

Reaching Inside Out

IBP PhD Congress

#12IBPPhD

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Vol. 12

12 amazing talks
that will change
your life



+40 posters
to charge up
your scientific ideas

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to communicate
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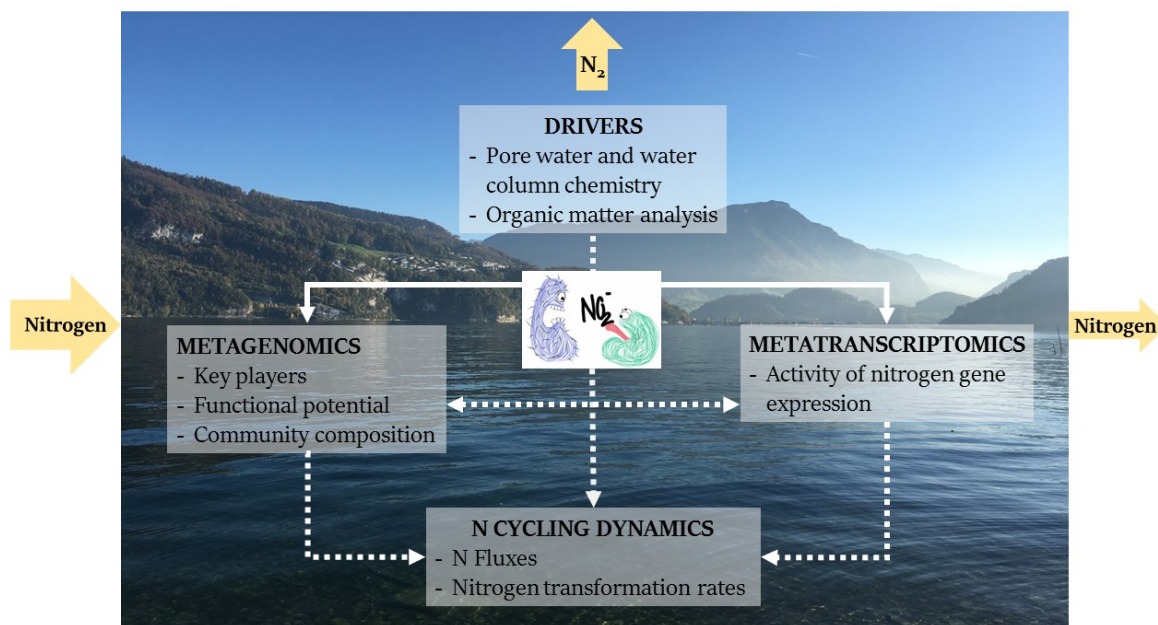
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A1 Kathrin Baumann

Nitrogen turnover and microbial communities in lake sediments

Lakes act as nitrogen sinks. However, increasing anthropogenic nitrogen input is altering the nitrogen cycle of aquatic systems. The nitrogen removal in lakes has received considerable attention, though a mechanistic understanding of the nitrogen cycling processes, its drivers, and the microbial community mediating the transformation processes is missing. This study aims to identify the microbial key players and to reveal the factors influencing the nitrogen cycling dynamics in lake sediments. We observed seasonal and spatial changes in the nitrogen cycling microbial community and different nitrogen transformation process rates in Lake Baldegg. The preliminary data showed that the interdisciplinary research approach helps to better understand the complex interplay of the nitrogen transformation processes, its underlying parameters, and the microbial community composition.

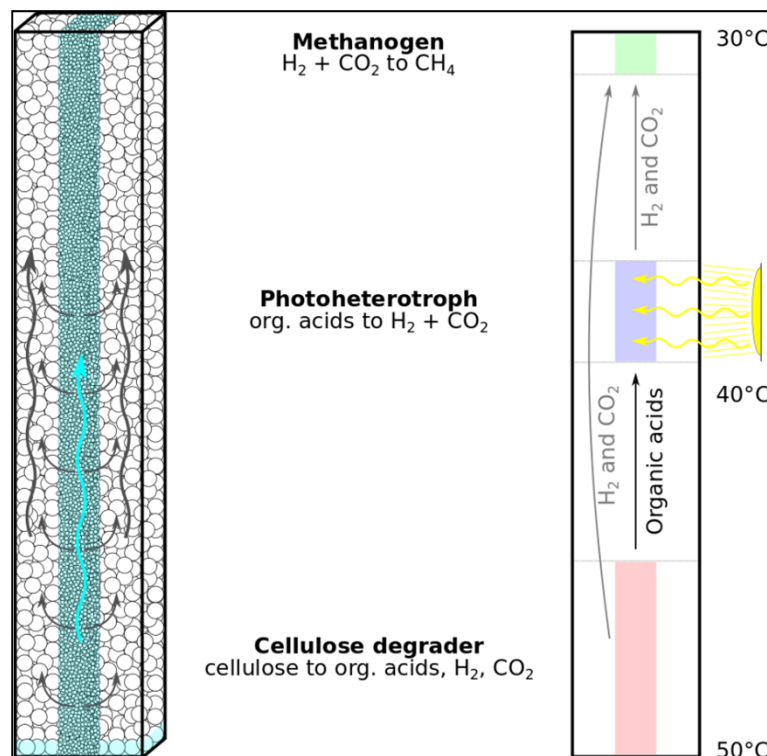


Overview of the interdisciplinary Nitrogen project.

A2 Sami Ben Said

A spatially organized microbial consortium for the conversion of cellulose to methane

Most biotechnological applications of microorganisms employ mono- or co-cultivation in well-mixed vessels. Therefore, there is a vast untapped potential for the development of multispecies microbial cultures with engineered spatial organization. Here, we propose the concept of spatially linked microbial consortia (SLMC), which aims at exploiting spatial arrangement to increase control and facilitate species combinations. We have developed a laboratory system with controlled thermal gradient to cultivate a microbial consortium of 3 members that cannot otherwise grow at the same temperature. A thermophile breaks down cellulose into organic acids, hydrogen, and carbon dioxide. A photoheterotroph converts the organic acids phototrophically and releases more hydrogen and carbon dioxide. Finally, a methanogen consumes hydrogen and carbon dioxide to produce methane.

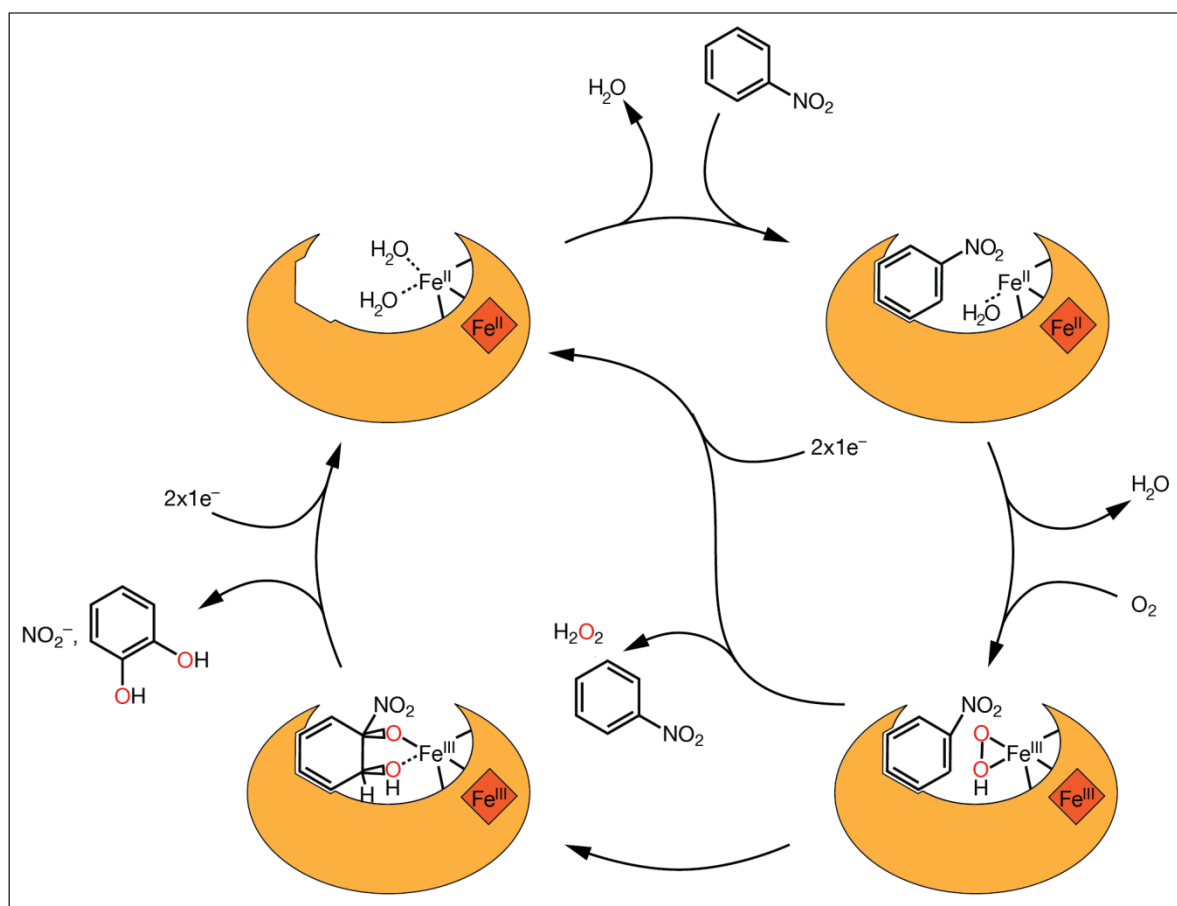


Glass bead column with thermal gradient hosting a microbial consortium composed of incompatible members for the conversion of cellulose to methane.

A3 Charlotte Bopp

Using isotope effects to understand enzymatic oxygenation kinetics

Enzymatic oxygenations are among the most important reactions that initiate the biodegradation of many persistent organic pollutants in soils and sediments. To quantify the rate of oxidative pollutant removal, however, it is crucial to understand how the enzymatic activation of oxygen impacts the kinetics of pollutant transformation. Using compound-specific isotope analysis, we determine enzyme- and substrate-specific kinetic isotope effects of two different Rieske non-heme iron dioxygenases to unravel the catalytic mechanism and identify the contribution of different elementary reaction steps to the rates of pollutant oxygenation. We show how the catalytic mechanism and oxygenation efficiency is affected by differences in active site and substrate structure.



Enzymatic oxygenation of nitrobenzene by a Rieske-non heme iron(II) dioxygenase.

A4 Mattia Cerri

Quantitative kinetics of polyester hydrolysis by simultaneous detection of embedded fluorogenic markers

Biodegradable polyesters are emerging as a possible solution to commercial agriculture's plastic waste problem. However, although several options are already available on the market, they remain niche products because of poor understanding and control of their break-down time and critical factors influencing it. Correlative studies of environmental parameters and biodegradation are hindered by time and costs limitations of direct assessment in the fields, and insufficient specificity of traditional *in vitro* esterase assays. We developed a new *in vitro* assay based on high molecular weight fluorogenic esters stably embedded in the polymer matrix at low doping ratios. We show that fluorescence development during the hydrolysis of doped polymer films is both a specific and quantitative proxy of polyesters enzymatic degradation.

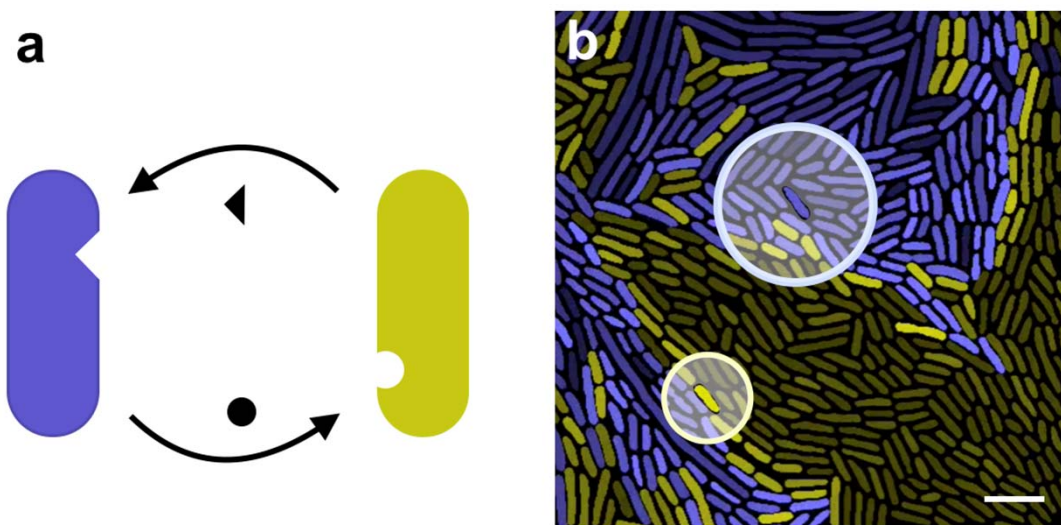


Plastic mulching in lettuce fields, Murcia (Spain).

A5 Alma Dal Co

Short-range interactions govern cellular dynamics in microbial multigenotype systems

Ecosystem processes result from interaction between organisms. When interactions are local, the spatial organization of organisms defines their network of interactions, and thus influences the system's functioning. This is especially relevant for microbial systems, which often consist of spatially structured communities of cells connected by a dense interaction network. We measured the spatial interaction network between cells inside microbial systems and we identify the factors that determine it. Combining single-cell analysis with mathematical modeling, we find that cells only interact with other cells in their immediate neighbourhood. This short interaction range impacts the functioning of the whole system by reducing its ability to perform metabolic processes collectively. Thus, the spatial scale of interaction plays a fundamental role in microbial communities.

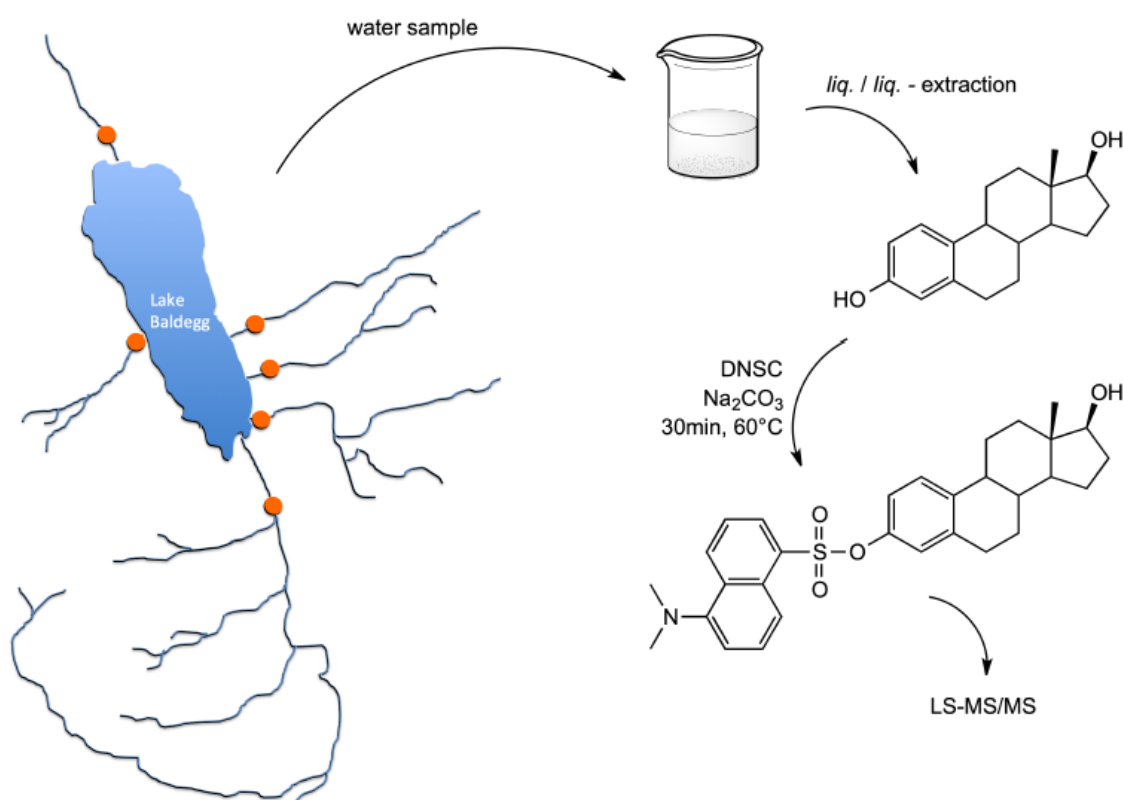


A simple microbial system of two interacting cell types (a) growing together in dense communities (b). Cells interact only with their immediate neighbours (shaded area).

A6 Francisca De Bruijn

Monitoring of agricultural derived natural estrogens in Swiss surface waters

The presence of estrogens (natural or synthetic) in aquatic ecosystems can significantly disturb reproductive cycles and development of exposed organisms. Due to the large amount of natural estrogens present in manure applied directly to the environment, manure is a major contributor to this concern. We decided to measure the estrogen load in the tributary waters and output of Lake Baldegg since these waters do not have any wastewater influx, allowing monitoring of only the agriculturally derived estrogens. The quantification method involves liquid-liquid extraction of the estrogens from water samples, derivatisation with dansyl chloride and quantitative measurement by LC-MS/MS. Additionally, a multitude of experiments was set up to ensure measurement and method quality / accuracy as well as analyte stability.

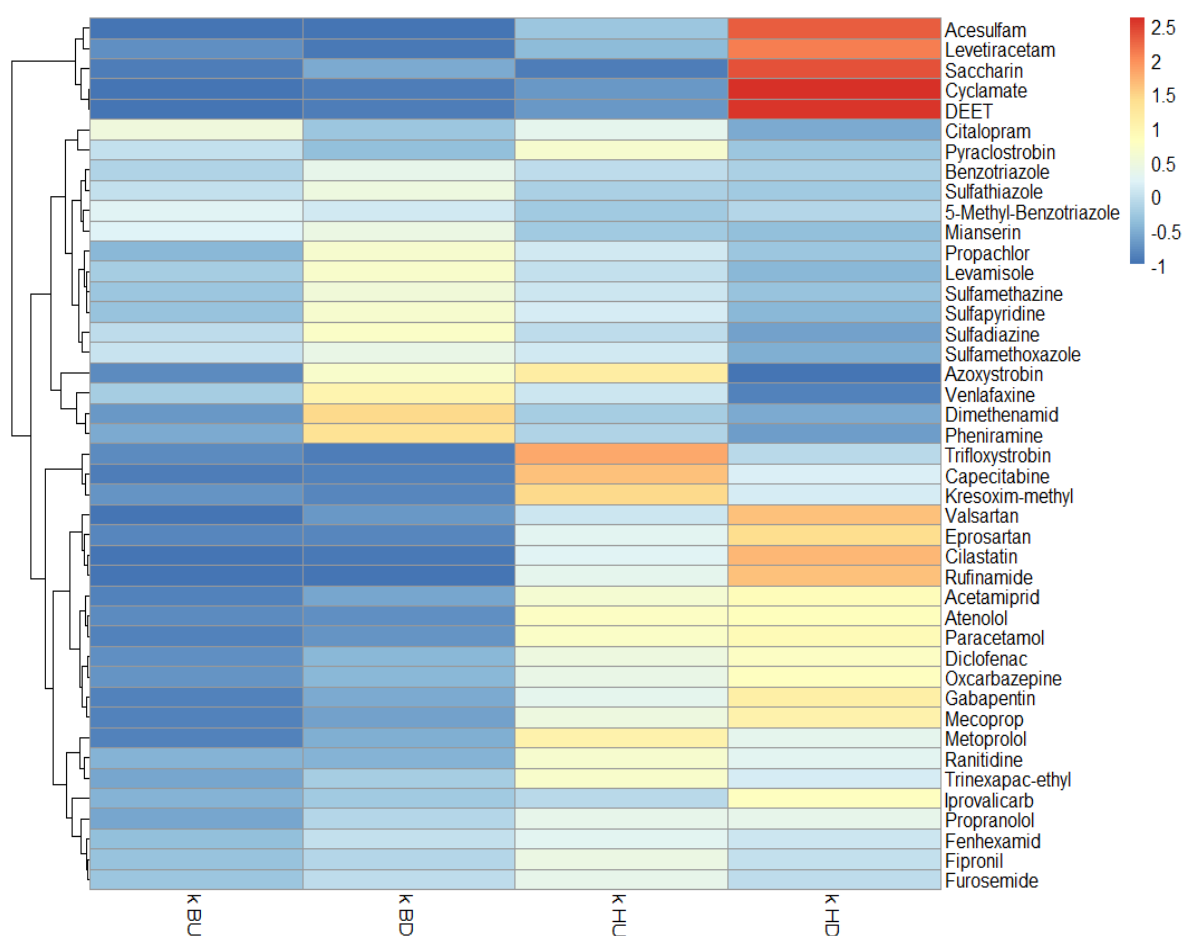


From Lake Baldegg to LC-MS/MS by example of 17 α -estradiol.

A7 Werner Desiante

Biotransformation linked to the adaptation history of stream biofilms

Stream biofilms, consisting of bacteria, algae, fungi and protozoa, fulfill essential ecosystem functions. They have been shown to act as sinks for micropollutants, such as pharmaceuticals or pesticides. In our study, we did a comparison of the micropollutant biotransformation potential of four differently adapted stream biofilms. The biofilms were cultivated in the field in two streams, up- and downstream of a wastewater treatment plant, respectively. Biotransformation experiments with a mixture of 63 micropollutants were done in the laboratory. Analysis of time-resolved HPLC-HRMS data from the four biofilm systems revealed consistent removal patterns across biofilms of different origins for specific compound groups. Our results thus demonstrate the presence of specific associations between micropollutant biotransformation and exposure/adaptation history of the microbial communities.

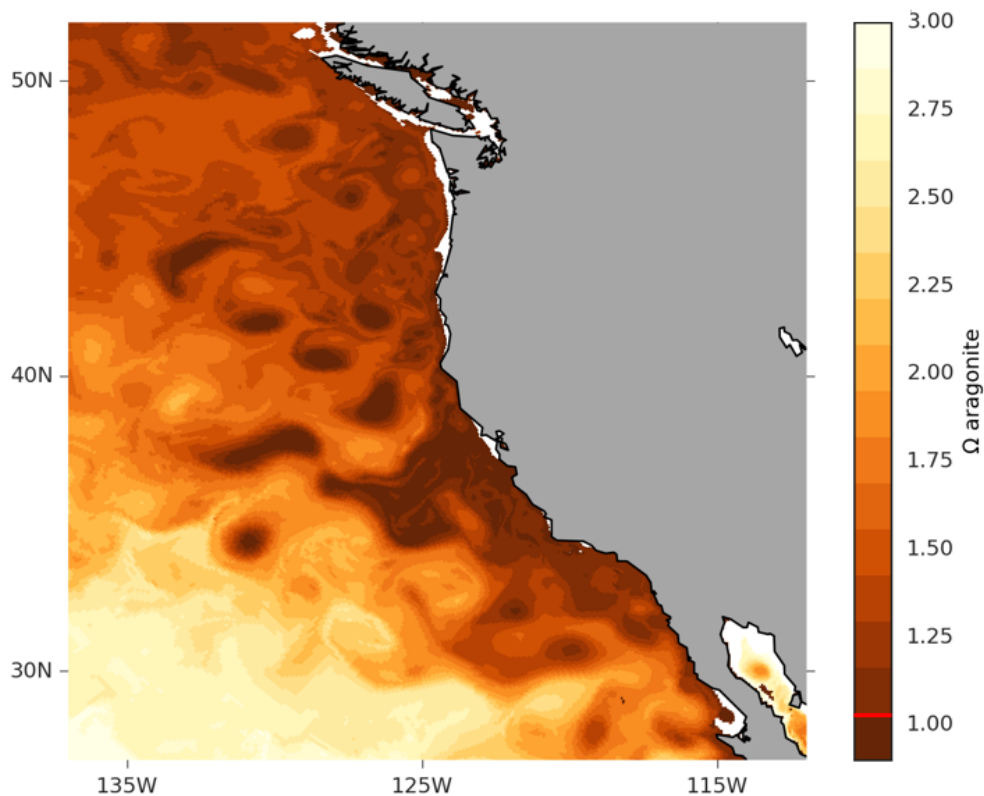


Heat map of the degradation rates (k) of the four investigated microbial communities (BU, BD, HU & HD) for a selection of compounds. The plot has been level scaled, in order to emphasize the differences between the investigated communities. Clustering of several compound groups is visible.

A8 Flora Desmet

Ocean acidification extreme events in the California Current System

Due to a long term decrease in surface pH associated with the uptake of anthropogenic CO_2 , ocean acidification in the California Current System (CCS) results in a substantial shoaling of the aragonite saturation horizon (i.e. the depth at which $\Omega_{\text{arag}} = 1$). While the saturation horizon remains mostly below 100m, extreme events can raise it to very shallow depths, negatively affecting calcifying organisms throughout the water column. Here, we use a high-resolution physical-biogeochemical regional ocean model (ROMS-BEC) to investigate the spatio-temporal distribution of aragonite undersaturation extreme events in the CCS, along with their duration, intensity, extent and severity. We further investigate the physical and biogeochemical drivers of variability of undersaturation events for the present ocean.



Snapshot of Ω_{arag} saturation level at 100m depth in the CCS for one day in May 2011 from the hindcast simulation (ROMS-BEC).

A9 Deniz Disa

Spatio-Temporal Variabilities in Coral Reef Biogeochemistry

Coral reefs contribute to the seawater carbon chemistry and CO₂ exchange with the atmosphere through photosynthesis and calcification. The physical and chemical conditions that the corals are exposed to, impact their photosynthesis and calcification rates. In order to quantify these interactions, we integrate a coral physiology module into a 3D ocean model. Our simulations for Moorea Island indicate that the metabolic rates of corals show spatial-temporal variability as a response to variabilities of environmental conditions. Light and flow rate are the two main drivers of this variability. Light-driven photosynthesis increases respiration, calcification and dissolved inorganic carbon uptake by corals lowering pCO₂ in the seawater. Flow conditions determine the material transfer between corals and seawater and restructures seawater accordingly.

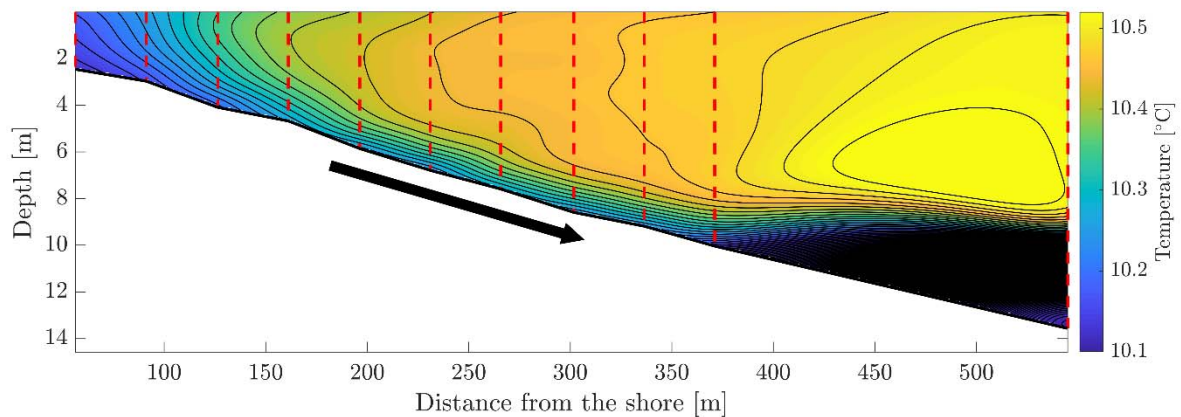


Moorea Island.

A10 Tomy Doda

Density currents induced by differential cooling in lakes: field observations

Cross-shore flows in lakes connect the littoral to the pelagic zones and can have major biogeochemical implications. An example of such currents is the “thermal siphon”, driven by horizontal density gradients due to differential cooling. Although this process has been the focus of laboratory and modelling work in the past, a parametrization of the cross-shore transport is missing in the field. The present study aims at quantifying thermal siphons in Lake Rotsee (Switzerland). Data collected in fall 2018 from thermistors chains, temperature profiles and an Acoustic Doppler Current Profiler show the temporal and spatial variability of the cold density current. Its thickness is in the order of 2 meters and its velocity can reach 3 cm/s.



Cross-shore transect of temperature measured in Lake Rotsee, on November 20, 2018 (12:20-13:00). The black lines are 0.02°C isotherms and the vertical red dashed lines show the locations of the temperature profiles.

A11 Barbara Günthardt

Suspect screening for phytotoxins – occurrence of natural toxins in surface waters

Phytotoxins are natural toxins produced by plants with varying molecular structures and toxic effects. Despite possibly high concentrations in vegetation, these compounds are only rarely monitored in the environment. Therefore, we conduct a suspect screening assessing the contamination of surface waters with phytotoxins. This far, water grab samples were taken in high vegetation (June 2018) from ten sites with different land use and high numbers of toxic plants in the catchment areas. The samples were analyzed using SPE enrichment and LC-HRMS techniques. First results indeed show the occurrence of different phytotoxins. Estrogenic isoflavones were detected at several sites in proximity to grasslands. Furthermore, we found toxic pyrrolizidine alkaloids leaching into the surface water with concentrations up to 100 ng/l.



Sampled creek surrounded by grassland containing clover from which estrogenic isoflavones are leaching.

A12 Surya Gupta

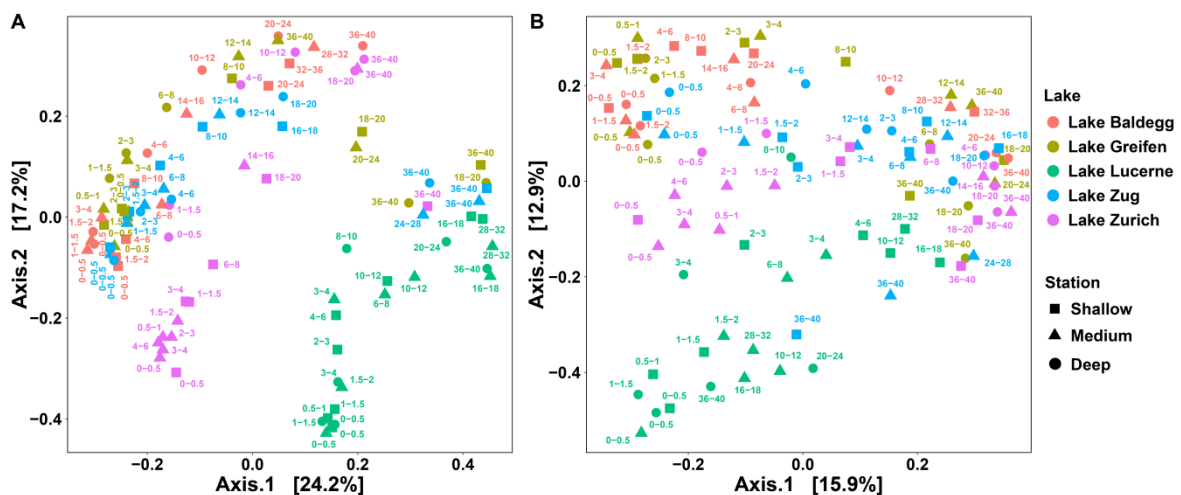
Using vegetation attributes to represent soil structure effects in pedotransfer functions

The representation of land-surface processes in hydrologic and climatic models requires soil hydraulic properties derived from auxiliary and easy-to-measure soil attributes like soil texture using pedotransfer functions (PTF). Present PTFs are deduced from measurements of small samples from arable land that omit soil structure found in forests. We capitalize on the strong links between vegetation cover and soil biological activity to propose a method for considering soil structural attributes to augment the PTFs. Remotely sensed primary productivity (GPP) and leaf area index (LAI) are used to modify soil hydraulic parameters considering soil type and climatic regions. Relationships between soil structure and hydraulic properties are developed and test procedures are devised to assess soil structural effects on hydrological and climatic processes.

A13 Xingguo Han

Eutrophication and organic matter sources control microbial communities in lake sediments

Lake sediments, well-recognized places for carbon sink, play a critical role in the global carbon cycle, which is controlled by microorganisms. However, microbial community compositions, and the relationship between them and environmental variables are less investigated in sediments of lakes with different trophic states. We investigated microbial abundances and compositions of Bacteria and Archaea and organic matter sources in surface sediments of five Swiss lakes. Results showed bacterial and archaeal compositions were quite different both along with different depths in one lake and between eutrophic and oligotrophic lakes. Meanwhile, eutrophic lakes are more abundant in aquatic organic input than oligotrophic lakes. Correlation analyses proved these differences were mainly attributed to the trophic status and organic matter sources in different lakes.



PCoA plots of bacterial (A) and archaeal communities (B) calculated based on Bray-Curtis dissimilarity method. The numbers close to the shapes indicate the sediment depths, e.g. 0-0.5 means 0-0.5 cm of the sediments.

A14 Kevin Hoffmann

Environmental conditions controlling the behavior of metal sulfide nanoparticles

In redox-dynamic environments that are subject to periods of prolonged waterlogging (river floodplains, wetlands), nanoscale precipitates of sparingly soluble metal sulfides form (Cu_xS , CdS). Depending on soil pore water composition, these natural metal sulfide nanoparticles (MS NPs) may have a crucial impact on trace metal mobility in natural environments. We performed experiments on Cu_xS and CdS nanoparticle formation using dynamic light scattering, size exclusion chromatography and transmission electron microscopy. Our results suggest that metal-to-sulfide ratio and Mn^{2+} concentration of the solution are critical for the stability of the precipitating MS NPs and that even low NOM concentrations can stabilize MS NPs against aggregation. As a consequence, the mobility of some MS NP species may be enhanced in NOM-rich natural waters.

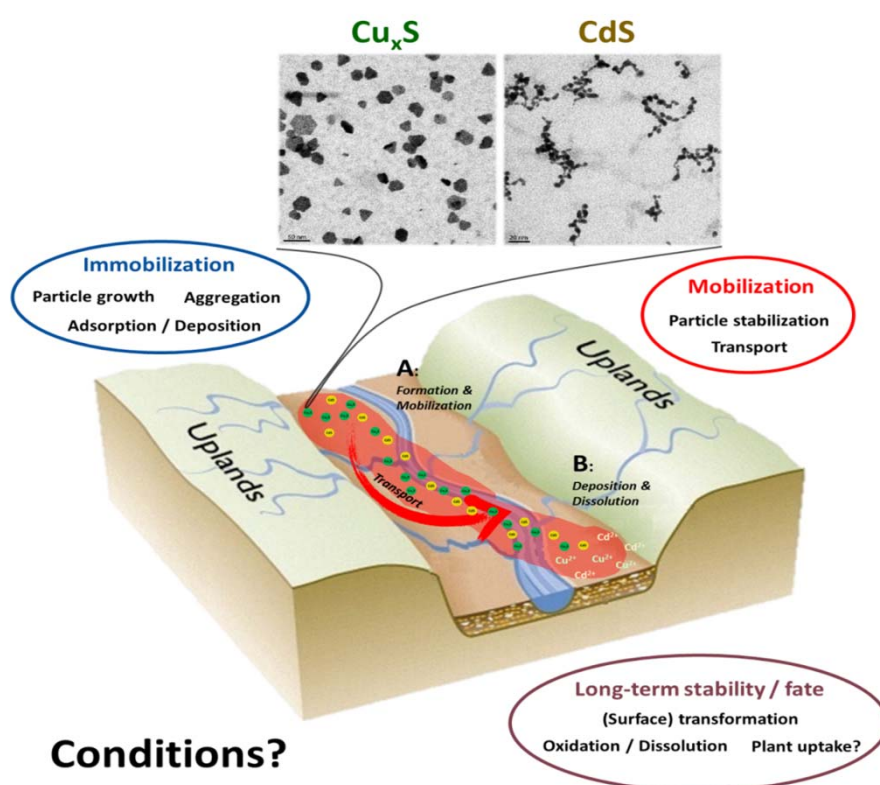
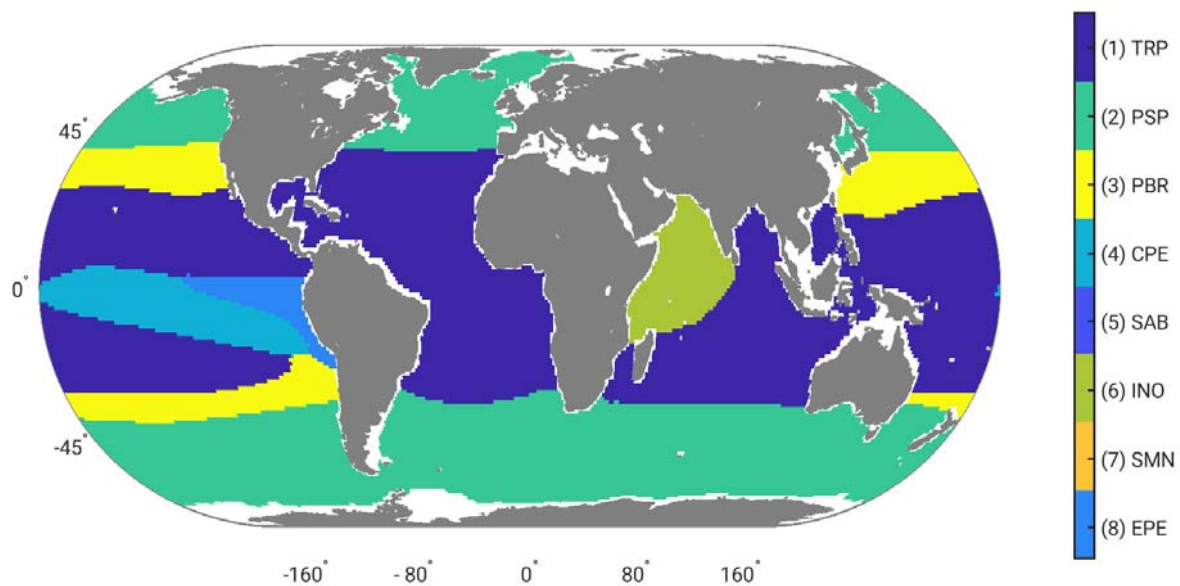


Illustration of governing processes for metal sulfide nanoparticle fate in a floodplain (top inset shows TEM images of typical nanoscale Cu_xS and CdS formed in the experiments).

A15 Urs Hofmann Elizondo

Marine biomes based on global species occurrence projections

We partition the global ocean into eight monthly and six annual oristic biomes using self-organizing maps, hierarchical agglomerative clustering, and more than 500 marine phytoplankton species habitat estimates derived from species distribution models. Each biome showed distinct phytoplankton species community compositions, with differences between biomes that follow a latitudinal gradient, which is likely related to temperature and macronutrient availability. We tested, whether the resulting biomes can be reproduced using biome-specific indicator species, or based on characteristic species co-occurrence networks. The comparison shows that in comparison to indicator species, species networks are a better predictor for our oceanic biome partitioning. The biomes we identify provide a basis for comparative analyses on the different functional roles of global ocean ecosystems



Annual distribution of plankton biomes. The distribution of each biomes was calculated based on the monthly scale distribution of the biomes, where for each 1-pixel the most frequent, unique biome was assigned as its annual biome.

A16 Edith Horstmann

Noble gas analysis of black smoker sediments

Black smokers are deep-sea hydrothermal vents, releasing hot mantle-derived fluids through chimney-like structures into the ocean. Noble gases (NG), especially helium concentrations, are a useful tool to identify the origin of fluids, as mantle-derived fluids show a uniquely high $^3\text{He}/^4\text{He}$ ratio. Fluid samples from the water column above a black smoker in the Gulf of California prove to be supersaturated in helium and are strongly enriched in ^3He . A sediment core collected in the vicinity of the black smoker was used to extract pore water for NG analysis to identify which transport process take place in the sediment. Heavy NG concentrations indicate advective transport of fluids is virtually absent, however, the pattern in the $^3\text{He}/^4\text{He}$ ratio suggests diffusive fluid transport.

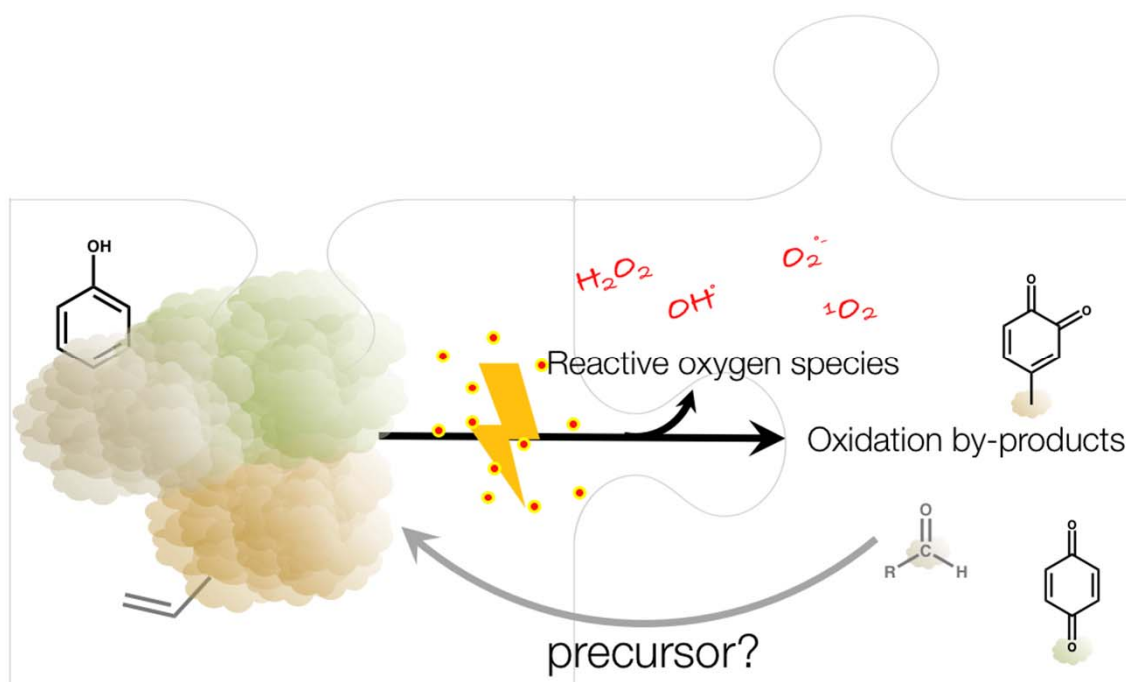


Hydrothermal vent in the Guaymas Basin, Gulf of California.

A17 Joanna Houska

An unresolved puzzle: Linking oxidation by-products in the water matrix to their precursors

The application of ozone for disinfection or abatement of micropollutants during treatment of water is accompanied by ozone reactions with electron-rich moieties in the dissolved organic matter (DOM), leading to the formation of undesired oxidation by-products (OBPs) such as low molecular weight aldehydes, ketones or quinones. Ozone applications to impaired waters as for enhanced wastewater treatment or water reuse due to water security or scarcity lead to an increase in OBPs. The formation and prediction of OBPs from DOM-precursors is still poorly understood and thus it is essential to elucidate the corresponding DOM moieties. We use oxidant selectivity and modeling efforts to determine the concentrations of reactive DOM moieties, elucidate OBPs and link them to their precursor moieties by using isotope ratio mass spectrometry and high-resolution mass spectrometry.

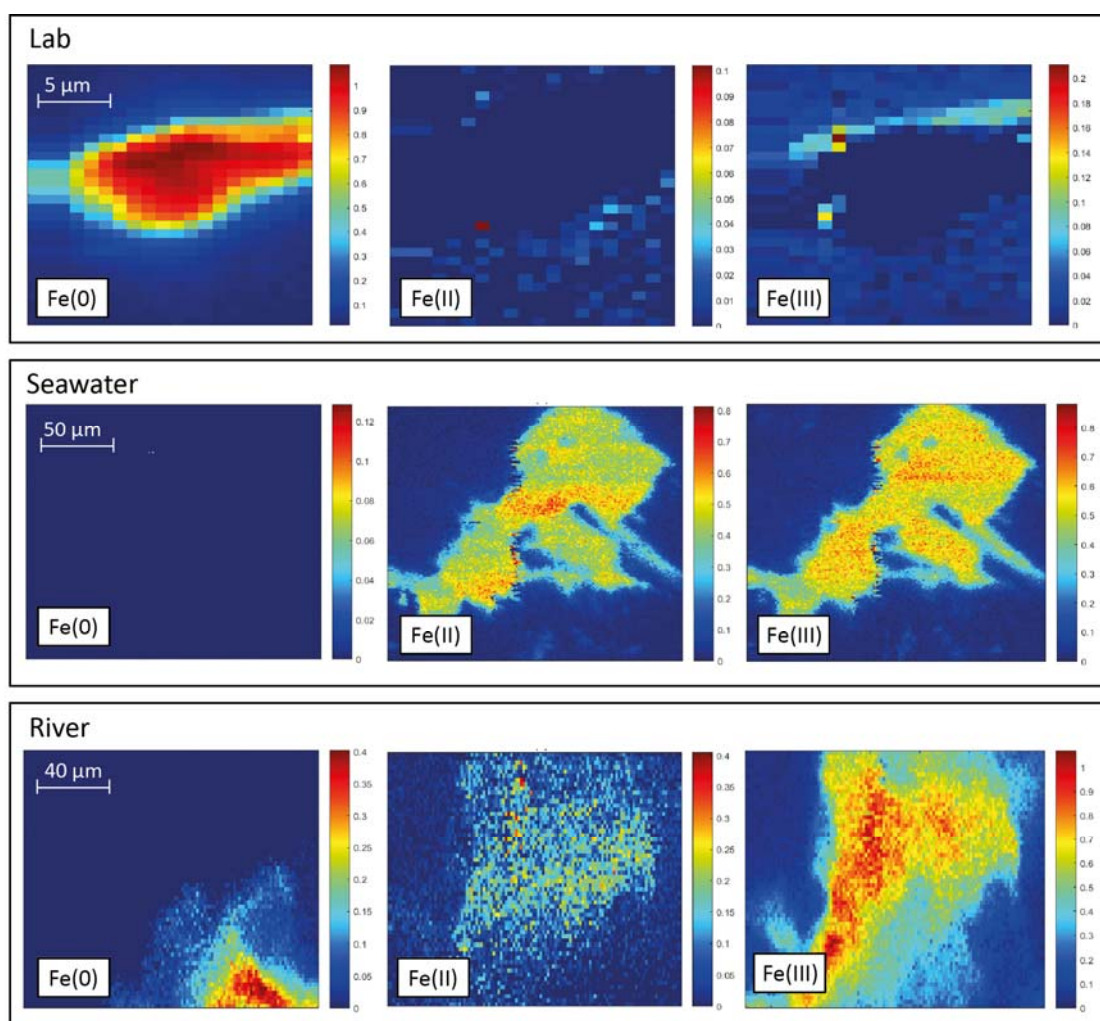


A18 Andrea Mancini

The fate of iron in cementitious environments

Cement manufacture contributes to over 7% global anthropogenic CO₂ emission due to the large volume of Portland cement produced annually worldwide. A reduction of this carbon footprint is achieved by replacing part of the clinker by inorganic supplementary cementitious materials, such as ground granulated blast furnace slag (GGBFS), a by-product of the iron-making industries. With time, iron particles will undergo corrosion, but the rate of corrosion and the kind of corrosion products generated is still unknown.

Synchrotron-based techniques were employed to investigate the speciation of iron in GGBFS cements under various conditions (lab, seawater and river water; see figure). Wet chemistry and spectroscopic experiments were carried out in order to determine the interaction of Fe(III) with the single cement phases.

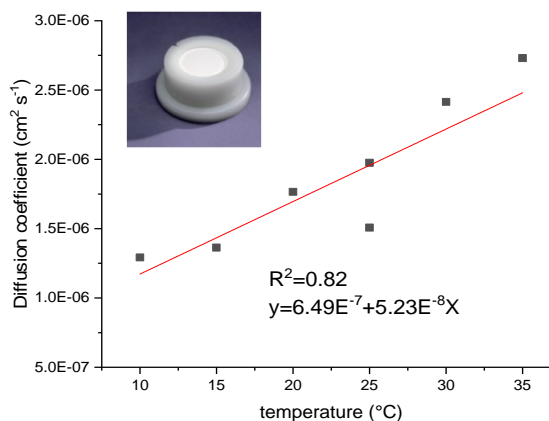


Iron redox mapping of three cement samples hydrated for different time and exposed to different environmental conditions

A19 Xingyu Liu

Sampling of labile As(III) in Chinese paddy rice soils using DGT technique

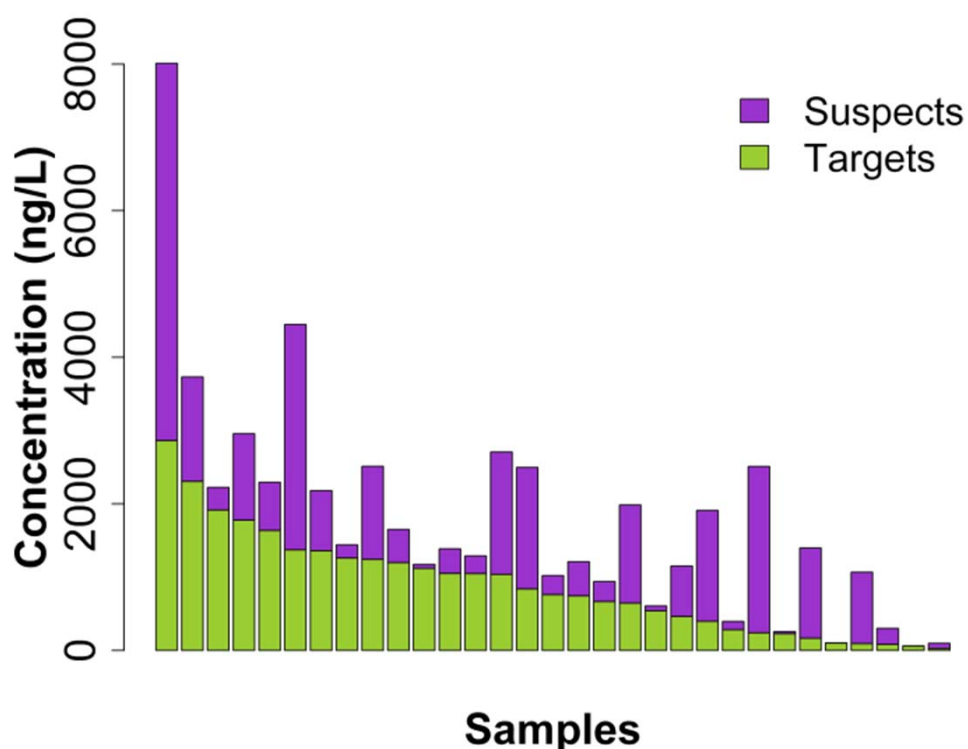
Inorganic arsenic (As) in paddy soils is a major problem for paddy rice production in many parts of Asia, especially due to the mobility and high phytoavailability of As(III). We sampled As(III) in situ using the diffusive gradients in thin films technique (DGT) in selected paddy rice fields in China. In laboratory experiments, the temperature dependence of As(III) diffusion into DGT samplers was determined at relevant environmental temperatures and diffusion coefficients were calculated to improve the accuracy of field measurements. First results indicate a relatively steep (pseudo-linear) increase of diffusion coefficients with temperature. We found As(III) diffusion coefficients at 35°C to be 2.5 times higher compared to measurements at 10°C. Accordingly, field DGT measurements of As(III) were refined, improving the results on As(III) phytoavailability.



B1 Karin Kiefer

Broad Groundwater Screening Reveals New Pesticide Transformation Products

Agricultural and urban land use threatens groundwater quality and thereby drinking water supply. However, groundwater quality regarding organic micropollutants, especially pesticide transformation products (TPs), is often insufficiently assessed due to the lack of appropriate analytical methods and reference material. Therefore, we performed a comprehensive target and suspect screening for more than 250 urban micropollutants, 300 pesticides, and 1100 pesticide TPs using liquid chromatography coupled to high resolution mass spectrometry. We detected twelve pesticide TPs which were so far rarely mentioned in literature or not known at all to be present in groundwater. One newly identified TP of the fungicide chlorothalonil was the only micropollutant detected in all samples, partially at relatively high concentrations, even in aquifers with low anthropogenic impact.



Total concentration of targets and confirmed suspects in the 31 groundwater samples indicating the importance of screening for suspects in addition to targets.

B2 Hannah Kleyer

Trends in bacterial community stability-diversity under hydration cycles in porous media

Central role of soil hydration in controlling microbial diversity and function was studied with focus on static effects on spatial arrangement of soil microhabitats. We hypothesized that hydration dynamics will affect species abundance and composition of a well-defined 11 member bacterial community. We compared constantly dry/wet conditions with two repeated 6-days cycles of drying and rewetting, mimicking soil conditions following irrigation or rainfall. Results illustrate main changes in community composition within the first 2 days irrespective of hydration and nutrient conditions. The initially even bacterial community became dominated by *Arthrobacter* and *Pseudomonas* species under all conditions, while other species (*Bacillus subtilis*, *Micrococcus luteus*) rapidly declined. Several species thrived under constant wet conditions while others were more abundant under dynamic regimes, supporting our hypothesis. This work demonstrates that hydration dynamic in soil-like habitats play an important role in shaping soil bacterial community composition. The dominance of community selection by the physical environment stands in stark contrast to behaviour in well-mixed laboratory studies.

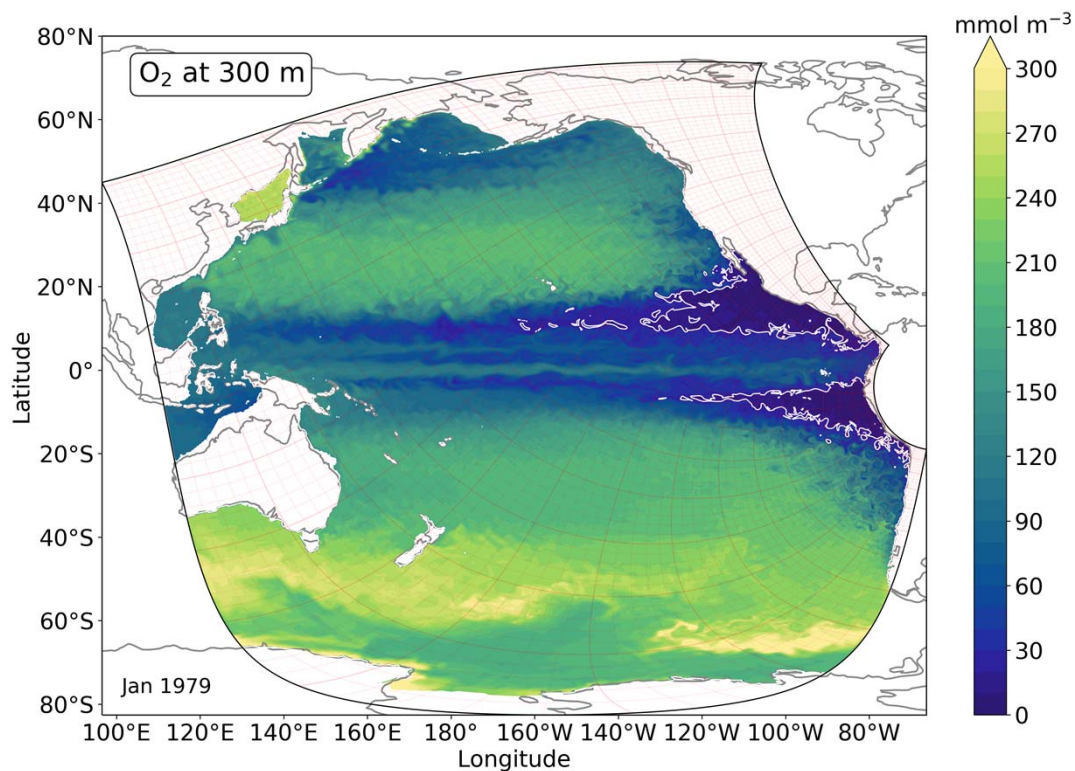


SEM micrograph showing bacterial community colonizing a soil-microcosm

B3 Eike Köhn

Oxygen extreme events in the Eastern Tropical Pacific

Anthropogenic global warming entails an oceanic loss of oxygen, increasing the likelihood of marine low oxygen extreme events. In the Eastern Tropical Pacific (ETP), the long-term expansion and intensification of the naturally occurring oxygen minimum zones (OMZs) induces an increase in low oxygen extremes, during which large volumes of water can be pushed to hypoxic levels. These extreme conditions can trigger biogeochemical reactions leading to the loss of fixed nitrogen, a crucial ingredient to marine productivity. Using a regional physical-biogeochemical ocean model (ROMS-BEC) and a hindcast simulation from 1979-2016, we study the frequency and characteristics of low oxygen extreme events in the ETP. We find that low oxygen mesoscale eddies can be hotspots for fixed nitrogen loss even outside the highly deoxygenated OMZ cores.



Snapshot of O_2 distribution in mmol m^{-3} at 300 m depth during the ROMS-BEC hindcast in the Pacific basin. The faint red lines show the model's underlying telescopic grid with the pole located on the South American continent. The white contour lines mark the 20 mmol m^{-3} oxygen level and outline the oxygen minimum zones of the ETP.

B4 Alexandra Lightfoot

The Role of Gases in an Arsenic Contaminated Aquifer

Gas concentrations in 21 wells at varying depths and locations were taken in Van Phuc, Vietnam, with the miniRUEDI; a portable mass spectrometer capable of measuring noble gases; He, Ar, Kr, and additional gases; H₂, CO₂, CH₄, N₂ and O₂. Results show a clear depletion of the gases Ar, Kr and N₂, with increased CH₄ concentrations. He, shows the opposite behaviour such that it increases in concentration as CH₄ saturates. The conceptual picture these results indicate, is that the production of Methane bubbles reduce the hydraulic conductivity in the aquifer; allowing enough time for He to accumulate, whilst simultaneously depleting Ar, Kr and N₂ in the groundwater as a result of their partitioning into the CH₄ gas bubbles. CH₄ monitoring is especially important, since its production is thought to be microbial; the same mechanism believed to be controlling Arsenic mobilisation into groundwaters at this site.

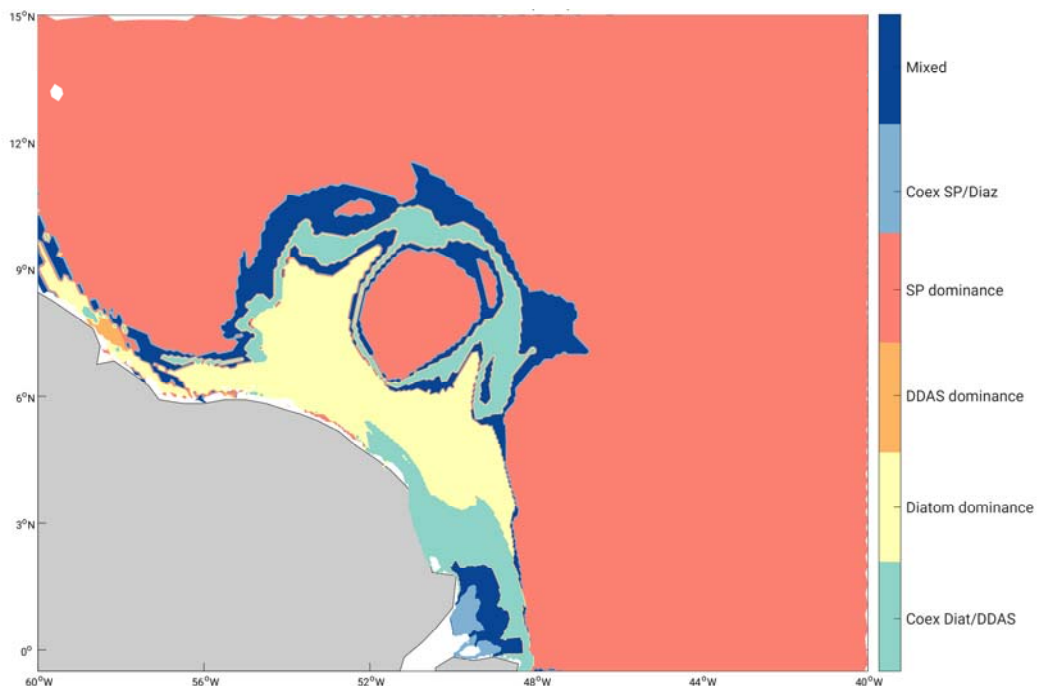


Fieldsite: Van Phuc, Vietnam; taking measurements of gases in groundwater using the miniRUEDI portable mass spectrometer.

B5 Domitille Louchard

Phytoplankton community structure and carbon export in the Amazon River plume

In the Tropical Atlantic Ocean, anomalously low pCO₂ values are observed in areas influenced by the Amazon River. As a result, these plume waters act as a sink of atmospheric CO₂. To unravel the complex interplay between physical and biogeochemical processes that leads to this unique effect of the Amazon plume, we use an eddy-resolving configuration of the Regional Ocean Modeling System incorporating a biogeochemical module. As expected, the large input of riverine nutrients leads to a substantial enhancement of the phytoplankton production in the otherwise oligotrophic tropical waters, providing new pathways for carbon sequestration. However, our results show that the efficiency of this biological pump is highly dependent on the phytoplankton community structure that shifts along the plume continuum.

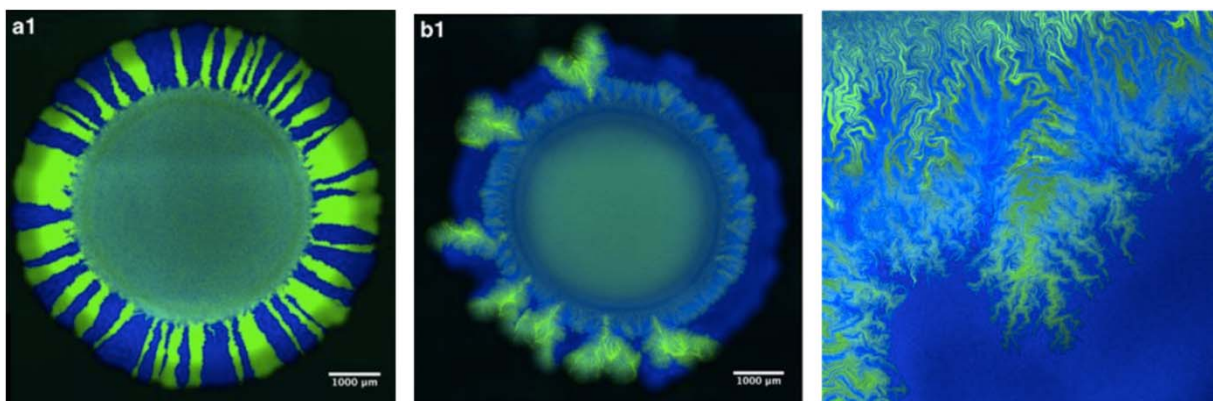


Phytoplankton community structure in the Amazon River plume region (mean state for the month of July). Diat stand for diatoms, DDAs for Diatom-Diazotroph Assemblages, SP for Small phytoplankton and Diaz for diazotroph.

B6 Yinyin Ma

Evolvability of spatial self-organization during microbial range expansion

Spatial self-organization (SSO) during microbial range expansion is the consequence of the collective dynamic behavior of surface-attached microbes. SSO refers to processes by which organisms arrange themselves non-randomly across space. SSO is determined by the local environmental conditions and the interactions that occur between genotypes. However, it remains unclear whether SSO is an evolvable trait (i.e., whether it can change in response to genetic changes). Here, I would like to investigate whether SSO is evolvable *per se* over time using experimental evolution. I will perform microbial range expansion experiments with a synthetic microbial community consisting of two genotypes. By consistently transferring the expanding colonies, I will quantify the observed changes in SSO and identify the targets of evolution.

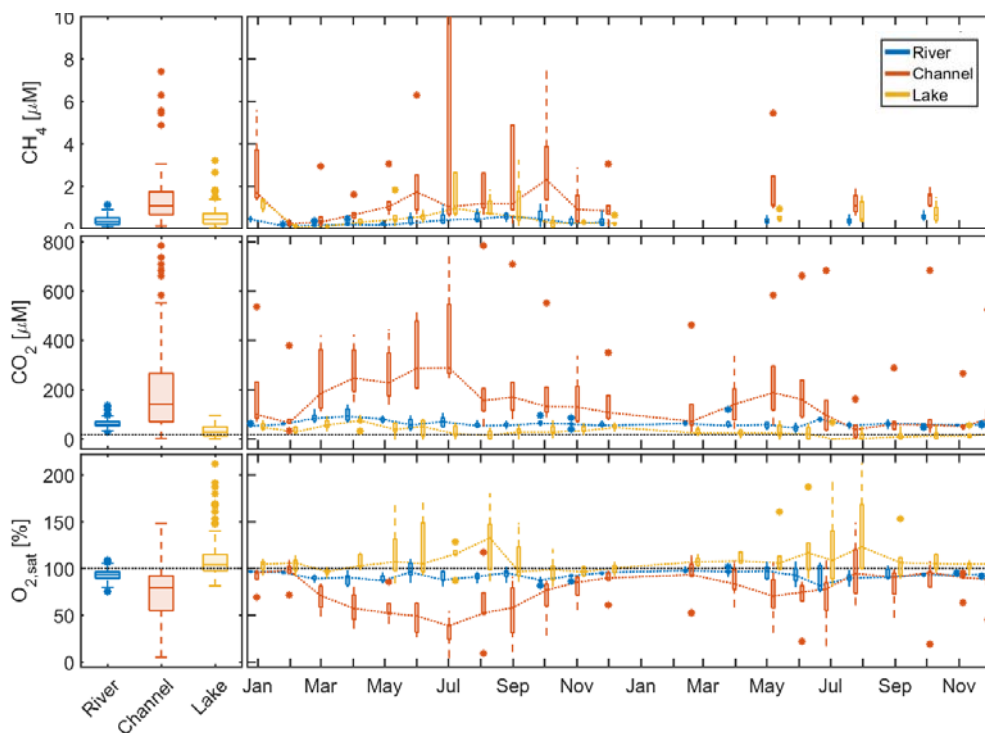


Spatial self-organization is determined by the interactions that occur between microbial genotypes. Different interactional modes will result in different SSO.

B7 Marie-Sophie Maier

Carbon cycling in different aquatic compartments of the Danube Delta

The Danube Delta in Romania is Europe's second largest river delta. Its heterogeneous assemblage of main river branches, small channels and shallow lakes releases greenhouse gases like carbon dioxide (CO₂) and methane (CH₄) to the atmosphere. To disentangle the Delta's complex carbon cycling, we monitored CH₄ and CO₂ concentrations and fluxes, together with other biogeochemical parameters of interest. Our two-year monitoring had a monthly time resolution and covered 19 sampling stations in the different aquatic compartments. The amount of carbon that is released varies strongly between the three different aquatic compartments, which can be linked to their characteristics: small channels receiving water from adjacent wetlands contribute disproportionately to the Delta's carbon footprint, while lakes with abundant macrophytes growth take up CO₂ in summer.

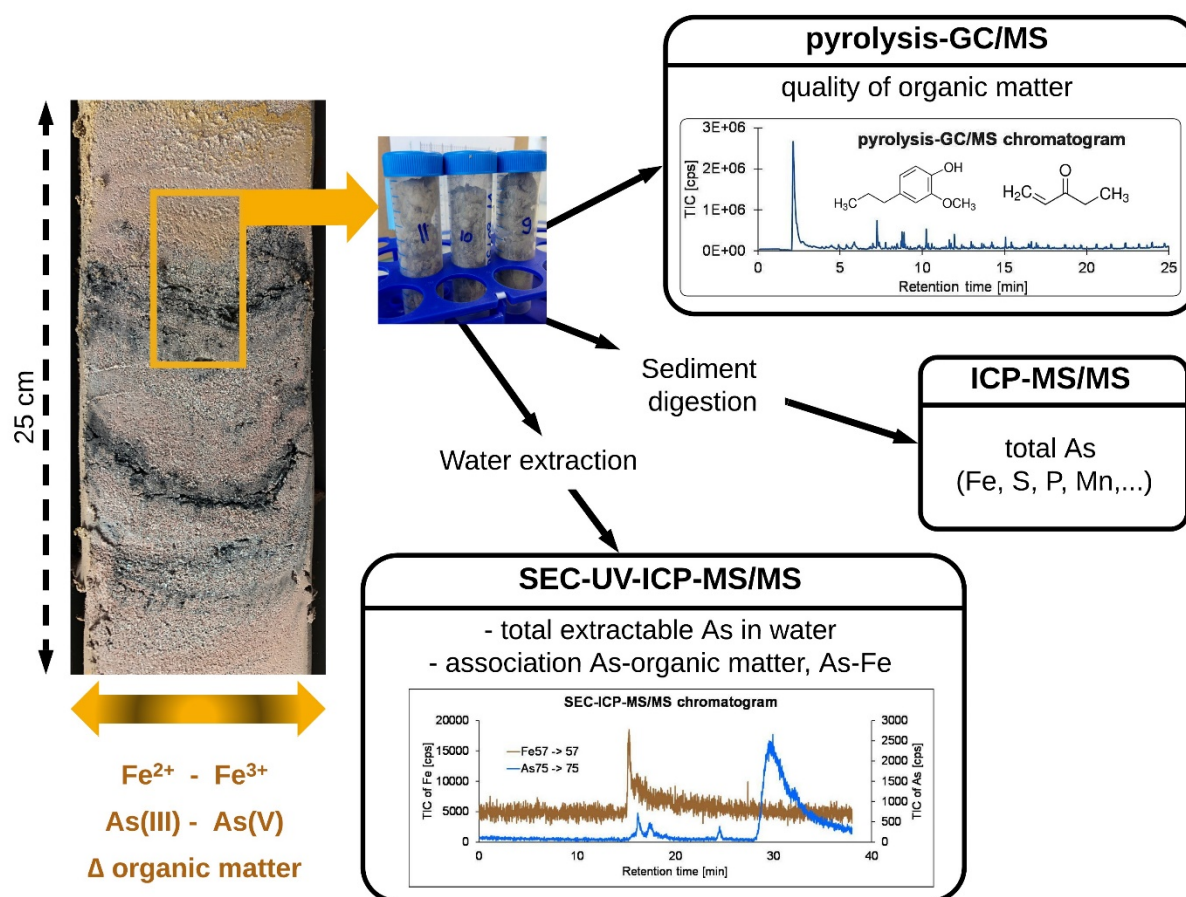


CH₄ and CO₂ concentration in μM and O₂ saturation measured in the Danube Delta over two consecutive years. Measurements are grouped into aquatic compartments ($n_{\text{river}} = 7$, $n_{\text{channel}} = 6$, $n_{\text{lake}} = 6$) for the whole observation period (left panel) and for individual months (right panel), respectively.

B8 Karin MacKevett

Effects of organic matter quality on arsenic (im)mobilisation

In South and Southeast Asia, millions of people are exposed to groundwater contaminated with Arsenic (As). The degradation of sedimentary organic matter (OM) coupled with the reduction of iron minerals is known to promote the release of As from sediments into groundwater. However, OM may also constitute a direct source of As and, on the other hand, may sorb As leading to its immobilisation. To achieve a better understanding of the role of OM in As (im)mobilisation, we currently investigate the relationship between OM quality and As speciation in a sediment core from the Red River Delta in Vietnam. In this poster, the latest results from combined ICP-MS/MS, SEC-UV-ICP-MS/MS and pyrolysis-GC/MS analyses will be presented.

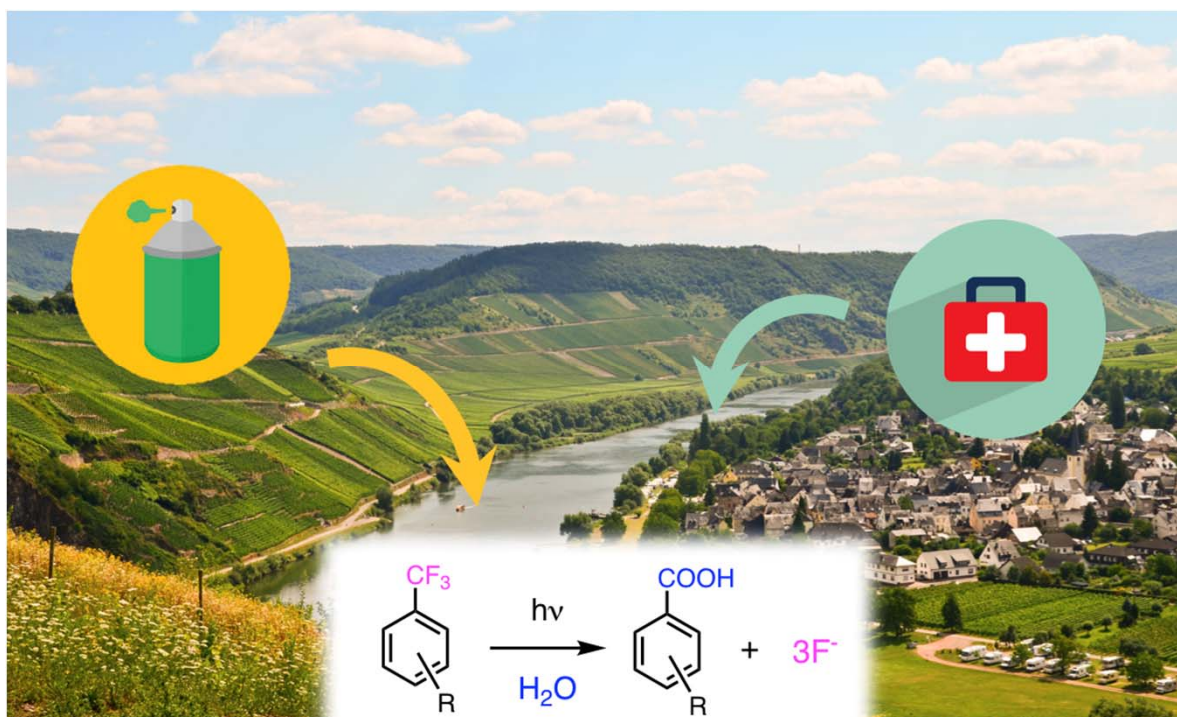


Picture of sediment core section (example from 42.5 – 42.75m depth, photo taken in Van Phuc, Vietnam, 2018; credit to Dr. Michael Berg). Scheme of work flow from sediment sampling to final analysis.

B9 Alessandro Manfrin

Substituent effect on the direct photodegradation of benzotrifluorides

Benzotrifluoride moieties are used since last decade in pharmaceutical and agricultural products. In the last 10 years, the turnover generated by benzotrifluoride drugs increased tenfold, naming them a new class of potential water contaminants. In these terms, it is crucial to understand their environmental fate. Recent literature showed that benzotrifluorides are not stable under UV irradiation and convert into benzoic acids. It was suggested that the ring substituent may play an important role on the reactivity of the CF_3 moiety, but a direct correlation between substituents and photo-reactivity was never established. In this study we explore this structure-activity relationship to provide a tool to consciously design new drugs and pesticides and understand the fate of those already commercialized and used.

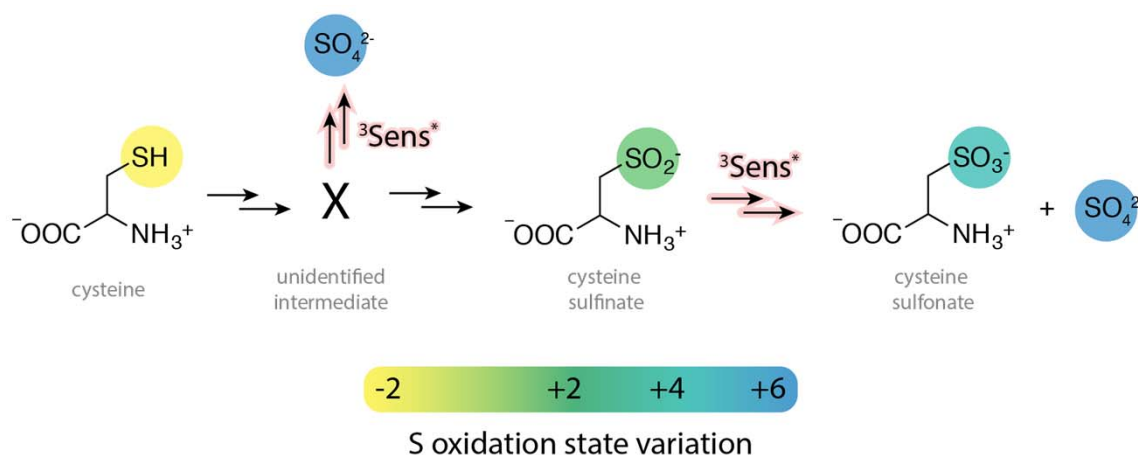


Direct photodegradation of benzotrifluoride derivatives in water.

B10 Rachele Ossola

Understanding sulfate production from photosensitized degradation of cysteine

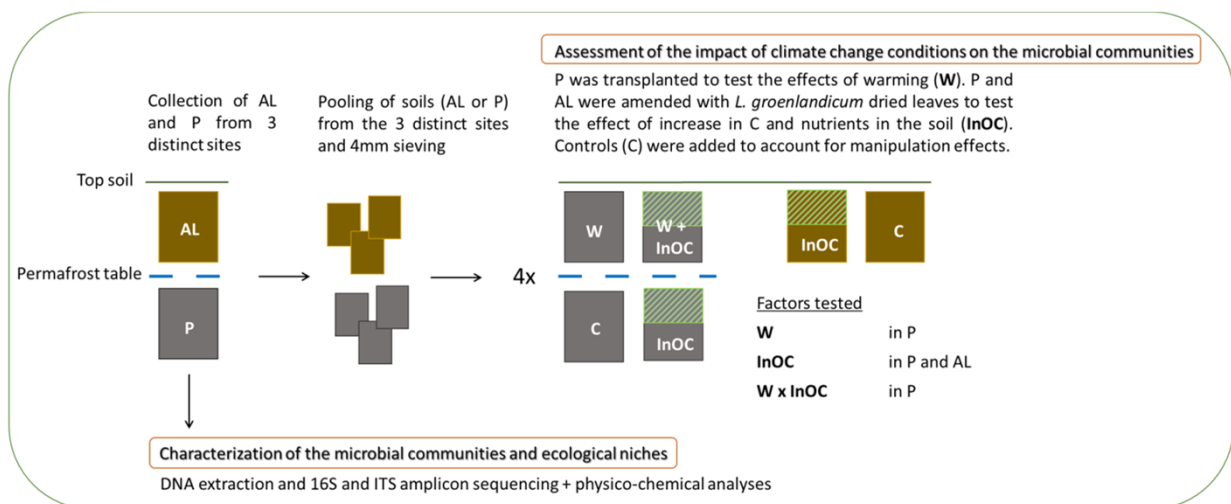
Photochemical formation of sulfate from the photodegradation of dissolved organic sulfur (DOS) occurs in a variety of freshwater environments. However, there is a lack of understanding regarding the molecular-level details behind this process. In order to address this knowledge gap, cysteine was selected as an environmentally relevant DOS model compound and was subjected to photosensitized degradation under well-defined laboratory conditions. Using state-of-the-art analytical techniques, we tracked the fate of the cysteine-S atom and we reconstructed the molecular events that ultimately lead to sulfate release. Our initial results indicate that at least two independent pathways can lead to sulfate production, which can both be initiated by triplet sensitizer-induced oxidation.



B11 Carla Perez Mon

Impact of temperatures and carbon and nutrients' increase on High-Arctic microbial communities

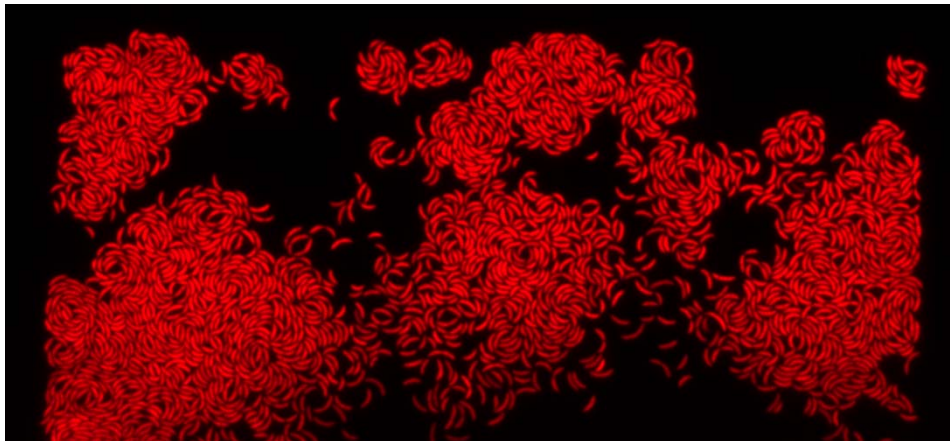
Global warming is causing the extensive thawing of permafrost in the Arctic and a greater input of carbon and nutrients in the soil, linked to the increase in the topsoil vegetation. We set-up a cross-factor field experiment to evaluate the impact of the increase in temperatures and plant-derived carbon and nutrients on under-characterized High-Arctic permafrost microbial communities (81°N). First analyses show that microbial alpha diversity is lower in the permafrost compared with the active layer. Clear compositional changes are observed for the prokaryotic communities along the soil depth gradient, while distribution of Fungi is highly heterogeneous. Evaluating the response of the microbial communities to warming is key for predicting the behavior of the soil ecosystem in the near-future.



B12 Vanessa Povoło

Drivers of metabolism-dependent growth strategy transitions in microbial collectives

How do bacteria adjust their growth strategy in response to different carbon sources and what are the molecular mechanisms involved? In natural systems, carbon is commonly stored in polymers that are too large for direct uptake by cells and need to be degraded extracellularly. The enzymes secreted by bacteria as well as the monomers that arise through enzymatic degradation are subject to loss through diffusion. Extracellular degradation of metabolites is presumably limited and inefficient for single cells. It might thus be beneficial for bacteria to form dense colonies in order to facilitate growth on carbon polymers. We use the model organisms *Caulobacter crescentus* with automated time-lapse microscopy in microfluidic devices and genetic modification to address the question above.

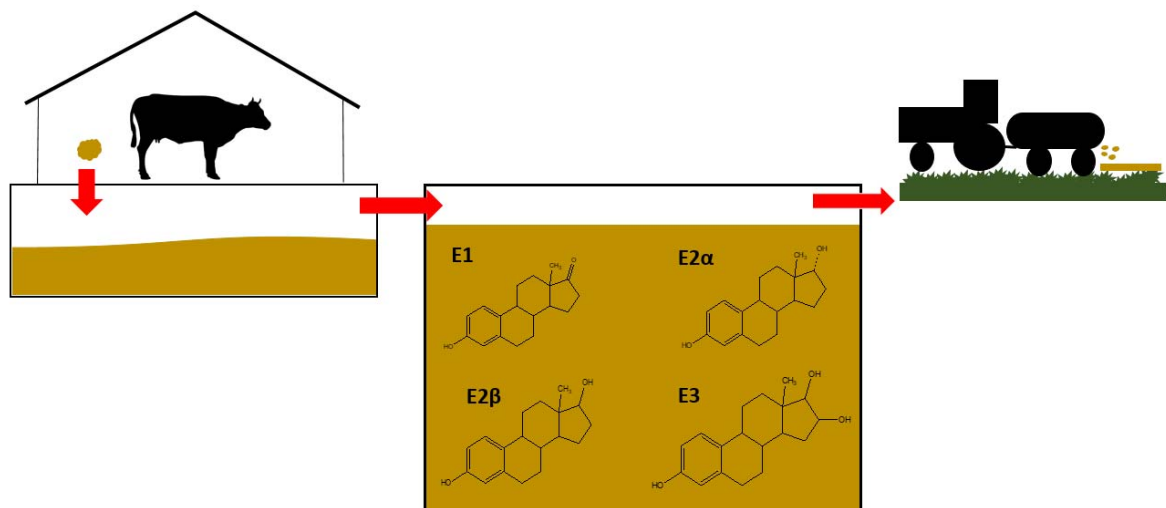


Caulobacter crescentus CB15 wildtype with constitutively expressed mKate2 growing in chambers of a microfluidics device on the xylose polymer xylan.

B13 Daniela Rechsteiner

Determination of natural estrogens in Swiss cattle and pig manure

Estrogens in surface waters have negative effects on the reproduction and development of aquatic organisms. Several studies in different countries have demonstrated that the application of manure from husbandry animals to soil causes the release of natural estrogens to surface waters. Therefore, we quantified the load of natural estrogens in cattle and pig manure with LC-MS/MS to estimate the natural estrogen input from agriculture to the environment. We collected samples of different pig and dairy farming manure storage pits to determine natural estrogen concentrations in Swiss manures. Additionally, over a period of three months we monitored natural estrogen concentrations in an experimental dairy farming manure storage pit to study the effect of aging on natural estrogen concentrations in manure.

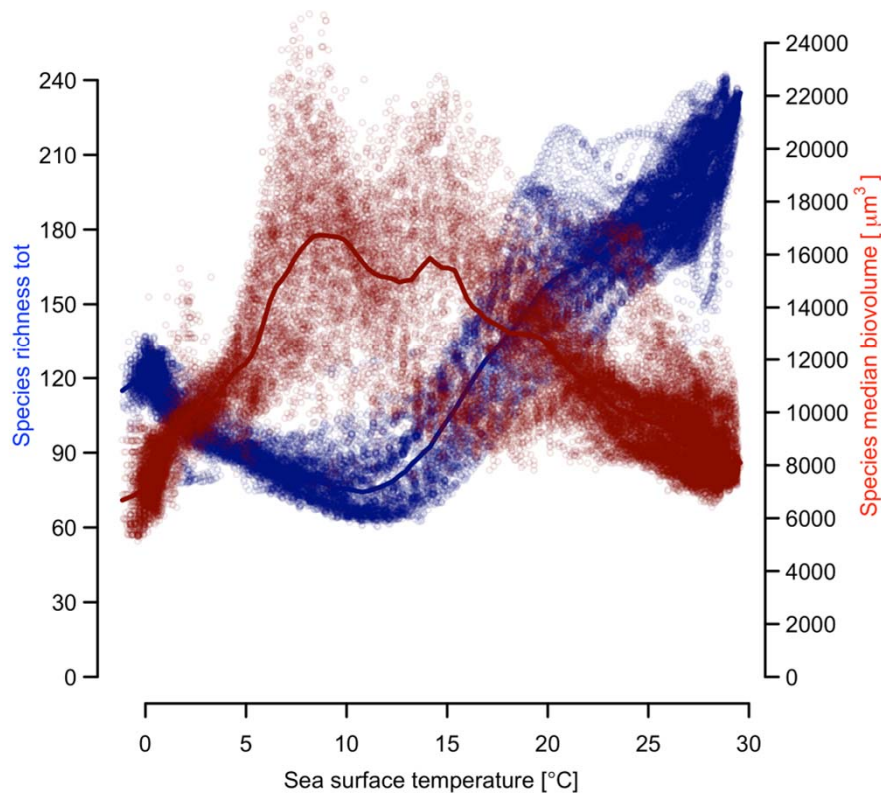


Fate of natural estrogens in manure and their emission to the environment.

B14 Damiano Righetti

Global patterns of phytoplankton diversity

The global diversity pattern of phytoplankton in the world's ocean has remained elusive despite its potential importance for ocean ecosystem function and global productivity. One long-standing tenet is that temperature controls global gradients of biodiversity, since it drives the pace of metabolisms. Yet, recent planktonic studies in the Atlantic provided no confirmatory evidence. Over a large fraction of the ocean, I confirm that the potential species richness of phytoplankton (inferred from *in situ* data on >500 species, and species distribution modeling) scales positively with temperature (blue dots in figure below). However, richness is surprisingly low at intermediate latitudes (~11°C). There is also strong global variation in cell size (red dots in figure below). Macroecological patterns of phytoplankton species richness and their thermal scaling may be altered by biotic interactions and by physical selection in turbulent ocean regimes, coincident with these mid latitudes.



Phytoplankton cell size and richness are inversely related in the global ocean.

B15 Lena Schinkel

POPs in microplastics in the South Atlantic gyre and their environmental risks

Plastic materials can enter the aquatic environment and disintegrate over time into smaller particles, so called microplastics (MP, < 5 mm). MP poses risks to aquatic organisms when being ingested. In addition, MP can act as a Trojan horse transporting persistent organic pollutants (POPs) and other toxic organic compounds. Original plastic items might already contained chemicals used as additives. MP can also act as a passive sampler for lipophilic pollutants present in the water phase. We investigate relations between POPs and MP in the South Atlantic gyre and assess environmental risks. For this, we sampled microplastics, larger plastic items, sea water, sediment and biomass during a sampling period of three weeks covering a distance of about 5000 km.

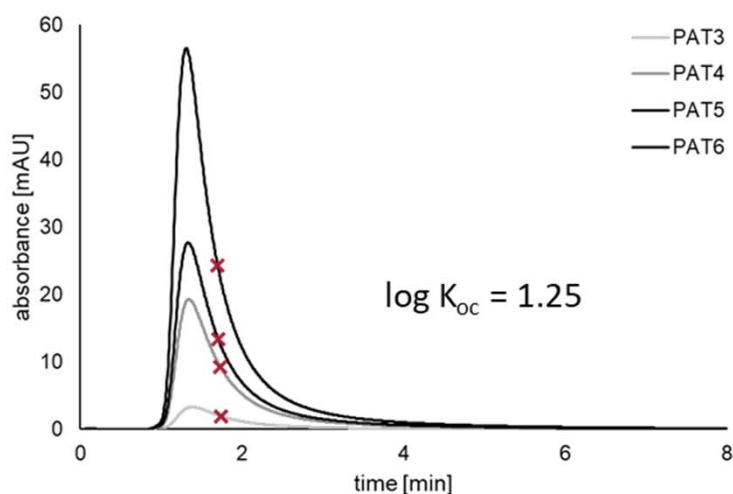


A manta trawl is used to collect microplastics. (Photos by Phillippe Delandmeter and Hans Limburg.)

B16 Carina Schönsee

Using column chromatography to assess natural toxin mobility in the aquatic environment

Over 34% of plant toxins fulfill the criteria for aquatic persistency, mobility and toxicity based on predicted property data. As prediction tools show limited applicability, experimental evaluation of the organic carbon-normalized sorption coefficient (K_{oc}) as primary mobility parameter is crucial in reliable risk assessment. Column chromatography was applied in the systematic evaluation of sorption behavior of a large diverse set of natural toxins to organic matter. Experimental conditions varied to study effects of e.g., temperature and pH on K_{oc} . Results shows that column chromatography is a suitable method for quantitative, reproducible sorption analysis of large sets of mobile compounds ($\log K_{oc}$ between 0.5 and 3.5). Analyzed phytotoxins are highly mobile and thus should be included in monitoring campaigns.

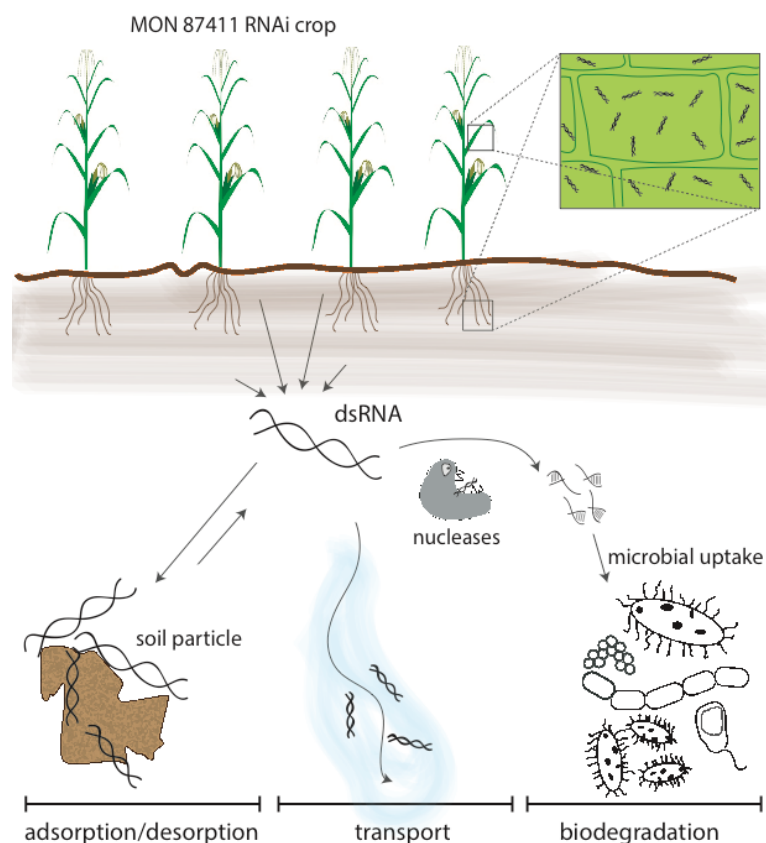


Picture of the column packing process and one representative chromatogram of the mycotoxin Patulin (PAT) with a $\log K_{oc}$ of 1.25.

B17 Katharina Sodnikar

Fate of double-stranded ribonucleic acid (dsRNA) plant incorporated protectants (PIPs) in agricultural soils

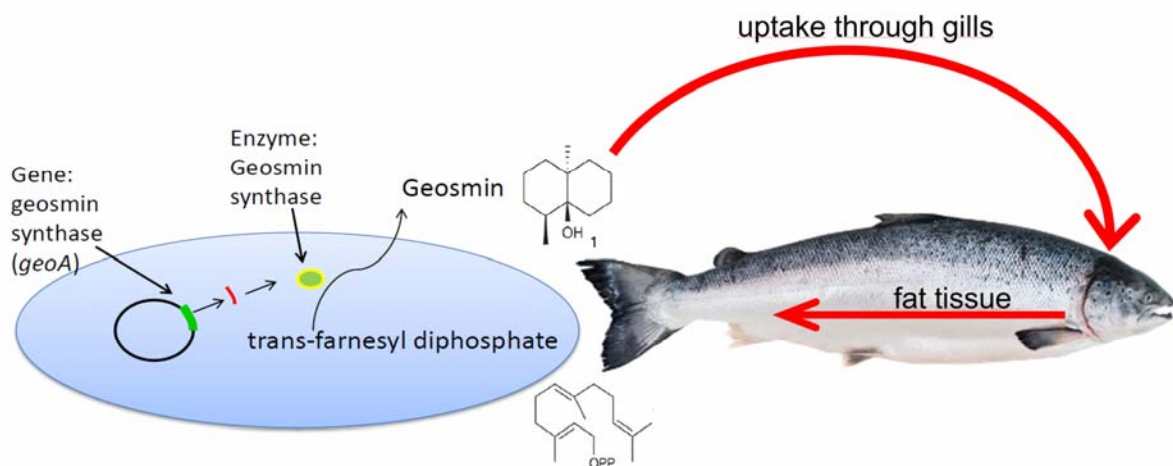
Next generation crop protection technology uses genetically-modified crops that express insecticidal dsRNA as PIPs. However, the environmental fate of these molecules in agricultural soils, the primary receiving environment, remains poorly understood. In my work, I assess adsorption of dsRNA to soil particle surfaces as this process affects both dsRNA transfer and transformation in soils. I complement adsorption studies of dsRNA with DNA given their structural similarities and given that the DNA fate in soils is better understood. This contribution will present results on dsRNA and DNA adsorption to iron oxide-coated quartz studied in column transport experiments. No adsorption of negatively charged dsRNA and DNA to like-charged quartz sand but significant adsorption to positively charged iron oxides are consistent with electrostatics governing adsorption.



B18 Pascal Wiesli

Off-flavour control in land-based salmon production

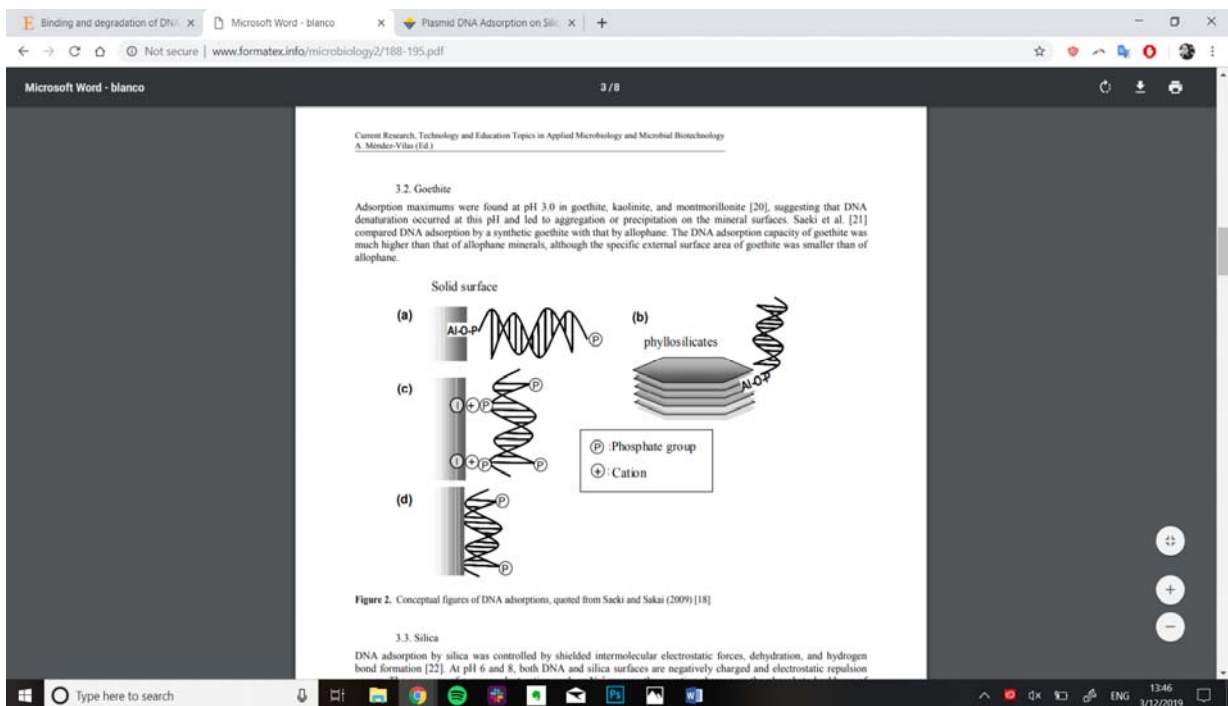
The global fish production and demand has increased remarkably in recent decades, even though capture fishery has remained constant. This is mainly due to the fact that the aquaculture sector has grown and increased its contribution to global fish supplies. But traditional aquaculture systems (e.g. open flow-through containments, artificial ponds, or marine net-cages) can also have serious negative environmental effects. In contrast, the novel recirculating aquaculture (RAS) technology is often regarded as a more environmentally friendly alternative. Despite a number of advantages, RAS has several economic limitations. A major drawback is the accumulation of off-flavours in filets of fish bred within these systems. One main goal of my PhD project is to investigate off-flavour sources and assimilation into salmon biomass.



B19 Lin Boynton

The effect of solution chemistry on DNA adsorption to soil minerals

With the United Nations predicting the world population to reach nearly 10 billion by 2050, global food security is a pressing concern. Genetic modification (GM) offers ways to improve crop yields and a new generation of plant-incorporated protectant technology using insecticidal double-stranded ribonucleic acid (dsRNA) has recently been developed. In order to assess the environmental fate of this new technology, research is needed to characterize the processes affecting dsRNA in agricultural soils, the primary receiving environment. The objective of this work is to assess adsorption of nucleic acid molecules to common soil minerals such as silica, iron oxide, and aluminum (hydr)oxide using batch experiments. The results presented here focusing on aluminum (hydr)oxides show that more genetic material adsorbs to surfaces at lower pH, higher ionic strength, and in the presence of divalent (Mg^{2+}) cations.



Conceptual drawing from Saeki and Kunito 2010.