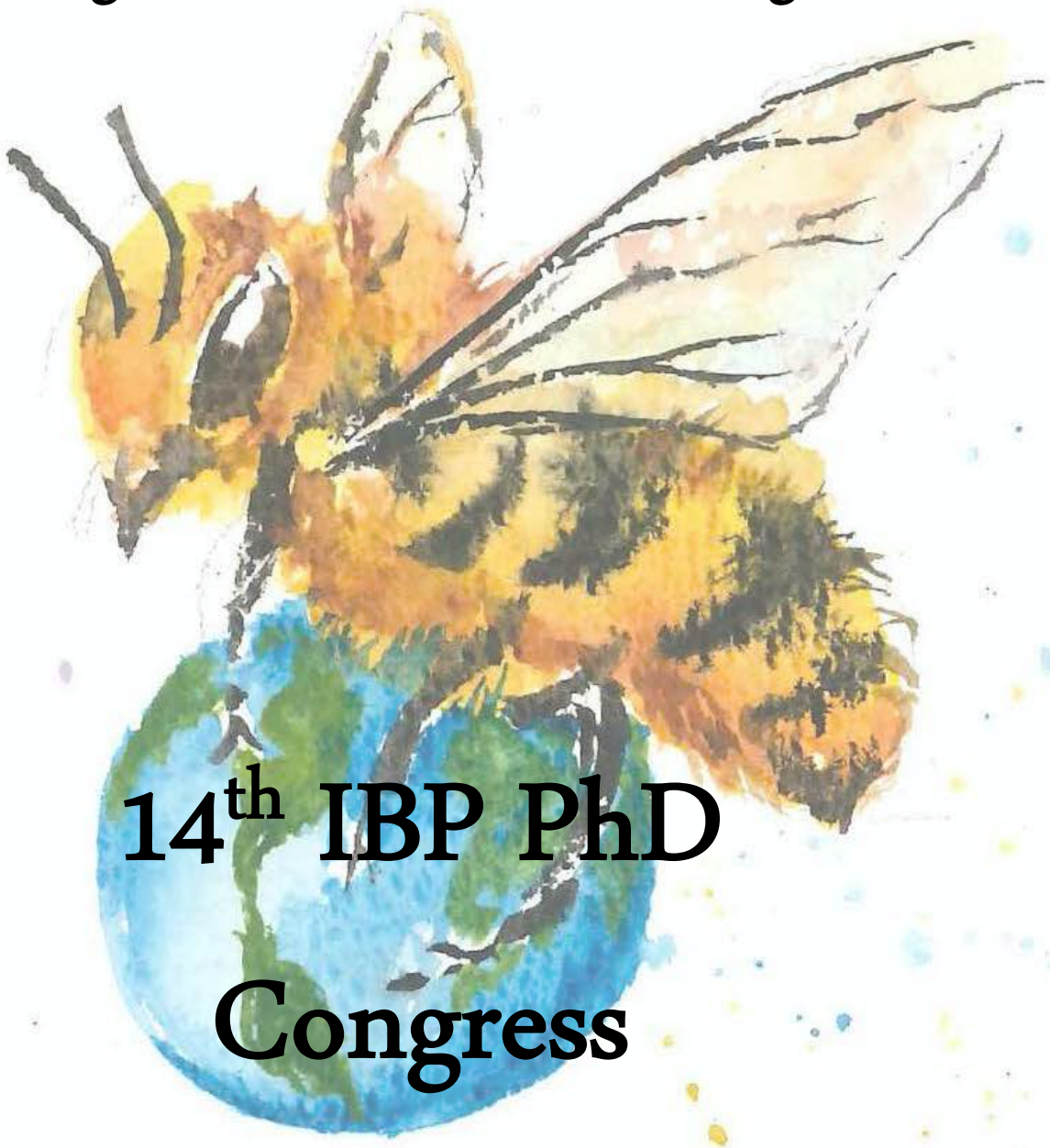
BE THE CHANGE!

12 amazing TALKS and 36 astonishing POSTERS



14th IBP PhD Congress

22 April 2022 8:30 AM – 7 PM in CAB ETH Zentrum

ETH zürich eawag aquatic research

Welcome!

We are very excited to welcome you in person again to the 14th IBP PhD Congress! This year, we present an overview of research at the institute of Biogeochemistry and Pollutant Dynamics (IBP). You will have the opportunity to explore the very diverse research disciplines and the connections between them to better understand the dynamics of our environment. We assure that today's Congress will allow you to connect scientifically and personally with new people, all while having lots of fun. Together we study the environment, and together we can *Be the Change!*

April 22, 2022
CAB Building
ETH Zentrum, Zürich

Organizing Committee

Maya Amacha
Kevin Kleemann
Tong Yang

Chairpersons

Charlotte Bopp
Rachel London

With great help from

Dr. Anouk N'Guyen van Chinh

PROGRAM

8:30 **Registration**

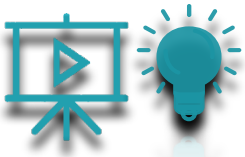
CAB Foyer

9:00 **Welcome by chairpersons**
Charlotte Bopp, Rachel London

Opening Speech
Prof Dr. Kris McNeill

G11

9:20 **Session 1 - The dynamics of the environment**



Joanna Houska
Non-target screening reveals the identity of carbonous and nitrogenous carbonyl- containing oxidation byproducts during ozonation of lake water and wastewater

Emanuele Fara
The role of lambda prophage in a cross-feeding bacterial community

G11

Anish Kirtane
A Matter of State: Evaluation of Methods for Sorting States of Environmental DNA

Andrew Grigg
Stability of jarosite in an acid sulfate soil from Central Thailand

10:45 **Poster session A & Coffee**

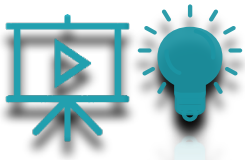
H41

12:00 **Lunch**

13:00

13:10 **Session 2- Environmental Exposure of Materials**

Barbora Pinlova
Microplastics; what happens to weathered textiles?

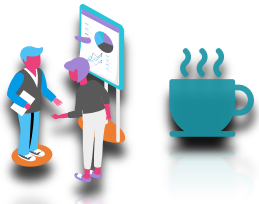


Mattia Cerri
Assessing biodegradation of commercial plastic mulches in Swiss soils.

Joel Rüthi
Metagenome mining of the alpine plastisphere for novel plastic degrading esterases.

G11

Hyunjoo Hong
Prospective dynamic and probabilistic material flow analysis of graphene-based materials in Europe from 2004 to 2030



14:35 **Poster session B & Coffee**

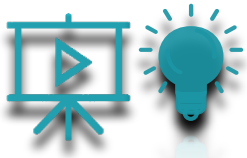
H41

15:50

16:00 **Session 3 - From land to sky**

Benedikt Lauper
Systematic Underestimation of Pesticide Burden for Invertebrates under Field Conditions: Comparing the Influence of Dietary Uptake and Aquatic Exposure Dynamics

Zoé Le Bras
Seasonal variability and production mechanisms of volatile selenium species at a coastal site in the Mediterranean Sea



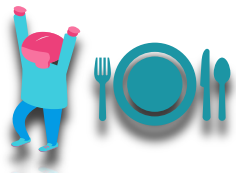
Esther Breuninger
Insights into the atmospheric cycle of selenium and arsenic: Linking elemental speciation with atmospheric transport in a 5-year aerosol series

G11

Sarah Partanen

Satellite-based non-clear-sky correction factors for clear-sky incident irradiance spectra

17:25



17:30 **Awards & Dinner**

Stuz

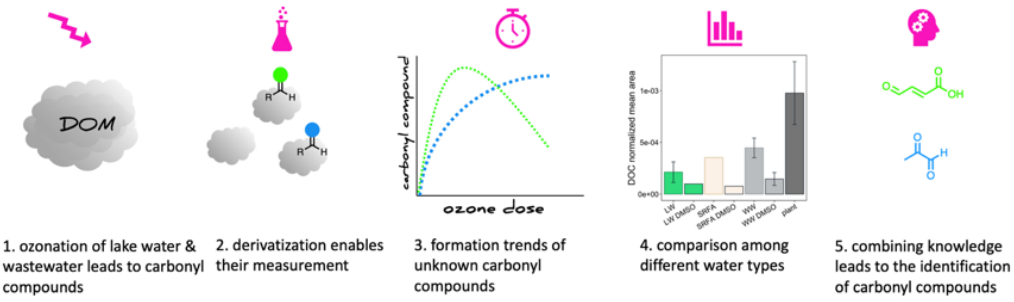
19:00 **After Party!**

Presentations

Joanna Houska
Water Resources and Drinking Water | EAWAG and EPFL

Non-target screening reveals the identity of carbonous and nitrogenous carbonyl- containing oxidation byproducts during ozonation of lake water and wastewater

The application of ozone for disinfection or abatement of micropollutants during treatment of drinking water and wastewater is accompanied by ozone reactions with matrix components such as dissolved organic matter (DOM) which leads to the formation of undesired oxidation by-products (OBPs) such as low molecular weight aldehydes and ketones. To date, the identification of unknown carbonyl compounds in complex water types remains a bottleneck in analytical chemistry. By applying a recently developed non-target workflow and combining the findings with kinetic and mechanistic information, the following three objectives were met: (1) evaluating the formation of carbonyl compounds at varying specific ozone doses across a wide range of water types revealed around 180 carbonous and nitrogenous carbonyl compounds with a significantly higher share of N-containing carbonyl compounds in wastewater compared to lakewater, (2) providing a link between carbonyl compounds and their precursors by combination with electron-donating capacity (EDC) and ozonation of model compounds proved successful and (3) identifying a set of relevant carbonyl compounds by non-target screening including mechanistic information, revealed the identity of many carbonyl compounds with confidence level 1 and 2 including a nitrogenous carbonyl compound.

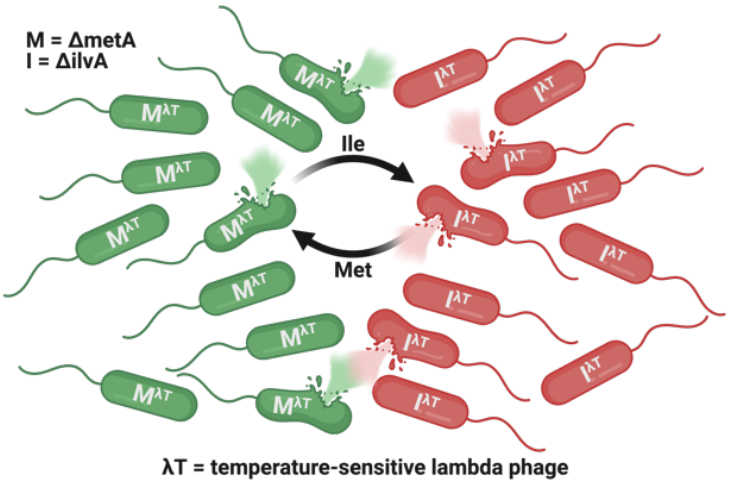


Approach to identify unknown carbonyl compounds

Emanuele Fara
Environmental Microbiology | EAWAG and ETH

The role of lambda prophage in a cross-feeding bacterial community

Microbes are present in almost every habitat on Earth and can form spatially structured communities. Often, each individual cell of a community cannot produce everything it needs but it relies on taking up metabolites produced by other organisms. Hence, microbial cells engage in metabolic interactions with surrounding cells of the same or another species. Such interactions change over time and are strongly influenced by biotic and abiotic factors like viruses and temperature. My research focuses on how bacterial viruses, or phages, influence metabolic interactions in microbial communities through induction and lysis. In fact, some phages can integrate their DNA into the host genome and become prophages. Depending on several factors, prophages can be induced and will ultimately lyse the host cell. I study the function of lambda prophage in a community composed by two amino acid auxotrophs derived from E. coli. The two strains need to exchange the two amino acids in order to grow in an environment deprived of such metabolites. The presence of a temperature-sensitive lambda prophage allows me to study the effect of prophage induction in this community, thus shining light on the role of prophages from an ecological perspective.



THE SYSTEM: Bacterial community where one strain (M) is auxotroph for methionine (Met) and the other one (I) for isoleucine (Ile). When amino acids are not externally available, the two strains need to exchange Met and Ile in order to grow. Lysis by phage (□T) can release amino acids in the environment and benefit the establishment of interactions between the two auxotrophic strains.

Anish Kirtane
Environmental DNA | ETH

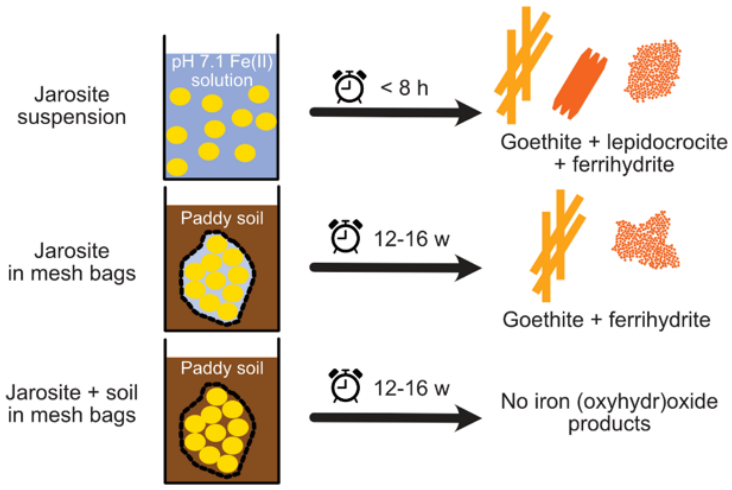
A Matter of State: Evaluation of Methods for Sorting States of Environmental DNA

Environmental DNA analysis has the potential to revolutionalize biodiversity assessment aiding in conservation and management decisions. eDNA once shed can exist in numerous states with varying behaviors including degradation rates and transport potential. In this study we consider three states of eDNA: 1) DNA enveloped in a cellular or organellar membrane, 2) dissolved extracellular DNA molecule without any interaction with other particles, and 3) extracellular DNA adsorbed to a particle surface in the environment. Capturing, isolating and analyzing a particular state of eDNA provides utility towards better interpretation of eDNA data. While methods for separating different states of DNA have been developed, they remain poorly evaluated due to the lack of state-controlled experimentation. We evaluate the methods for separating states of eDNA by using DNA from three different species to represent the three states of eDNA as state-specific controls. We use chicken DNA to represent the dissolved state, salmon DNA adsorbed to clay particles as the adsorbed state, and mouse cells grown in liquid culture for the membrane-bound state. We perform the separation in three water matrices, two environmental and one synthetic, spiked with the three eDNA states. The success of isolation and recovery of each state are evaluated.

Andrew Grigg
Soil Chemistry | ETH

Stability of jarosite in an acid sulfate soil from Central Thailand

Jarosite is an iron hydroxysulfate mineral that is prominent in acid sulfate soils, where it regulates the cycling of trace elements, iron, and acidity. In controlled laboratory experiments, Fe(II) catalyses jarosite transformation to crystalline iron (oxyhydr)oxides. However, the rates and products of jarosite transformation in complex geochemical conditions remain unclear. We compared the transformation of synthetic jarosite in a mixed-suspension system with transformation in Thai rice paddy soil. Jarosite suspended in 50mM MOPS buffer (pH 7.1) and 0.5 or 5 mM Fe(II) transformed into ferrihydrite, lepidocrocite, and goethite within eight hours. In contrast, complete transformation of jarosite to goethite, with minor ferrihydrite, occurred within twelve to sixteen weeks when jarosite was reacted with pore-water by burying jarosite-filled mesh bags in rice paddy topsoil. Transformation was not observed in subsoils, which did not become reducing following flooding. When contact between jarosite and soil was maximised by burying mesh bags containing soil with 57Fe-labelled jarosite enrichment, jarosite was no longer observed by 57Fe Mössbauer spectroscopy after sixteen weeks in topsoil. However, crystalline products such as ferrihydrite, goethite and lepidocrocite were not formed. The differing behaviour of jarosite in these experiments demonstrates the importance of the media in mineral transformation experiments.



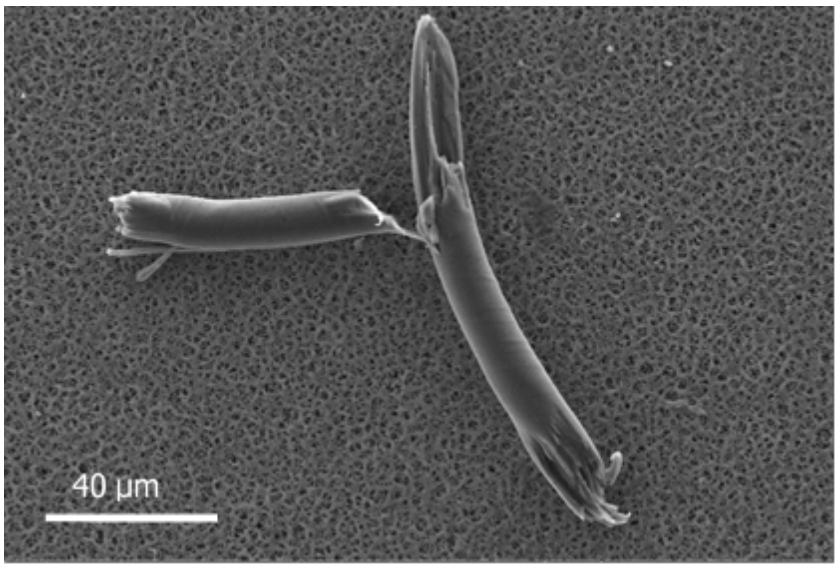
Jarosite (yellow dots, left hand side) transforms to different products depending on the reaction conditions.

Barbora Pinlova
Environmental Risk Assessment and Management | EMPA

Microplastics; what happens to weathered textiles?

We live surrounded by textiles. Many of these textiles are made of synthetic fibers, in 2021 almost 60 metric tons of polyester were produced. We already know that textiles are one of the prime sources of microplastics in the environment, often released into waste water during laundry washing. However, what happens, when the textiles are left to weather, either as outdoor textiles, or a lost piece of clothing during hiking, or disposed at a landfill? Do they contribute to the microplastics found in the environment? We aimed to answer those questions by selecting a range of polyester textiles and exposing them to artificial weathering by UV light for 2 months.

Our findings show that the fibers in the textiles experience structural damage from the UV exposure over time, forming pits and cracks on the surface. Once an additional mechanical force is introduced, such as during washing, the cracks propagate and produce microplastics. This results in increased release of microplastic fibers, from hundreds of fibers per gram of textile at the beginning of the experiment, to hundred thousands fibers per gram of textile after 2 months of weathering. In addition, we found different forms of microplastic fibers, which have not been previously differentiated in literature.



Weathered microplastic fiber splitting into two shorter pieces

Mattia Cerri
Environmental Chemistry | ETH

Assessing biodegradation of commercial plastic mulches in Swiss soils

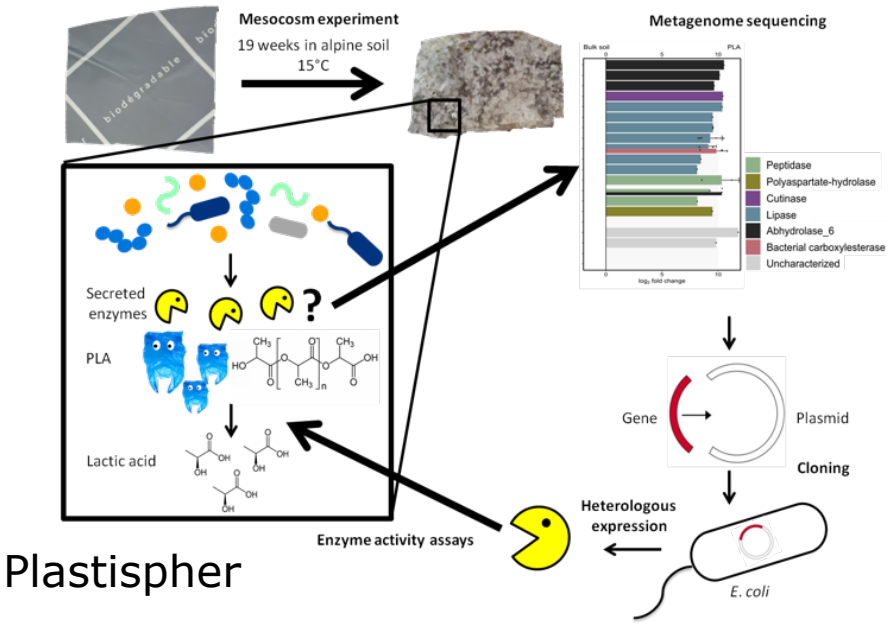
Modern agriculture relies heavily on the use of plastic mulch films to increase crop yields while lowering use of water and herbicides. However, repeated application of films composed of non-biodegradable plastics - primarily polyethylene - leads to accumulation of plastic residues in soils, raising concerns on long-term negative effects. A possible strategy to avoid plastic pollution is to employ biodegradable mulch films designed to be degraded in situ by native soil microorganisms. While such products are already available on the market, the environmental chemistry of these films and our understanding of the factors that drive their biodegradation in soils remains poorly understood. To overcome this knowledge gap, we are performing long-term incubations of commercially available mulch films - composed of polybutylene adipate-co-terephthalate (PBAT) and poly lactic acid (PLA) - in three Swiss agricultural soils at three scales – laboratory, greenhouse mesocosm and field. In this contribution, we will discuss the experimental setup and show results of film biodegradation over the first year of the incubation, as determined by quantification of the residual polymer using Soxhlet extraction of the soil followed by quantitative 1H-NMR.

Incubation setup at the greenhouse scale

Joel Rüthi
Forest Soils and Biogeochemistry | WSL

Metagenome mining of the alpine plastisphere for novel plastic degrading esterases

Plastic pollution is a global issue affecting even the most remote ecosystems such as high alpine soils. Whereas biodegradable plastics like PLA and PBAT are easily mineralized in favorable environments like industrial compost, it has barely been studied whether cold-adapted microorganisms are able to degrade bioplastics in soils by producing plastic degrading enzymes. A major challenge in the discovery of novel enzymes is the fact that only a small fraction of microorganisms are cultivable in the laboratory. Here, we identified genes coding for potential novel plastic-degrading enzymes from plastisphere metagenomes of alpine soils. Twelve esterase and protease encoding genes, which were highly abundant in the metagenomes, were synthesized, cloned and heterologously expressed using the pMAL-p5g vector in E. coli BL21 (DE3). For five of the produced enzymes we detected esterase activity and two of these five also showed activity against the polyurethane dispersion impranil® as a proof-of-concept. These novel enzymes reveal the potential of uncultivated alpine soil microorganisms to degrade biodegradable polyesters and might represent a valuable biotechnological approach of bioplastics for a circular economy at low temperature.

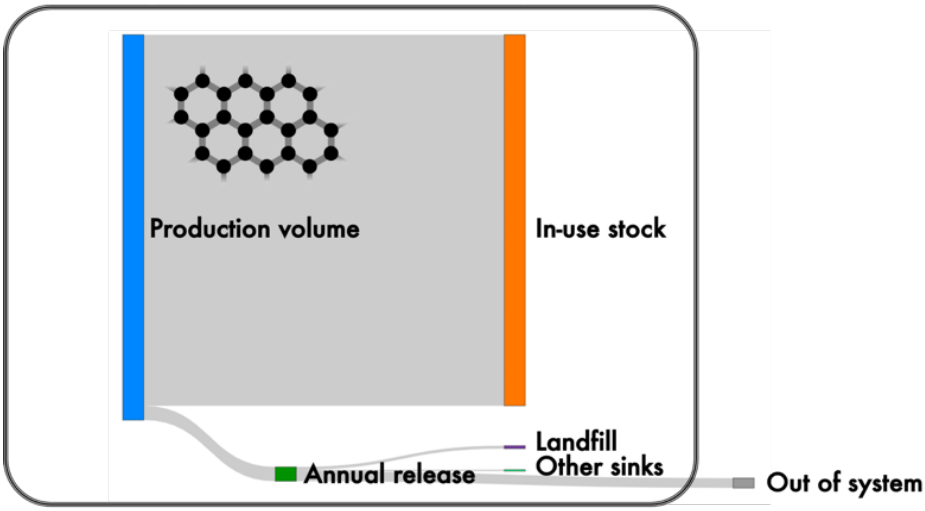


Plastisphere metagenome mining approach

Hyunjoo Hong
Environmental Risk Assessment and Management | EMPA

Prospective dynamic and probabilistic material flow analysis of graphene-based materials in Europe from 2004 to 2030

Attention to the potential environmental risks of graphene-based materials (GBM) has grown with the positive expectation of a higher demand for GBM in research and industry. We present a first study on the possible environmental exposure of GBM. The model considers production volume and use-scenarios of GBM in various consumer products, spanning the years from 2004 to 2030. The transfer coefficients of the model were estimated based on physico-chemical properties of GBM and their behavior during release and in technical compartments. Although the production volume of GBM is expected to increase strongly in the next years, the annual release of GBM shows only a slight positive trend due to the delay of some applications entering end-of-life processes where release of GBM can occur. Of all the GBM that will have been released until 2030 in Europe, more than half will be eliminated in waste incineration plants and 12 % will be exported out of the Europe. The results of the study characterize the release concentration of GBM in various environmental compartments such as surface water (1.4 ng/L) and natural and urban soil (16 ng/kg). Therefore, the results can be used for further environmental risk assessment.

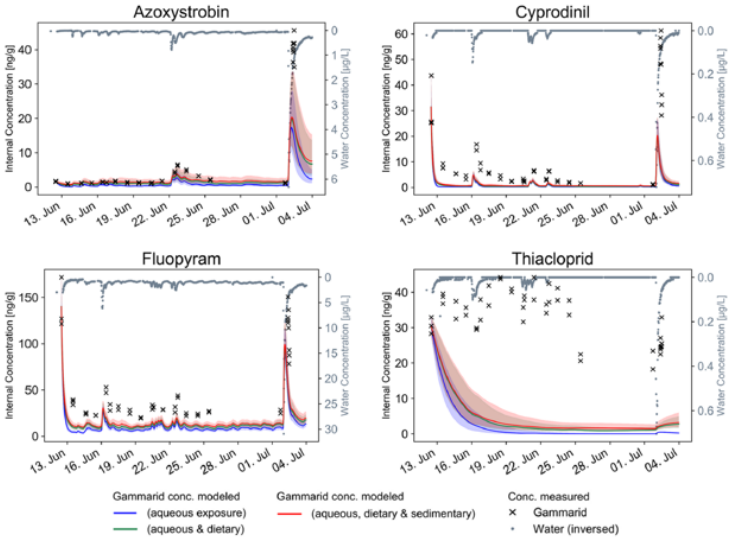


Life of graphene based material in Europe, 2030

Benedikt Lauper
Environmental Chemistry | EAWAG

Systematic Underestimation of Pesticide Burden for Invertebrates under Field Conditions: Comparing the Influence of Dietary Uptake and Aquatic Exposure Dynamics

Bioaccumulation and biotransformation of organic micropollutants in aquatic organisms have been investigated extensively for risk assessment using laboratory experiments. But for several pesticides the measured internal concentrations in gammarids in field trials exceeded the predictions based on the laboratory data, sometimes by orders of magnitude. To investigate this discrepancy, we conducted a field bioaccumulation study in a stream known to receive pollutant loadings from agriculture. Our work incorporated measurements of stream pesticide concentrations at high temporal resolution (every 20 min), as well as sediment, leaves, and caged gammarid analyses (every 2−24 h) over several weeks. The internal concentration of gammarids was subsequently modelled using a one-compartment toxicokinetic model using the measured field data as well as toxicokinetic parameters taken from accompanying lab studies and feeding rates from literature. This showed that the pesticide burden on gammarids remains underestimated by a factor of 1.9 ± 0.1 to 31 ± 3.0, with the highest underestimations occurring after rain events. Including dietary uptake from polluted detritus leaves and sediment in the model explained this underestimation only to a minor proportion. However, suspended solids analyzed during rain events had high pesticide concentrations, and uptake from them could partially explain the underestimation after rain.

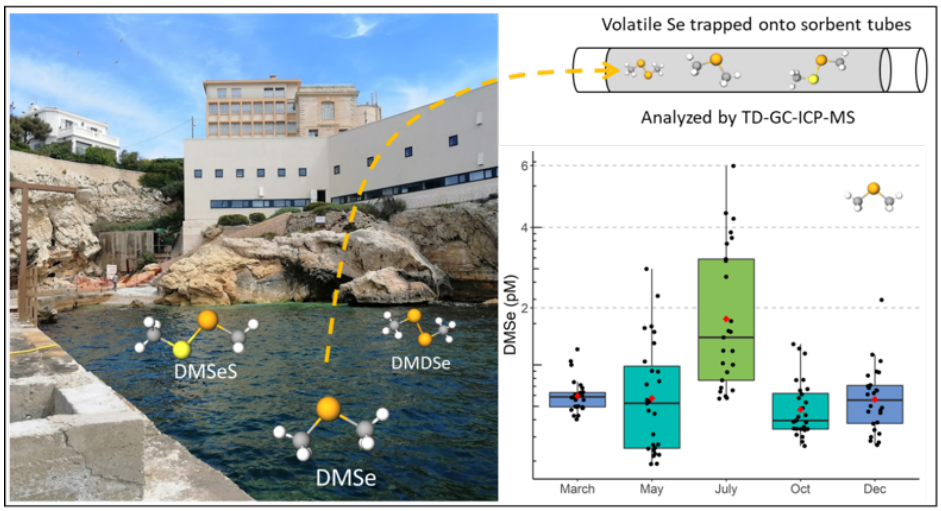


Modeled internal concentration of the pesticides azoxystrobin, cyprodinil, fluopyram and thiacloprid in gammarids when considering only aqueous uptake (blue line), aqueous and dietary uptake combined (green), and when considering uptake from sediment as well (red). The colored band represents the error range of the model (mainly 95% CIs). Their measured internal concentrations (black crosses) and the measured water concentrations (gray dots) are plotted for comparison.

Zoé Le Bras
Inorganic Environmental Geochemistry|ETH

Seasonal variability and production mechanisms of volatile selenium species at a coastal site in the Mediterranean Sea

Selenium (Se) is an essential trace element for humans and animals mainly acquired through consumption of terrestrial food products. The atmosphere is an important reservoir of Se and a source of Se to terrestrial ecosystems. Marine biogenic emissions of volatile organic Se, e.g., dimethyl selenide (DMSe), are the main source of atmospheric Se. However, the spatial distribution and temporal variability as well as the mechanisms of formation of these Se species in marine environments are poorly constrained due to a lack of efficient methods to detect these species present in trace levels (fM-pM) in seawater. We developed a new high throughput and sensitive method combining thermal desorption with gas chromatography inductively coupled plasma mass spectrometry to quantify concentrations of volatile Se species in seawater and implemented it in six two-week time periods between March 2021-2022 at the coastal station of Endoume in the Mediterranean Sea to study the daily and seasonal cycling of volatile Se species. In the same time periods, incubation experiments with natural seawater were carried out under various conditions, (dark/light, size fractions, biological inhibitors) to give insights into (a)biotic processes involved in the production of volatile Se species, for which the results will also be presented here.



Esther Breuninger
Inorganic Environmental Geochemistry | ETH and EAWAG

Insights into the atmospheric cycle of selenium and arsenic: Linking elemental speciation with atmospheric transport in a 5-year aerosol series

The atmosphere is an important reservoir of the essential metalloid selenium but also the toxic metalloid arsenic. Atmospheric deposition is a source of these elements to marine and terrestrial ecosystems, including agricultural soils, impacting environmental and human health. However, atmospheric cycling of these trace elements is still rather unknown, i.e., open questions are: i) what are seasonal inputs of anthropogenic and biogenic sources, ii) what are (bio)geochemical transformations in the atmosphere and iii) what is the fate of these elements deposited to surface environments? Knowing the chemical speciation of these elements in atmospheric samples is of key importance to answer these questions.

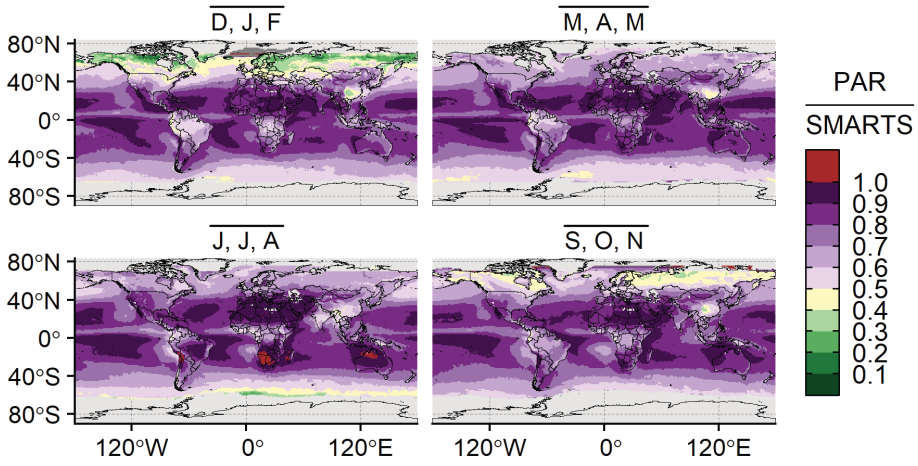
In this study, we applied new ICP-MS/MS based methods to investigate concentrations and speciation of selenium and arsenic in aerosol samples collected weekly from 2015-2020 at Pic du Midi Observatory (French Pyrenees). This high-altitude site enables the investigation of local and long-range elemental transport from both marine and continental environments. In addition to trace elements, speciation of sulfur and organic composition (using pyrolysis-GC/MS) of aerosols was studied and air parcel backward trajectories were calculated. The combination of these analyses gives new insights into the seasonal variability of atmospheric sources and cycling of selenium and arsenic.

Pic du Midi Observatory

Sarah Partanen
Environmental Chemistry | ETH

Satellite-based non-clear-sky correction factors for clear-sky incident irradiance spectra

Photochemical transformation can be an important removal process for some organic contaminants in surface waters such as lakes and rivers, as well as in oceans. An important environmental variable affecting photochemical processes in surface waters and oceans is the incoming solar irradiance, as this is the energy source required for these processes to occur. However, clear-sky incident irradiance spectra are often used when evaluating the fate of aquatic contaminants, leading to an underestimation of contaminant half-lives due to photochemical transformation. In this work incident irradiance satellite data were used to develop global scale non-clear-sky correction factors for commonly used reference irradiance spectra. Non-clear-sky conditions can decrease incident irradiance by over 90% depending on geographic location and time of year, with latitudes above 40°N being most heavily affected by season. The impact of non-clear-sky conditions on contaminant half-lives has been highlighted in a case study of triclosan in Lake Greifensee, which show a 33% increase in triclosan half-life over the course of a year. The correction factors developed in this work are available at daily, monthly, and seasonal resolutions for every point on the globe, and can be used by researchers and practitioners who need accurate estimates of incident irradiance.



Maps of non-clear-sky correction factors for clear-sky incident irradiance spectra displayed at a seasonal resolution

Poster Session A

A01. Silvan Arn
Quantifying biodegradable mulch film residues in agricultural fields

A02. Simon Rath
Simulation of Realistic Aqueous Ozonation Conditions: Use of Small Scavenger Molecules as Surrogate for Dissolved Organic Matter

A03. Pauline Béziat
Phytoplankton in the marine selenium cycle - optimizing extraction and analytical techniques for algal intracellular Se speciation

A04. Alessio Cavallaro
Probiotic control of Legionella in building plumbing systems: a two-sided approach towards identifying and characterizing antagonistic bacteria

A05. Emma Chollet Ramampiandra
Learning ecological species responses from machine learning models

A06. Duncan Dale
Using anthropogenic radionuclides to trace ocean circulation around Iceland

A07. Sarah Descloux
Benthic diatoms as indicators for pesticide pollution in the Swiss watercourses

A08. Flora Desmet
Anthropogenically forced increase of acidification extreme conditions in the Northeast Pacific Ocean modulated by climate modes

A09. Dominic Eriksson
Predicting global distribution of diazotrophs using species distribution models

Poster Session A

A10. Xu Fang
Decreasing arsenic and cadmium in rice: Interactions of soil sulfate amendment, liming, and soil texture under intermittent flooding

A11. Niroshan Gajendra
How does sediment temperature affect the long-term storage of organic carbon in marine sediments?

A12. Andrew Grigg
Interactions between jarosite and the aluminum cycle

A13. David Haaf
Understanding Hydrogeological Effects on Groundwater Arsenic Contamination in Hanoi, Vietnam

A14. Urs Elizondo Hofmann
Pteropod population-level responses to acidification across different timescales in the California Current System

A15. Eike Köhn
On the vertical structure and propagation of marine heatwaves in the Eastern Pacific

A16. Rachel London
What is the Right Method for Assessing the Alternatives to PFAS?

A17. Jill Bachelder
How do organic matter-rich fertilizers impact bioavailable Zn, and Cd, in an unpolluted arable Swiss soil?

A18. Johannes Raths
Speed it up: Temperature drives toxicokinetic processes in aquatic invertebrates

Poster Session B

B01. Amy Macfarlane
Evolution of micro and macro-structural changes of melting sea ice and influence on reflectance

B02. Céline Margot
Impact of boiler temperature on L. pneumophila in building plumbing: a long-term case study

B03. Yuchen Meng
Blue carbon “hidden” in mangroves

B04. Sahar Naim
A comparative study of the photochemical behavior of aliphatic and aromatic methyl thioethers and their photoproduction of methane sulfonic acid

B05. Ville Nenonen
Phosphate retention by Fe(III)- and Ca-precipitates formed upon oxidation of Fe(II)

B06. Juliana Oliveira
Tintenstrich communities: occurrence, mobility and potential risk of cyanobacteria and their toxins in lichen communities

B07. Francesco Parrella
Influence of Microplastics and Freshwater Snow Heteroaggregation on Particle Settling Rates in Freshwater

B08. Annabel Payne
A multi-tracer investigation of ocean circulation and ventilation in the Canada Basin

B09. Katie Platt
The Photochemical Reactivity of 6PPD and 6PPD Quinone: The Coho Salmon Killer

Poster Session B

B10. Grégoire Saboret
Stable isotope insights on the ecosystem effects of migratory salmonids on stream food webs.

B11. Roman Schefer
Eco-corona Formation on Plastic: Effect of Plastic Type and Aging

B12. Robert Schmitz
Characterization of electron exchange with peat particulate organic matter and its impact on methane formation dynamics

B13. Johannes Schorr
Temporally highly resolved in-situ monitoring of pesticide dynamics in a karst spring in the Swiss Jura

B14. Katrin Schulz
Moving from the lab to the field - Ferrihydrite and lepidocrocite mineral transformations in model systems and a rice paddy soil

B15. Alissa Tophinke
Systematic Development of Extraction Methods for Quantitative Microplastic Analysis in Soil using Metal-Doped Plastics

B16. Morgan Vallières
Photo-Oxidation of C1 Compounds; Formaldehyde, Formic acid and Methanol, Via Natural Water Components.

B17. Xuejian Wang
Seasonal and annual profiles of cyanobacterial non-ribosomal peptides in Lake Greifensee and their stability in waters

B18. Meng Wong
Characteristics of Recent Compound Extremes in the Global Ocean

List of Participants

Ackermann	Martin	Professor	martin.ackermann@env.ethz.ch
Amacha	Maya	Doctoral Student	maya.amacha@usys.ethz.ch
Arn	Silvan	Doctoral Student	silvan.arn@usys.ethz.ch
Bachelder	Jill	Doctoral Student	jbachelder@ethz.ch
Benedetti	Fabio	Postdoc	fabio.benedetti@usys.ethz.ch
Bernet	Nora	Master Student	bernetn@student.ethz.ch
Beyrouti	Elyssa	Other	elyssa.beyrouti@eawag.ch
Béziat	Pauline	Doctoral Student	pauline.beziat@usys.ethz.ch
Bogler	Sophie	Master Student	sbogler@student.ethz.ch
Bolotin	Jakov	Technician	jakov.bolotin@eawag.ch
Bouchet	Sylvain	Postdoc	sylvain.bouchet@usys.ethz.ch
Breuninger	Esther	Doctoral Student	esther.breuninger@eawag.ch
Cavallaro	Alessio	Doctoral Student	alessio.cavallaro@eawag.ch
Cerri	Mattia	Doctoral Student	mattia.cerri@usys.ethz.ch
Chénier	Noémy	Master Student	noemy.chenier@usys.ethz.ch
Childress	Jasmine	Doctoral Student	jnchildress@gmail.com
Chollet Ramampiandra	Emma	Doctoral Student	emma.chollet@eawag.ch
Crippa	Donat	Master Student	dcrippa@mail.ethz.ch
Dale	Duncan	Doctoral Student	duncan.dale@usys.ethz.ch
Deiner	Kristy	Professor	kristy.deiner@usys.ethz.ch
Descloux	Sarah	Doctoral Student	sarah.descloux@eawag.ch
Desmet	Flora	Doctoral Student	flora.desmet@usys.ethz.ch
Eirund	Gesa	Postdoc	Gesa.eirund@env.ethz.ch
Engelhardt	Edith	Doctoral Student	edith.horstmann@eawag.ch
Eriksson	Dominic	Doctoral Student	deriksson@ethz.ch
Fang	Xu	Doctoral Student	xu.fang@usys.ethz.ch
Fara	Emanuele	Doctoral Student	emanuele.fara@eawag.ch
Gajendra	Niroshan	Doctoral Student	niroshan.gajendra@usys.ethz.ch
Giroud	SÈbastien	Doctoral Student	sebastien.giroud@eawag.ch
Greenwood	Esther	Doctoral Student	esther.greenwood@eawag.ch
Gregor	Luke	Postdoc	luke.gregor@usys.ethz.ch
Grigg	Andrew	Doctoral Student	andrew.grigg@usys.ethz.ch
Haaf	David	Doctoral Student	david.haaf@eawag.ch

List of Participants

Hering	Janet	Professor	janet.hering@eawag.ch
Hofmann Elizondo	Urs	Doctoral Student	urs.hofmann@usys.ethz.ch
Hollender	Juliane	Professor	juliane.hollender@eawag.ch
Hong	Hyunjoo	Doctoral Student	hyunjoo.hong@empa.ch
Houska	Joanna	Doctoral Student	joanna.houska@eawag.ch
Khan	Riyaz	Research Assistant	riyaz.khan@eawag.ch
Kirtane	Anish	Doctoral Student	anishajay.kirtane@usys.ethz.ch
Kleemann	Kevin	Doctoral Student	kevin.kleemann@usys.ethz.ch
Köhn	Eike	Doctoral Student	eike.koehn@usys.ethz.ch
Kubeneck	Joëlle	Doctoral Student	luisa.kubeneck@usys.ethz.ch
Lauper	Benedikt	Doctoral Student	benedikt.lauper@eawag.ch
Le Bars	Maureen	Postdoc	maureen.lebars@usys.ethz.ch
Le Bras	Zoé	Doctoral Student	zoe.lebras@usys.ethz.ch
Liang	Yiheng	Doctoral Student	yiheng.liang@usys.ethz.ch
Lightfoot	Alexandra	Doctoral Student	lightfoot@eawag.ch
London	Rachel	Doctoral Student	rachellucy.london@usys.ethz.ch
Louchard	Domitille	Postdoc	domitille.louchard@usys.ethz.ch
Ma	Yinyin	Doctoral Student	yinyin.ma@eawag.ch
Macfarlane	Macfarlane	Doctoral Student	amyrmacfarlane@msn.com
Margot	CÈline	Doctoral Student	celine.margot@eawag.ch
McNeill	Kris	Professor	kris.mcneill@env.ethz.ch
Meier	Dimitri	Postdoc	dimitri.meier@usys.ethz.ch
Meng	Yuchen	Doctoral Student	yuchen.meng@usys.ethz.ch
Meyer	Corina	Doctoral Student	Corina.meyer@eawag.ch
Mosimann	Sven	Doctoral Student	svenm@student.ethz.ch
N'Guyen	Anouk	Other	nanouk@ethz.ch
Naim	Sahar	Doctoral Student	sahar.naim@usys.ethz.ch
Nenonen	Ville	Doctoral Student	ville.nenonen@eawag.ch
Nghiem	Athena	Postdoc	athena.nghiem@usys.ethz.ch
Nunez	Jonathan	Postdoc	jonathan.nunez@usys.ethz.ch
Oliveira	Juliana	Doctoral Student	jdearaujo@student.ethz.ch
Parrella	Francesco	Doctoral Student	francesco.parrella@usys.ethz.ch
Partanen	Sarah	Doctoral Student	sarah.partanen@usys.ethz.ch
Payne	Annabel	Doctoral Student	annabel.payne@usys.ethz.ch
Pinlova	Barbora	Doctoral Student	barbora.pinlova@empa.ch
Platt	Katie	Doctoral Student	kathrynlouise.platt@usys.ethz.ch
Pradel	Alice	Postdoc	alice.pradel@usys.ethz.ch
Raimondi	Lorenza	Postdoc	lorenza.raimondi@usys.ethz.ch

List of Participants

Rath	Simon	Doctoral Student	simon.rath@eawag.ch
Raths	Johannes	Doctoral Student	johannes.raths@eawag.ch
Roger	Fabian	Postdoc	fabian.roger@usys.ethz.ch
Rothwell	Katherine	Postdoc	katherine.rothwell@usys.ethz.ch
Rudin	Elvira	Master Student	rudine@ethz.ch
Ruppen	Désirée	Doctoral Student	desiree.ruppen@istp.ethzc.h
Rüthi	Joel	Doctoral Student	joel.ruethi@wsl.ch
Saboret	Gregoire	Doctoral Student	gregoire.saboret@eawag.ch
Sander	Michael	Professor	michael.sander@env.ethz.ch
Sarnowski	Chris	Postdoc	chris.sarnowski@eawag.ch
Schefer	Roman	Doctoral Student	roman.schefer@usys.ethz.ch
Schmid	Martin	Senior Scientist	martin.schmid@eawag.ch
Schmitz	Robert	Postdoc	rschmitz@ethz.ch
Schorr	Johannes	Doctoral Student	johannes.schorr@eawag.ch
Schroth	Martin	Professor	martin.schroth@env.ethz.ch
Schubert	Olga	Senior Scientist	olga.schubert@usys.ethz.ch
Schubert	Carsten	Professor	carsten.schubert@eawag.ch
Schulz	Katrin	Doctoral Student	katrin.schulz@usys.ethz.ch
Seyfferth	Angelia	Professor	angelia.seyfferth@usys.ethz.ch
Simon	Carsten	Postdoc	carsten.simon@usys.ethz.ch
Stenke	Andrea	Senior Scientist	andrea.stenke@env.ethz.ch
Stubbusch	Astrid	Doctoral Student	astubbusch@ethz.ch
Sullivan	Ryan	Professor	ryan.sullivan@usys.ethz.ch
Tophinke	Alissa	Master Student	alissahelena.tophinke@usys.ethz.ch
Vallieres	Morgan	Doctoral Student	morgan.vallieres@usys.ethz.ch
Vargas	Rodrigo	Professor	rvargas@udel.edu
Wang	Xuejian	Doctoral Student	xuejian.wang@eawag.ch
Wefing	Anne-Marie	Postdoc	annemarie.wefing@usys.ethz.ch
Wehrli	Bernhard	Professor	bernhard.wehrli@env.ethz.ch
Wille	Flora	Doctoral Student	floraelisabeth.wille@usys.ethz.ch
Winkel	Lenny	Professor	lenny.winkel@eawag.ch
Wong	Meng	Doctoral Student	joel.wongmengcheng@usys.ethz.ch
Wullschleger	Simon	Research Assistant	simon.wullschleger@eawag.ch
Yang	Tong	Doctoral Student	tong.yang@empa.ch

Notes

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