BayCEER Workshop 2022

13.10.2022

Book of Abstracts

University of Bayreuth, NW III

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Organization:

BayCEER
University of Bayreuth
95440 Bayreuth

UNIVERSITÄT BAYREUTH

Bayceer
Bayreuth Center of Ecology and Environmental Research

Programm

Thursday, 13.10.2022

Time	H 36
08:45	**Registration Start (Foyer NW III)**
09:30	**Workshop Opening & Welcome Message** **Prof. Dr. Stefan Peiffer, BayCEER Director**
09:45	**"BayCEER Early Career Research Recognition - Excellent Doctoral Research"** Chair: Stefan Peiffer D 1.1: **Sebastian Steibl**: Biodiversity, ecology, and human land use on atolls
10:05	D 1.2: **Saskia Klink**: Tracing soil carbon and nitrogen cycling in arbuscular and ectomycorrhizal systems
10:25	O 1.3: **Stefan Peiffer**: Big money meets geoengineering - the challenges for environmental and ecological research
10:40	**Poster presentation in "Lightning Talks"**
10:55	**Morning Poster Session**
11:30	**"Morning Session"** Chair: Tillmann Lüders O 2.1: **Efstathios Diamantopoulos et al.**: Modeling the environmental fate of the natural toxin ptaquiloside: production, release and leaching to groundwater
11:45	O 2.2: **Emeka Emecheta**: Adsorption and Desorption of Persistent Organic Pollutants to and from Micro- and Nanoplastics (MNPs): Implications for human exposure to MNPs.
12:00	O 2.3: **Peter Stimmler**: aRctic: Generating elemental maps of the Arctic using the R Markdown function
12:15	O 2.4: **Nicolas Tyborski et al.**: Selection of the bacterial microbiome at the soil-root interface compared among varieties of Zea mays L.

12:30	**Lunch**
14:00	**"Afternoon Session"** Chair: Steven Higgins O 3.1: **Frank Weiser et al.**: Impact of volcanic sulfur and ash emission on the flora of La Palma, Spain
14:15	O 3.2: **Anna Walentowitz et al.**: Paleoecological trajectories of non-native vegetation on islands
14:30	O 3.3: **Veronika Mitterwallner et al.**: Human-wildlife interactions: The potential of AI and camera trapping
14:45	O 3.4: **Ridwan Adeyemi Shittu et al.**: Composition of mosquito species in a Mediterranean wetland: modeling the effects of species interactions and environmental parameters
15:00	O 3.5: **Nadine Arzt et al.**: Competition between honey bees and wild bees - a global literature review
15:15	**Afternoon Poster Coffee**
16:00	**Come together & BayCEER Awards Session (Foyer NW III)**

D 1.1 in *BayCEER Early Career Research Recognition - Excellent Doctoral Research*: H 36, 13.10.2022, 09:45-10:05

Biodiversity, ecology, and human land use on atolls

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Atolls form a mosaic of tiny island ecosystems stretching over vast areas of the tropical Indo-Pacific. Despite their general susceptibility to climate disruptions, various emerging success stories of atoll ecosystem restoration highlight the potential of these systems for conservation. However, atoll islands remain one of the least studied and understood terrestrial ecosystems, which greatly limits the implementation of management actions and conservation science. During my PhD, I explored fundamental aspects in atoll biodiversity and ecology, and investigated how the accelerating urbanization and tourism development on atolls alter ecosystem structure. I tested and confirmed the hypothesis that these two land uses have different impacts on atoll biodiversity, habitat and food web structure, and thus require separate management strategies in order to mitigate their environmental impacts. The focus was thereby put on the arthropod community, as it is taxonomically and functionally the most diverse species group on atolls. I showed that atoll arthropods organise in two distinct species clusters, both in terms of ecological and trophic niches, with little overlap and energy transfers occurring between them. As a result, species can experience different impacts under the two investigated land use regimes, as exemplified in a case study on terrestrial decapod crustaceans. Together, these results quantify for the first time the biodiversity loss and ecological deteriorations from two dominant land development types on atolls. Therefore, they help forming the basis for advocating for and implementing habitat protection on atolls. The findings on ecological organization and structuring are further used and integrated in ongoing atoll restoration programs to improve our understanding and the protection of this unique type of island ecosystem.

D 1.2 in *BayCEER Early Career Research Recognition - Excellent Doctoral Research*: H 36, 13.10.2022, 10:05-10:25

Tracing soil carbon and nitrogen cycling in arbuscular and ectomycorrhizal systems

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Plant-soil-microbe systems trades carbon (C) and nutrients and control the storage or release of these compounds. The intimate association of mycorrhizal fungi with plants facilitates plant nutrient provisioning, contributing to the decomposition and formation of soil organic matter (SOM). In temperate climates, dominating fungal guilds are arbuscular mycorrhizal fungi (AM), ectomycorrhizal fungi (ECM), and saprotrophic fungi (SAP). Although these fungi's distinct nutrient acquisition strategies influence nutrient cycling, SOM formation, and C and nutrient storage, the impacts of the diverse fungal guilds on these processes are still elusive. Hence, (i) the role of distinct fungal guilds on C and nutrient cycling and SOM formation and (ii) the nutrient acquisition of these fungi were investigated. For this, we applied the source and process information stable ^{13}C and ^{15}N isotopes possess, allowing to trace the origin and the fate of compounds. Collectively, this research supports the need to consider fungal guilds in predicting C and nutrient cycling and storage patterns in ecosystems.

O 1.3 in *BayCEER Early Career Research Recognition - Excellent Doctoral Research*: H 36, 13.10.2022, 10:25-10:40

Big money meets geoengineering - the challenges for environmental and ecological research

Stefan Peiffer[1]

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O 2.1 in *Morning Session*: H 36, 13.10.2022, 11:30-11:45

Modeling the environmental fate of the natural toxin ptaquiloside: production, release and leaching to groundwater

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Plants produce a diverse array of toxic compounds which may be released by precipitation, that explains their wide occurrence in surrounding soil and water. This study presents the first mechanistic model for describing the generation and environmental fate of a natural toxin, viz. ptaquiloside (PTA), a carcinogenic phytotoxin produced by bracken fern (Pteridium aquilinum L. Kuhn). The newly adapted DAISY model was calibrated based on two-year monitoring performed in the period 2018-2019 in a Danish bracken population located in a forest glade. Several functions related to the fate of PTA were calibrated, covering processes from toxin generation in the canopy, wash off by precipitation and degradation in the soil. Model results (2018-2019) show a good description of observed bracken biomass and PTA contents, indicating that toxin production can be explained by biomass and bracken development stage. The wash off is maximum in the middle of summer, coinciding with the moment of maximum biomass, fully developed canopy and highest PTA content. Model results show that only 1.7% of the PTA produced in bracken is washed off by precipitation, from both canopy and litter. Once in the soil, PTA degrades rapidly, especially during summer due to the high soil temperatures. Leaching takes place in form of pulses directly connected to precipitation events, with maximum simulated concentrations up to 1.49 µg L^{-1} at 50 cm depth. Macropore transport is responsible for the events with highest PTA concentrations, contributing to 38% of the total mass of PTA leached. Based on the results, we identify areas with high precipitation and soils characterized by fast transport, as the most vulnerable to groundwater pollution by phytotoxins.

O 2.2 in *Morning Session*: H 36, 13.10.2022, 11:45-12:00

Adsorption and Desorption of Persistent Organic Pollutants to and from Micro- and Nanoplastics (MNPs): Implications for human exposure to MNPs.

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Owing to the ubiquity of micro- and nanoplastics (MNPs), human exposure has become inevitable. While the evidence for direct adverse effects of MNPs on humans is scarce, MNPs can adsorb toxic pollutants like polycyclic aromatic hydrocarbons (PAHs) and subsequently release them under favorable conditions e.g. the human gastrointestinal (GI) tract.

To address the carrier behavior of MNPs, we investigated their sorption of PAHs using a novel third-phase partitioning (TPP) method. In brief, PAHs were incubated in water containing MNP particles and a polydimethylsiloxane-coated stir-bar until equilibrium is reached. The MNP-water adsorption coefficient for the target PAH is subsequently calculated. Benzo[a]pyrene (B[a]P) was selected as a lead substance along with dibenzo[a,l]pyrene (DB[a,l]P) and anthracene (Ant). The sorption of B[a]P to 20 MNPs was analyzed. To simulate human exposure to pollutants-contaminated MNPs, we investigated the GI bioaccessibility of MNP-sorbed PAHs using a sequential in-vitro digestive model.

Using the TPP method, we could demonstrate strong adsorption of B[a]P to MNPs which differed by over two-orders of magnitude, clustering according to polymer types. When comparing PAHs, their sorption to selected MNPs increased by over five-orders magnitude according to their hydrophobicity: Ant<B[a]P<DB[a,l]P. Regarding desorption, B[a]P's bioaccessibility increased along the GI tract. The desorption of B[a]P from PA-6 was substantial and particle-size dependent. Under the current exposure scenario, the calculated contribution of MNPs to the total PAHs intake by humans is very small (< 0.1%). The novel TPP-method can become universally applicable for fast and reliable evaluation of contaminants adsorption to micro- and nanoparticles including MNPs. Our work provides realistic estimates of the risk posed by microplastics as PAH carriers under the current exposure level but also supports a possible grouping of MNPs according to their potential risks.

Keywords: Microplastics, Nanoplastics, Adsorption, Desorption, Polycyclic aromatic hydrocarbons.

O 2.3 in *Morning Session*: H 36, 13.10.2022, 12:00-12:15

aRctic: Generating elemental maps of the Arctic using the R Markdown function

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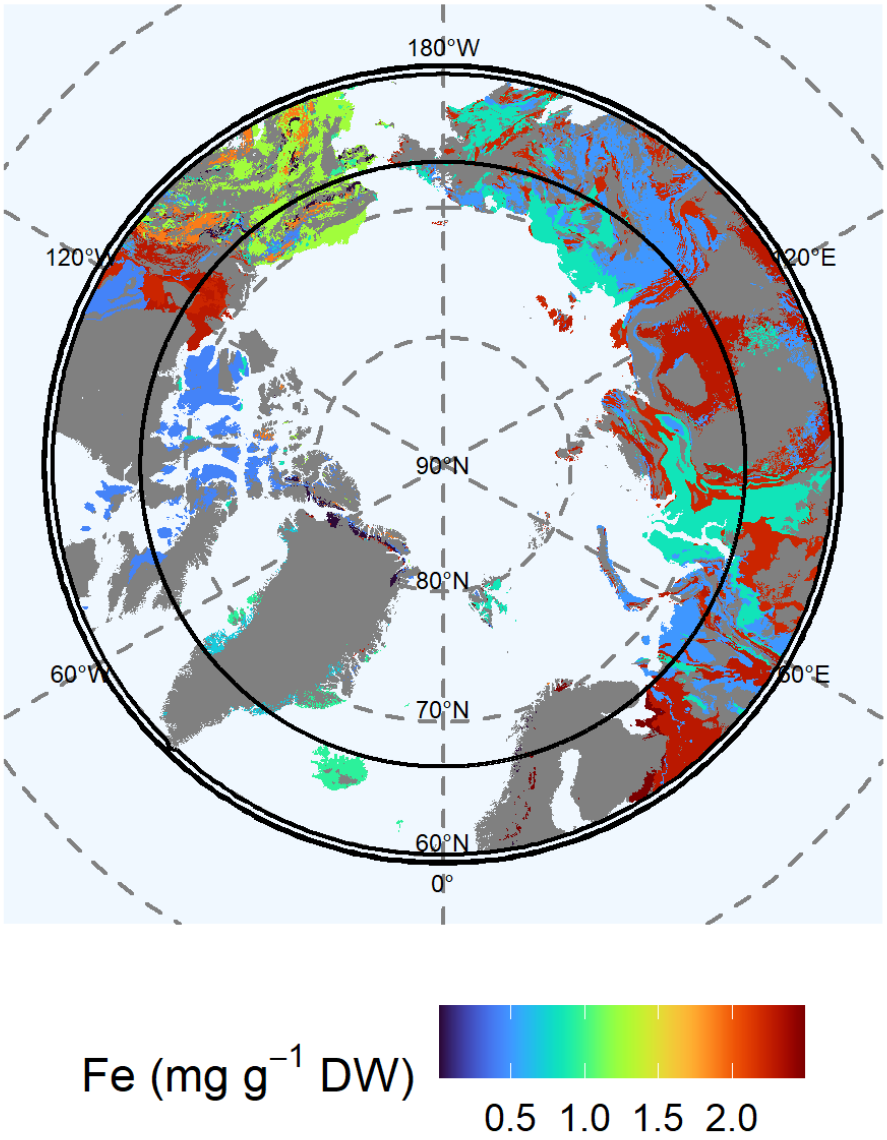
Arctic soils store large amounts of organic carbon and other elements such as amorphous silica, silicon, calcium, iron, aluminium, and phosphorous. Global warming is projected to be most pronounced in the Arctic leading to thawing permafrost, which in turn is changing the soil element availability. To project how biogeochemical cycling in Arctic ecosystems will be affected by climate change, there is a need for data on element availability.

In this study, we present Pan-Arctic maps of concentrations amorphous silica (ASi), silicon (Si), calcium (Ca), iron (Fe), phosphorus (P), and aluminium (Al) availability. of the top 100 cm of Arctic soil. Furthermore, we provide values for element availability for the organic and the mineral layer of the seasonally thawing active layer as well as for the uppermost permafrost layer. For this we analyzed 574 soil samples from the circumpolar Arctic region and used the "Markdown" function from R to generate maps, based on the Geological Map of the Arctic. We show large differences in ASi, Si, Ca, Fe, P, and Al availability among different lithologies and Arctic regions.

Our spatially explicit data on differences in the availability of elements between the different lithological classes and regions now and in the future will improve Arctic Earth system models for estimating current and future carbon and nutrient feedbacks under climate change



Keywords: Arctic permafrost, element availability, silicon, climate change

Selection of the bacterial microbiome at the soil-root interface compared among varieties of Zea mays L.

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Root-associated microbiomes are well known to affect fitness and performance of their hosts. Plants can harness this by promoting the formation of beneficial microbial communities. Microbes colonizing roots mainly originate from the surrounding soil. Species richness decreases and community composition changes towards the rhizosphere and endosphere due to selection by the plant. We hypothesize that different varieties of a widely used crop plant, *Zea mays* L., promote the formation of distinct microbial communities and ask how the influence of the plant differs between root associated compartments.

Using SSU rRNA amplicon sequencing, we investigated the bacterial community composition within multiple compartments of the soil-root interface for different varieties of *Z. mays* grown under field conditions. Furthermore, we compared two field sites with two different soil types, two sampling times and different sampling techniques for the rhizosphere soil.

Microbial communities were clearly distinguishable between field sites. At both sites, we observed marked differences between the compartments, with the root associated community (including endosphere and rhizoplane) being most different from the bulk soil community. Within this compartment, differences between plant varieties were readily detectable, with proteobacteria being particularly affected. The effects of sampling time and technique were comparably small or limited to specific microbial taxa.

These findings support the observation that plants actively shape the root associated microbial community. Environmental variables, probably especially edaphic properties, have large influence on the microbiome. Effects of variables with comparatively small impact such as plant variety are most likely to be found within the root compartment, since the influence of the plant is strongest there.

Keywords: root, soil, rhizosphere, plant microbiome, maize

Impact of volcanic sulfur and ash emission on the flora of La Palma, Spain

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The volcanic eruption on La Palma, Canary islands in autumn 2021 was the largest in historic records of the island. The eruption had a considerable impact on many ecosystems on the island. In addition to the lava stream and significant ash deposition, the volcano emitted 1 Tg of SO2.

The sulfuric emissions impacted the Canary pine (Pinus canariensis) forest around the crater, leading to widespread browning of needles. We used Sentinel-2 remote sensing data to investigate the spatial distribution of chlorotic damage after the end of the eruption. Damage to the forest canopy decreased with distance and was visible up to seven kilometers from the eruption crater. Overall, chlorotic damage affected 10% of the pine forest on the island. Due to the extraordinary resilience of Canary pine due to it's adaption to fire, we expect a full recovery for the majority of trees.

Additionally, we investigate the effect of ash on the local flora. We interpolated local ash measurements for the whole island and analyze their distribution. Ash fall occurs frequently on evolutionary timescales and is therefore likely to be a driver of island woodiness. We analyze survival rates of endemic, native and non-native species at different ash depths.

Ash depth measurements 4 months after the volcanic eruption

Keywords: La Palma, Pinus Canariensis, endemic species,volcano, sulfur, ash

Paleoecological trajectories of non-native vegetation on islands

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Current changes in island vegetation are caused among others by the introduction and spread of non-native plant species. While current invasion statuses are well-known and insular biodiversity is being monitored, a paleoecological perspective on the timing, trajectories, and magnitude of vegetational change on islands caused by non-native plants is largely missing. By matching long-term low-resolution pollen data with short-term high-resolution plant data, we quantify the changes caused by non-native plants on islands globally during the last 5000 years. In general, non-native plants have been present in many systems but started to increase massively only during the last 1000 years, without any signs of slowing down. Thus, although humans have altered the vegetation on islands for centuries and millennia, the recent increase in non-native plants is unprecedented. We show that palynological data can be used to obtain a historic perspective on the development of non-native vegetation on islands.

Human-wildlife interactions: The potential of AI and camera trapping

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Assessing interactions of species in complex natural ecosystems is challenging, but combining camera traps and automated image recognition has rapidly improved data acquisition on wildlife activity patterns lately. However, although most natural systems are highly influenced by human activities such as recreational activities, the potential of using camera traps and automated object detection to monitor human and wildlife activities simultaneously is yet rarely used. We tested an algorithm for automated object detection on camera trap data of three study areas in Bavaria (Bavarian Forest, Fichtelgebirge Mountains, Veldenstein Forest). We evaluated the performance of Microsoft MegaDetector, a deep-learning algorithm for automated object detection, on detecting persons, animals and vehicles on 365163 images from 261 camera trap stations. First results show that manually detected objects strongly correlate with AI-detections (0.62 – 0.92 average correlation estimate) and that detection performance varies between camera trap locations and object classes. Although AI-based automated object classification slightly under- or overestimates visitor and wildlife frequencies, patterns of their activities are well detected. Overall, MegaDetector serves as a reliable as well as time and cost efficient tool for handling big data from camera trap images of human and wildlife activities in natural systems. The resulting data on spatiotemporal behaviour of humans and wildlife allows assessments of their complex interactions.

Automated classification of Eurasien Lynx (Lynx lynx) on a camera trap image.

Keywords: machine learning, camera traps, recreation ecology

O 3.4 in *Afternoon Session*: H 36, 13.10.2022, 14:45-15:00

Composition of mosquito species in a Mediterranean wetland: modeling the effects of species interactions and environmental parameters

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Recently, there have been frequent West Nile virus outbreaks in southern Spain, a region with important wetlands and biodiversity, including vector mosquitoes. We analyzed the role of species interactions and environmental parameters affecting mosquito species composition in a Mediterranean wetland in the Donana natural space.

We applied a Joint Species Distribution Model JSDM, specifically the Hierarchical Modelling of Species Communities approach to simultaneously model the effects of different landscape types, normalized difference vegetation index, hydroperiods, distance to river, land surface temperature, and the abundance of seven mosquito species. We created models with varied parameters. We evaluated the effect of selected abiotic parameters and species-to-species association, which served as a proxy for species interactions.

Our model estimated the response of the mosquito community to environmental parameters, and the responses differ for each species. Hydroperiods, distance to river, and landscape types were the most important environmental parameters influencing the variation in the abundance of mosquitoes. The result signified a favorable association within the Culex community in the wetland to potential biotic interactions. The *Culex* species estimated to be interacting are all potential vectors of West Nile virus. However, *Ochlerotatus caspius*, *Ochlerotatus detritus*, and *Anopheles atroparvus* have no statistical-supported association with the other species after accounting for the effect of environmental parameters. The potential biotic interactions among the mosquito species could also be shaped by missing covariates not included in the model.

JSDM approach supports the identification of the direction of biotic interactions and allows the spatial projection of mosquito abundance, an important parameter for epidemiological models. Moving forward, including predators or species that are blood meals would enhance the ability to project abundance in the mosquito community.

Keywords: mosquito community, species to species associations, landscapes, wetland, environmental parameters, joint species distribution model.

O 3.5 in *Afternoon Session*: H 36, 13.10.2022, 15:00-15:15

Competition between honey bees and wild bees - a global literature review

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The results of our literature review suggest that competitive situations do occur. Contest for floral resources like nectar and pollen seems to take place. The degree of overlapping host plants is highly variable, as it can differ from species to species. Sharing of food sources is a prerequisite so that wild bees can experience consequences. The majority of studies reviewed here imply negative impacts of honeybees on solitary or state-forming wild bees. The extent of these effects depends on various variables, including habitat, resources, distance to the honeybees hive, and the degree of specialisation. Nevertheless, it should be noted that a switch of wild bees to other plants does not necessarily mean a

loss of fitness in a population. However, if the substitute sources are less suitable for example reproduction may be reduced. Many studies also show combined effects. This means that different parameters investigated exhibit different results, or that the reactions of individual bee species differ. According to our analyses, the original distribution area also plays an important role. Most of the literature with negative consequences was conducted outside the natural range of Apis mellifera. In addition, there is a tendency towards more adverse impacts in wild habitats compared to agricultural sites. This leads to the proposal to act according to the precautionary principle and to avoid installing apiaries in nature reserves. In contrast to floral resources, there seems to be no evidence of rivalry for nesting sites. An individually adjustable limit of honeybee densities should be set and subsequently not exceeded. In conclusion, competition between honeybees and wild bees is highly variable and individual. The situation is complex, and the question of negative effects cannot be answered uniformly. As the focus is still on Apis mellifera as the main pollinator, more attention should be paid to wild bees and their fascinating ways of living.


Andrena hattorfiana (Knautien-Sandbiene)

Keywords: honey bees, wild bees, competition, literature review,

P 4.1

The effect of post-emission filtration systems on urban air quality

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[2] **Micrometeorology**

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Dense city planning in combination with static atmospheric conditions and high traffic may lead to an accumulation of pollutants like nitrogen dioxide (NO_2) in the surrounding air. Increased levels of air-pollution influence human health and reduce the livability in cities. Therefore, atmospheric NO_2 concentrations are regulated by law. Despite decreasing tendency, the NO_2 concentrations at urban hot-spots like the Landshuter Allee in Munich still exceed legal thresholds. Post-emission filtration systems may offer a short-term solution to this problem and and improve the air quality. However, studies which support the positive effect of such systems in the air volume of a street canyon are sparse.

The goal of this study is to evaluate if and under which circumstances post-emission filtration systems may help to efficiently clean the air from nitrogen dioxide in direct vicinity to highly frequented roadways. Therefore, we installed nine post-emission filtration systems along the Landshuter Allee and tested their efficiency in the field by selectively regulating the air flow through the systems, while continuously measuring the NO_2 concentrations as well as meteorological conditions including turbulent transport. Performing measurements in the wind cone exiting the post-emission filtration systems while regularly switching between power off and power on, we successfully separated the air filtration effect from the traffic- and mixing-driven variability in NO_2 concentrations and quantified a decrease of up to 18 % in NO_2 concentrations when the air filtration systems were powered on compared to them being powered off.

This project is funded by the Bavarian Ministry of the Environment and Consumer Protection.

Keywords: urban air quality, air filtration systems, nitrogen dioxide, air pollution, air purification

P 4.2

Improved plastic detection in artificial soil using offline pyrolysis and TD-GC-MS/MS

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An efficient method to quantify traces of plastic from different sources within soil matrices is needed to understand the fate of plastics in the terrestrial environment. Improvement of existing methods is needed to: a) minimize time-consuming clean-up of soil samples (i.e. removal of organic matter), b) increase selectivity, and c) simultaneously detect and quantify a variety of plastics. We analyzed 200-400 µm-scale polystyrene (PS), polyethylene (PE), polyethylene terephthalate (PET) and extracted characteristic MS/MS profiles using a new combination of large-scale pyrolysis with thermal desorption-gas chromatography-tandem mass spectrometry (TD-GC-MS/MS) and tested for overlap with organic matter. Pyrolysis products were transferred to on a non-polar sorbent, then subjected to gas chromatography. MS/MS profiles were derived from two electron ionizations of plastic pyrolysis products. These were successfully identified in mixes of plastics with sand and humic acids as model substances for soil matrices without removal of organic matter. We suggest SRM settings for five additional plastic polymers including biodegradables. Repeatability for PS, PE, and PET was shown with relative standard deviation (RSD) between 19% to 27% and linear regression (R^2) between 0.80 to 0.98. Limit of detection was calculated to be 0.1, 0.03, and 0.01 µg g^{-1} for PE, PET, and PS respectively, using our novel method. This new method is a base to simultaneously evaluate a variety of microplastics in larger (>1 g) soil

samples down to a concentration of 1 mg kg^{-1}, potentially shortening analysis time from days to approximately 4 hours with prepared dry soil. Still, reference materials need to be developed and pyrolysis efficiency needs to be tested before quantification of the variety of microplastic in soils or other environmental matrices is possible.

Keywords: biodegradable plastic, gas chromatography-tandem mass spectrometry, microplastic, pyrolysis, soil

P 4.3

Investigation of the Non-Linear Tropospheric Ozone Production Along an Urban - Rural Gradient

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To reduce tropospheric ozone production and improve air quality, the precursor compounds nitrogen oxides and aromatic volatiles have been regulated in many states worldwide for several decades. Despite the successful reduction of these precursors, tropospheric ozone in urban and suburban areas exhibits positive, rising trends. These observations are caused by complex and non-linear ozone photochemistry, which is not fully understood to date.

Here, the temporal and spatial ozone trends and their regulated precursors were analyzed over the last 30 years. Additionally, the content of volatile organic compounds (VOC) in the air at contrasting locations was determined using thermal-desorption gas chromatography. We selected these measurement sites in Bavaria (Germany) based on their degree of urbanization and population, resulting in three categories: Urban, Suburban and Rural areas.

It was shown that in urban ambient air nitrogen monoxide decreased at a rate of 1.6 µg/m³ per year over the course of the last 30 years, whereas ozone concentrations increased about 0.5 µg/m³ annually. Similar behavior could also be detected in suburban areas with a decrease in nitrogen monoxide of 0.9 µg/m³ per year and an ozone increase of 0.5 µg/m³. In contrast, at a site located remotely, stagnating low levels of nitrogen oxides and persistently high levels of ozone reaching more than 100 µg/m³ during the summer 2022 were observed. For further analysis, we combined spatial and temporal scales to bridge over long-term trends (decades), seasons, weekly and diurnal variability, and to highlight dependencies on the underlying chemical mechanisms regarding regional and local contributions to ozone production.

Keywords: Tropospheric Ozonechemistry, Photochemistry, Data analysis

P 4.4

Tuning sampling and analysis strategies for UFP: Laboratory and field tests with selected anthropogenic and biogenic marker components

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Airborne particles impact weather, climate, and air quality. Ultrafine particles (UFP; diameter <100nm) account for the majority, by number, of these particles. Whether or not UFPs pose a risk to human and/or environmental health strongly depends on their size and chemical composition. A precise chemical investigation of UFPs can help to understand underlying atmospheric processes and their impact.

Impactors are useful tools to separate and collect environmental particles from the air. After physical characterization of different cascade impactors regarding their cut-off characteristic, pressure drop and sampling volume, we report on size dependent UFP sampling during the winter season in urban and rural areas in Bavaria, Germany. The impactors were operated simultaneously for different time-periods, partly after their optimization for the separation and collection of the ultrafine fraction. The chemical composition of the collected UFPs was examined off-line with various chromatographic analytical methods.

For testing our methods, we focused on specific marker components of anthropogenic and biogenic sources. Our aims are first, to draw comparisons between the performance of the impactors, second, to investigate different analytical methods for chemical UFP analysis and third, to provide data on the spatial distribution.

The initial results of the physical characterization of various impactors indicate that not all devices are suitable for separating and collecting UFPs. Additionally we found variations in the chemical composition of the size class of ultrafine particles for the tested marker components depending on the deployed impactor. Another cause of uncertainty were the different analytical methods used. Our findings highlight, that it is crucial for the quality of airborne UFP analysis to compare and evaluate the currently applied methodology. This project is financed by the Bavarian Ministry of the Environment and Consumer Protection.

Keywords: Ultrafine Particles – Impactors - Chemical Composition – Method comparison

P 4.5

A landscape-scale model of soil organic carbon mineralization in space, depth, and time

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Soil organic carbon (SOC) mineralization plays a crucial role in the carbon cycle and in determining whether soil is a net carbon source or sink. Multiple factors are influencing SOC mineralization rates. Yet, their spatial and temporal patterns at landscape scale remain elusive so far, especially with respect to the role of subsoils. In the Carbon4D project, we apply a new approach in soil biogeochemistry to model

SOC mineralization with a machine learning algorithm. The model will be based on remote sensing data (e.g. soil maps, land use), meteorological data, and measurements of SOC mineralization in different soil depth under respective in-situ temperature and moisture conditions over one year. With these data the algorithm will "learn" the relationship between measured SOC mineralization and various predictor variables. The goal of this project is to provide the first near real-time modelling framework of SOC mineralization rates in all 4 dimensions, which will provide new insights into controlling factors of spatial and seasonal patterns.
We will present first results from the fieldwork with a specific focus on the relationship between moisture, temperature and SOC mineralization as well as sub- versus topsoil.

P 4.6

A novel approach to extract, purify, and fractionate microplastics from environmental matrices by isopycnic ultracentrifugation

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The increasing accumulation of microplastics (MP) in the environment is considered one of the most important global challenges of our time. Reliable extraction and detection methods for MP in environmental samples are essential for determining the extent of pollution and assessing ecological risks. However, extraction of MP from complex environmental matrices such as soils remains a difficult task. Today, density-based extractions with saturated salt solutions are a widely applied practice. Nevertheless, current extraction approaches do not allow fractionation of different MP particle types according to their specific polymer densities. Here, we present a novel isopycnic ultracentrifugation approach for the simultaneous extraction and fractionation of MP mixtures based on the particle-specific buoyant densities. In this proof-of-concept, diffusion-based density gradients were prepared using caesium chloride media, covering a density range between 1.1 and 1.5 g mL^{-1}, sufficient to resolve many common polymer densities. We selected MP particles with a low (PA66), medium (PBAT), and high (PET) density to validate the separation performance. Pristine MP mixtures and particles pre-incubated in soil showed a clear banding pattern at expected buoyant densities after isopycnic separation. µFTIR imaging of subsamples collected from resolved MP fractions exhibited a polymer-specific separation of ≥ 87.6 %. In addition, our workflow provided quantitative MP recoveries between 86-99%. Further, the potential of our approach to preserve the MP-associated biofilms was also assessed. Soil-incubated MP particles were inspected by fluorescence microscopy before and after isopycnic separation, indicating a preservation of extracellular polymeric substances and microbes. Hence, isopycnic ultracentrifugation offers a powerful novel approach for polymer-specific extraction and resolution of MP particles with wide potential for applications in MP research.

Keywords: soil pollution, microplastic analysis, isopycnic ultracentrifugation, µFTIR spectroscopy

P 4.7

Apple Replant Disease - Which soil properties play a role on regional scales?

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Apple replant disease (ARD) is a major economic problem in fruit-growing regions worldwide. Repeated cultivation of apple trees on the same fields results in growth depression and significant yield reduction. The altered microbial community in the soil is the suspected main cause of growth depression, but it is not fully understood how soil properties, e.g. texture, water holding capacity, humus and nutrient stocks with their controls on microbial activity and microbial functions, may affect the intensity of replant disease. We are investigating the influence of soil properties on replant disease using the example of apple as part of the BMBF-funded project ORDIAmur (Overcoming Replant Disease by an Integrated Approach). In this study, shoot and root length of apple plants as well as soil respiration parameters were used as parameters for replant disease and the activity of soil microorganisms. In a previous field experiment (Mahnkopp et al. 2018) we learned from a limited number of reference sites and these results indicated a correlation between ARD intensity and soil texture: sandy sites were more affected than loess-loam sites. In sandy soils, soil respiration measurements showed a significantly increased metabolic quotient, which can be interpreted as an indicator of microbial stress, as well as signs of lower nutrient availability. However, these results are site-specific and need to be tested for a higher number of soils. Hence, we now continue with ARD intensity mapping on a regional scale in order to be able to prove the relationship between replant disease and soil properties.

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P 4.8

Warming induced changes in the microbiome and carbon dynamics in the soil-plant-system of Vaccinium vitis-idaea

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Plants exude up to 20% of the recently assimilated carbon into the rhizosphere, which partly leads to microbially mediated C-stabilisation in the soil. Understanding of temperature dependencies during this process and thus, the effect of global warming are scarce. We hypothesize that i) the flow of recently assimilated carbon into organic layers and soil increases with temperature, ii) microbiome composition and activities change with temperature, leading to iii) an accumulation of C in microbial biomass and specifically in C stabilizing organisms with higher temperature.

To investigate these questions, we conducted a translocation experiment in Finland exposing Lingonberries (Vaccinium vitis-idaea) and its underlaying soil to a higher temperature (+ 4 °C MAT). After three years, we applied $^{13}CO_2$-pulse labelling and are now analysing the $\delta^{13}C$ in the soil (organic layer, mineral soil, and rhizosphere), the gas phase, and the plant. In parallel we use different methods to

characterize the microbial composition and activity (16s rRNA, PLFA, chloroform-fumigation-extraction, staining to count the mycorrhizal infection, and respiration analysis). Ultimately, we will analyse the $\delta^{13}C$ in the total microbial biomass and selected functional groups.

The experiments are ongoing and the latest, preliminary results will be presented.

Keywords: Carbon stabilisation, Climate change, Isotope labelling, Plant microbiome

P 4.9

Phosphorus mobilization and interactions with iron in response to redox dynamics in a drained wetland area

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Riparian wetlands are highly reactive biogeochemical interfaces and can play a crucial role in the retention and mobilization of nutrients and contaminants. Due to fluctuating hydrogeochemical conditions, this critical zone can strongly influence the fate of phosphorus, which is controlled by the redox status of Fe (hydr)oxides. Previously adsorbed or coprecipitated P may release from reductive dissolution of Fe-oxides under anoxic conditions. In a study area located in the basin of granitic, apatite-rich mountains in north-eastern Bavaria, Germany, the drainage system releases a significant amount of dissolved Fe and P and may cause eutrophication in a recreational lake.

This work aimed to address the enrichment of groundwater-borne P and its response to changing redox conditions. We established a monitoring site with four groundwater wells to identify the processes which govern Fe and P dynamics in a reducing geochemical environment. Multilevel sampling by dialysis bags has been conducted in GWs to investigate water chemistry at the redox interface. In addition, soil sequential extractions have been applied to address the interaction between GW P and Fe with surrounding sediment.

The measured concentration in the drainage water was up to 13 µmol/L (0.4 mg/L) for SRP and 170 µmol/L (9.4 mg/L) for Fe2+. Among four groundwater wells, the average SRP showed significant difference and ranged between 1.2 and 14.3 µmol/L, while the redox potential varied from oxidizing to weakly reducing. Our preliminary results indicated that reductive dissolution of P-rich aquifer sediments and organic-P mineralization in the entire region lead to geogenic P and Fe accumulation. However, the local redox dynamics result from hydrological fluctuations that control the measured groundwater P and Fe concentrations. We found that both P-retention capacity and soil P-content were the highest at the groundwater surface. Therefore, the soil capillary fringe may be considered as a critical zone for P mobilization.

Keywords: phosphorus mobilization redox dynamics

P 4.10

Can silicon alleviate high light stress in tropical tree seedlings?

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Tropical tree seedlings growing in the forest understory are adapted to very low light conditions. But natural tree fall gaps or forest clearing can result in a sudden and strong increase in light. If the absorbed light energy exceeds the amount required for photosynthesis it can damage the photosystems, resulting in high light stress and decreased plant performance. The nutrient silicon has been shown to reduce high light stress in some agricultural crops. In general, much of the research on silicon is focused on agricultural systems. Since there is little known about the ecological role of silicon in tropical forests, we aim to answer the question of whether silicon can alleviate high light stress in tropical tree seedlings in this study.

In a greenhouse experiment in Panama, seedlings of seven tropical tree species were grown in the shade under low and high soil silicon concentrations. Transfer of the seedlings into full sunlight simulated a treefall gap. High light stress was quantified by chlorophyll fluorescence, a measure for the efficiency of photosystem II, as well as several additional indicators. If silicon alleviates high light stress, it is expected that seedlings grown under high silicon concentrations experience less of a reduction in the measured chlorophyll fluorescence parameter after transfer into full sunlight, then seedlings grown under low silicon concentrations.

Since this is an ongoing study preliminary results will be presented. Preliminary analyses indicates that the effect of silicon on high light stress in tropical tree seedlings varies between species.

Keywords: silicon, high light stress, seedlings, tropics

P 4.11

Effects of clipping and invasion on African savanna lawn and bunch grass communities

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The grass layer of African savannas can be described as heterogeneous mosaics of lawn and bunch grass communities. The transformation of bunch grass states to lawn grass states is expected when bunch grasslands are heavily utilised by herbivores allowing lawn grass invasion to persist under frequent grazing. The dynamic nature of these transformations suggests lawn and bunch grasslands can exist as alternative ecosystem states however, empirical evidence has so far been lacking. In this study, we focus on how invasion of lawn grasses in bunch dominant grass communities may change with different grazing frequencies, we used an experimental approach to create artificial ecosystems in mesocosms to test if different clipping treatments coupled with invasion by lawn grasses can shift bunch grass communities into lawn dominant communities. Our experiment investigated (1) under which clipping frequencies are lawn grasses able to invade bunch grass systems successfully. The initial species composition was dominated by 80% bunch grass with 20% lawn grass, we manipulated different clipping treatments ranging from frequent to infrequent clipping. (2) To understand how the average growth rate of lawn and bunch grass species differ with clipping treatments, a biomass model was developed within a Bayesian state-space modeling framework. We used biomass data from the experiment and a Markov chain Monte Carlo method to estimate model parameters. We found that under frequent clipping lawn grasses have higher growth rates and are able to invade bunch-dominated systems and under infrequent clipping lawn grasses are unable to invade. These results suggest

frequent clipping can maintain grass communities in a lawn-dominant state while infrequent clipping removes lawn grasses from the system. Our analysis provides evidence to the theory that lawn grass species persist under intense frequent grazing and that two alternative grass states can exist under different clipping treatments.

Keywords: alternative ecosystem states, experimental test, lawn and bunch grass, invasion, clipping

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