BayCEER Workshop 2021

14.10.2021

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, 14.10.2021

Time	H 36
08:15	**Registration Start (Foyer NW III)**
09:00	**Workshop Opening & Welcome Message** **Prof. Dr. Tillmann Lüders, BayCEER Vice Director**
09:15	**"Methods in Ecology and Environmental Research"** Chair: Taina Conrad, Matthias Schott O 4.1: **Gregor Mathes et al.**: Towards robust statistical inference in ecology
09:21	O 4.2: **Dimitri Seidenath et al.**: Bumblebee tagging – a new method to track individual flight activity in the field
09:27	O 4.3: **Frederic Hüftlein et al.**: Phenoloxidase activity and electroantennography – methods to measure sublethal effects of particulate stressors in insects
09:33	O 4.4: **Edward Muhoko et al.**: Assessing phenological changes in the conservation areas of southern Africa
09:39	O 4.5: **Elisabeth Eckenberger et al.**: Catch me if you can: Evaluating sampling methods for airborne submicron particles' composition analysis
09:45	O 4.7: **Andrea E. Colina Blanco et al.**: Enemy in disguise? Dimethylmonothioarsenate (DMMTA) in rice
09:51	O 4.8: **Ryan Bartnick et al.**: Method Development for Detection of PE, PET, and PS in Soil using Offline Pyrolysis combined with TD-GC-MS/MS
09:57	O 4.9: **Gerhard Gebauer**: Hydrogen stable isotopes in organic matter – an underrepresented tool in ecological and environmental studies with great potential
10:03	O 4.10: **Jacqueline Sahm et al.**: Effect of age on the juvenile hormone III and methyl geranate levels produced by burying beetle females
10:09	O 4.11: **Madlen Prang et al.**: Sibling cooperation in a genus with interspecific variation in offspring dependence
10:15	O 4.12: **Marvin Kiene et al.**: The defence index: a framework to simplify studies on complex defence strategies
10:21	
10:30	**Poster presentation in "Lightning Talks"**
10:45	**Morning Poster Session**
11:30	**"Forest disturbances and future choices"** Chair: Anke Jentsch, Andreas von Heßberg, Tanja Sanders O 2.1: **Mani Shrestha et al.**: At the brink: extreme weather event intensity and interactions determine ecological response across tree species
11:45	O 2.2: **Pia Bradler et al.**: Klimawald Bayreuth - Forests in a changing climate
12:00	O 2.3: **Daniel Thomas et al.**: Evidence for alternate stable states in an Ecuadorian Andean Cloud Forest

12:15	O 2.5: **Anne Gnilke**: Remote sensing allows reconstruction of forest disturbance history
12:30	O 2.6: **Catrin Stadelmann et al.**: Vulnerability of forest stands to storm damage - How well can we model critical wind speed?
12:45	**Lunch**
13:45	**"BayCEER Tales: Earth-atmosphere exchange told by volatile organic compounds" Keynote speaker: Prof. Anke Nölscher, Atmospheric Chemistry**
14:30	**"What goes around comes around - Biogeochemical cycling of Iron, Sulfur & Carbon in the Environment"** Chair: Kerstin Hockmann, Felix Beulig, Martin Obst O 3.1: **Philipp Knobloch et al.**: Not with our species! Peatlands being no sinks for methylated and thiolated arsenates
14:45	O 3.2: **Laura Wegner et al.**: Mobility of toxic antimony during aeration of Fe(II)-rich waters
15:00	O 3.3: **José Miguel León Ninin et al.**: Old and gassy: Increasing methane release from a paddy soils chronosequence with climate change
15:15	O 3.4: **Peter Stimmler et al.**: Deep thaw - What is the answer to permafrost, microbes, silicon and all the rest?
15:30	**Afternoon Poster Session**
16:00	**"Soil-vegetation-atmosphere interactions in a changing climate"** Chair: Eva Lehndorff, Nele Meyer, Anke Nölscher, Johanna Pausch O 1.1: **Nele Meyer et al.**: Soil and ecosystem carbon dynamics in a warming Subarctic
16:12	O 1.2: **Steve Kwatcho Kengdo et al.**: Long-term soil warming alters fine root dynamics and morphology, and their ectomycorrhizal fungal community in a temperate forest soil
16:24	O 1.3: **Tina Köhler et al.**: Responsiveness to soil drying of maize is related to decreasing belowground hydraulic conductivity
16:36	O 1.4: **Muhammad Usman Munir et al.**: Investigating the Impact of Local Climate Change on Surface/Groundwater Interactions in Headwater Catchments
16:48	O 1.5: **Franziska Zahn et al.**: Increasing 'self-supply' of orchid Cremastra appendiculata during ontogenetic development with changing subterranean morphology and fungal associates
17:00	O 1.6: **Julius Seidler et al.**: Variability of Airborne Ultrafine Particles around Munich Airport: Preliminary Results from Summer 2021
17:12	
17:15	**Come together & BayCEER Awards Session (Foyer NW III)**
18:00	

Keynote

BayCEER Tales: Earth-atmosphere exchange told by volatile organic compounds

ANKE NÖLSCHER[1]

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Oral Presentation

O 1.1: H 36, 14.10.2021, 16:00-16:12

Soil and ecosystem carbon dynamics in a warming Subarctic

Nele Meyer[1], Juha Mikola[2], Tarja Silfver[3], Kristiina Myller[4], Yi Xu[5], Outi-Maaria Sietiö[5], Eero Myrsky[6], Elina Oksanen[4], Matti Rousi[7], Kristiina Karhu[5]

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[2] Natural Resources Institute Finland (Luke)

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Climate warming in the Subarctic will likely stimulate soil organic carbon (SOC) mineralization but also plant primary production and thereby C input into soil. However, increasing insect herbivory may dampen this positive response. Thus, it remains uncertain whether the Subarctic will become a sink or source for CO_2. This study aims at exploring the interactive effect of climate warming, insect herbivory, and plant growth in the Subarctic.

We conducted an open-air warming experiment in North Finland to explore the effects of warming (+3°C) and reduced insect herbivory (using an insecticide) on SOC dynamics, net ecosystem exchange, and plant growth. Further, to understand the long-term effect of plant growth and herbivory, we conducted a comprehensive survey of soil and ecosystem C stocks under living trees, treeless tundra, and under trees that died due to insect outbreaks.

We found a positive effect of warming on plant growth, which went along with larger ecosystem CO_2 uptake. As a result of larger C input into soil, SOC contents increased despite the observed stimulation of SOC turnover. The positive effect of plant growth on SOC stocks was also corroborated by the finding that SOC stocks were considerably larger under trees in comparison with treeless tundra. Yet, insect herbivory significantly reduced plant growth and if their numbers increase with warming, they may curtail the positive effect of warming. Surprisingly, we found strong effects of warming or herbivory reduction on soil and microbial variables but most of these effects were not additive. This was in contrast to the additive positive effects of warming and herbivory reduction on plant growth. Our study draws attention to the multiple interacting mechanisms behind warming effects on C dynamics in the Subarctic, creating nonlinear and unexpected responses to changes in temperature. This calls for careful consideration when predicting the fate of Subarctic C sink under climate warming.

Long-term soil warming alters fine root dynamics and morphology, and their ectomycorrhizal fungal community in a temperate forest soil

Steve Kwatcho Kengdo[1], Derek Peršoh[2], Andreas Schindlbacher[3], Jakob Heinzle[3], Ye Tian[4], Wolfgang Wanek[4], Werner Borken[1]

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Climate warming is predicted to affect temperate forests severely, but the response of fine roots, key to plant nutrition, water uptake, soil carbon and nutrient cycling is unclear. Understanding how fine roots will respond to increasing temperature is a prerequisite for predicting the functioning of forests in a warmer climate. We assessed the response of fine roots and colonizing ectomycorrhizal (EcM) fungal and root-associated bacterial communities to soil warming by 4 °C in a forest soil in the Austrian Limestone Alps after 8 and 14 years of soil warming, respectively. Fine root biomass and fine root production were 17% and 128% higher in the warmed plots after 14 years, respectively. The increase in fine root biomass (13%) was not significant after 8 years of treatment, whereas specific root length, specific root area, and the number of root tips increased in warmed plots at both sampling occasions. Soil warming did not affect EcM exploration types and diversity, but changed their community composition, with an increase in the relative abundance of *Cenococum* at 0 – 10 cm soil depth, a drought-stress tolerant genus, and an increase in short and long-distance exploration types like *Sebacina* and *Boletus* at 10 – 20 cm soil depth. Warming increased the root-associated bacterial diversity but did not affect their community composition. Soil warming did not affect nutrient concentrations of fine roots, but there was an indication of limited phosphorus (P) and potassium (K) availability in the soil. Our findings suggest that, in the studied ecosystem, global warming could persistently increase fine root growth as well as biomass, and could simultaneously alter fine root morphology and EcM fungal community composition towards improved nutrient forage. Increased carbon input by higher fine root production has the potential to partially offset the warming-induced carbon losses by enhanced carbon mineralization.

Keywords: climate warming, fine root biomass, fine root production, fine root morphology, ectomycorrhiza, exploration types, bacterial community, nutrients.

Responsiveness to soil drying of maize is related to decreasing belowground hydraulic conductivity

Tina Köhler[1], Carolin Schaum[1], Shu-Yin Tung[2], Franziska Steiner[3], Nicolas Tyborski[1], Andreas Wild[1], Wouter Wahl[2], Sebastian Wofrum[2], Alix Vidal[4], Carsten Müller[5], Tillmann Lüders[1], Johanna Pausch[1], Andrea Carminati[6]

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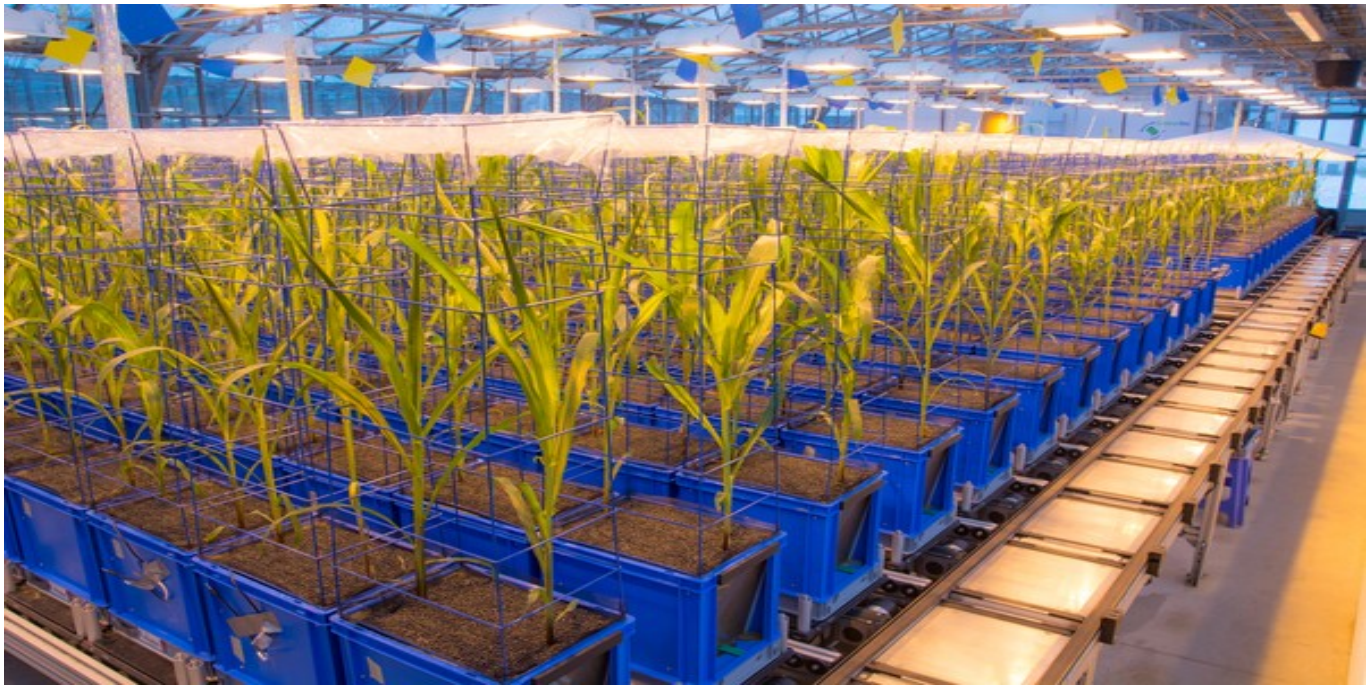
Limited water supply is one of the largest impediments to food production worldwide in the light of climate change and increasing food demand. Functional traits of the plant's rhizosphere have not been explored in relation to their potential role for increasing plant drought tolerance and for improving crops capacity to optimally manage soil water depletion. So far, an optimization of root and rhizosphere hydraulic traits has been rarely considered in plant breeding. Although recent studies hinted towards an intimately tied link between belowground hydraulic conductivities and stomatal regulation under water deficit, the effect of belowground hydraulics on soil-plant water relations remain disputable. The overall objective of this study was to investigate a systematic understanding of the most important rhizosphere traits and the mechanisms by which they support drought resistance.

Therefore, we have exposed a selection of 48 maize (Zea mays L.) varieties, equally consisting of modern hybrids and landraces, to soil water stress in a phenotyping experiment. We measured the relation between leaf xylem water potential, soil water potential, soil water content and transpiration rate, as well the expression of root and rhizosphere traits like root length or rhizosheath mass between genotypes. Our hypothesis is that stomatal response to soil drying is related to a loss in soil hydraulic conductivity and that key root and rhizosphere hydraulic traits affect such relation.

We have found that the genotypes differed in their responsiveness to drought, indicated by the critical soil water content at which plants felt stressed enough to close stomata, and that this is related to a combination of plant hydraulic conductivity, maximum transpiration, and root and rhizosphere biomass. Those findings stress the importance of belowground hydraulic properties on stomatal regulation and thereby drought responsiveness of maize.



Moving fields phenotyping facility of the Bavarian State Research Center for Agriculture (by the courtesy of N. Tyborski)

Keywords: rhizosphere traits, drought, belowground hydraulic conductivity, maize

O 1.4: H 36, 14.10.2021, 16:36-16:48

Investigating the Impact of Local Climate Change on Surface/Groundwater Interactions in Headwater Catchments

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Interaction between surface and subsurface water is an essential component for the surface flow in streams, particularly for those which are primarily dependent on the base flow. During drought conditions inflow of water from groundwater into streams is a prime water source and essential for ecosystems. In summer, dropping groundwater levels can be responsible for a disconnection between groundwater and stream, causing high infiltration rates and dried-up stream reaches. This phenomenon was increasingly observed in central Europe in the last years, particularly for headwater catchments due to climate change. Climate change is affecting not only surface water resources but also groundwater. Increasing groundwater temperatures and dropping water levels is clear evidence that climate change already has a significant impact on natural water resources. To understand this sensitive interaction between surface and groundwater in these systems, a process-based understanding is necessary. A fully integrated hydrological model (HydroGeoSphere) is used to assess the impact of local climate change to the Grosse Ohe catchment (Bavaria, Germany). A multi-scale model was set up, calibrated and validated for the years 2001-2021. The model was used to simulate and understand the interaction between surface and groundwater mechanistically. Different scenarios were simulated using projection from Regional Climate Change Models (RCMs) under three different representative concentration pathways (RCP2.6, RCP4.5 and RCP8.5) up to the year 2100. From projected scenarios, it can be observed that an increase in temperature is responsible for higher evapotranspiration rates, which significantly affects the water balance and water availability during summer. The model was used to identify reaches with preferential groundwater inflow and outflow. Simulations indicate that gaining sections more frequently turn into losing ones in future.

Keywords: Climate change, Integrated hydrological modelling, Forested catchment, Regional climate models

O 1.5: H 36, 14.10.2021, 16:48-17:00

Increasing ‘self-supply’ of orchid Cremastra appendiculata during ontogenetic development with changing subterranean morphology and fungal associates

Franziska Zahn[1], Yung-I Lee[2], Gerhard Gebauer[1]

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Exchange processes in the mycorhizosphere are essential for the nutrition of Orchidaceae. Orchids exhibit different trophic strategies ranging from autotrophy to mycoheterotrophy, with the latter being recognized as a partial or entire carbon gain by exploiting diverse associating fungi. Particularly in their below-ground development stage as protocorms orchids depend on fungal nutrition.

We examined how a change in fungal community and subterranean morphology accompanies a nutrition mode alteration during the ontogenesis of the chlorophyllous, terrestrial orchid Cremastra appendiculata from Taiwan. Trophic strategies were revealed by comparing different development stages of C. appendiculata to surrounding autotrophic reference plants based on $\delta^{13}C$, $\delta^{15}N$, $\delta^{2}H$ and $\delta^{18}O$ stable isotope natural abundance and total N concentration analyses. Mycorrhizal fungi of C. appendiculata were determined using next generation DNA sequencing.

We identified saprotrophic non-rhizoctonia Psathyrellaceae as dominant fungi in protocorm and seedling coralloid rhizomes, while roots of seedlings and mature C. appendiculata were mainly colonizes with rhizoctonia fungi. Mature C. appendiculata did not differ in isotopic signature from autotrophic reference plants suggesting a fully autotrophic nutrition. Characteristic of mycoheterotrophic orchid specimens, C. appendiculata protocorms were enriched in ^{15}N, ^{13}C and ^{2}H compared to reference plants. Seedlings showed a dispersive, intermediate isotope signature, underpinning their transitional nutrition mode and the differences in fungal community depending on their subterranean morphology.

Considering recent literature we suggest a high within-species variability in nutrition and fungal association depending on subterranean morphology and development stage of C. appendiculata. To conclude, C. appendiculata is a key species covering the entire spectrum on the continuous gradient from autotrophic to mycoheterotrophic nutrition.

Keywords: Cremastra appendiculata, mycoheterotrophy, Orchidaceae, stable isotopes, protocorm, ontogenesis, subterranean morphology, rhizoctonia, saprotrophic, Taiwan

O 1.6: H 36, 14.10.2021, 17:00-17:12

Variability of Airborne Ultrafine Particles around Munich Airport: Preliminary Results from Summer 2021

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Airports and air traffic can be major sources of ultrafine particles (UFP), next to other anthropogenic and natural sources. UFP are in the size range of 100 nm or less and can be either liquid or solid. When airborne, UFP can have multiple effects on climate, weather and air quality i.e. when impacting cloud formation as condensation nuclei, altering chemical processes in the atmosphere, or being aspirated or taken up.

This project investigates to what extent a large airport and the respective near-ground air traffic contribute to the overall atmospheric UFP mixture. Further focussing on the lowermost atmosphere being in exchange with Earth's surface, we aim to elucidate the transport of these UFP into adjacent urban areas.

We designed and established two monitoring stations around Munich Airport on a North-South axis. Both stations are equipped for measuring UFP by means of a mobility particle size spectrometer (MPSS, 8...800 nm) and a total condensation particle counter (CPC, 8...3000 nm). The setup is completed by meteorological measurements (wind speed and direction, precipitation, solar radiation, humidity, pressure and temperature). Particularly wind speed and wind direction are relevant parameters to analyse the origin of detected UFP.

Officially launched in May 2021, we will present first results showing diurnal and weekly time series of UFP measurements and how they are connected to weather conditions, airport operation and other emission sectors in the surroundings.

This project is funded by the Bavarian State Ministry of the Environment and Consumer Protection (TLK01U-76519).

Keywords: ultrafine particles, airport, air traffic

O 2.1: H 36, 14.10.2021, 11:30-11:45

At the brink: extreme weather event intensity and interactions determine ecological response across tree species

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Extreme Weather Events (EWE), such as late frosts and summer droughts, are increasingly frequent and drive devastating impacts on ecosystems. Non-linear responses are commonly associated with EWE but are poorly captured by traditional replicated experimental designs. Further, it is unclear how thresholds associated with one event type are modulated by other extreme events. We present the first manipulative experiment that explicitly assesses the prevalence of non-additive and non-linear responses to multiple EWE using a crossed-gradient approach. We exposed 450 seedlings of seven tree species that are common in Central European forests (Abies alba, Fagus sylvatica, Larix decidua, Picea abies, Pinus mugo ssp. rotundifolia, Pseudotzuga menziesii and Sorbus torminalis) to late frosts of varying severity (six regimes, -2°C to -11°C) and to droughts of varying lengths (ten regimes, no drought through to 12 weeks' drought). We measured a variety of ecologically relevant responses: growth, mortality, phenology and biomass allocation. While responses varied across species, EWE near-invariably elicited non-linear responses irrespective of species or response parameter of interest. We found similar prevalence of non-additive EWE interactions. Our experiment highlights the relevance of manipulative approaches that enable researchers to resolve interactive and non-linear effects of EWE and other global environmental change drivers.

Keywords: Late frost, drought, European tree species, gradient experiments, thresholds, driver interactions.

O 2.2: H 36, 14.10.2021, 11:45-12:00

Klimawald Bayreuth - Forests in a changing climate

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Forests increasingly suffer from impacts of global change such as increased frequency of droughts, bark beetle attacks or wind throw. With quickly changing environmental conditions, long-lived trees may not be able to keep up. Stable forests, however, are important as they do not only counteract global changes by acting as a carbon sink but also provide multiple other ecosystem services like water provision, temperature regulation or recreation.

The question for both science and forest practice is: How should forests develop and change to be able to cope with future conditions? Currently, large proportions of the German forests are dominated by tree species (Picea abies, Pinus sylvestris) which suffer from the impacts of climate change. A potential mitigation and adaptation strategy is the conversion into species-rich and resilient mixed stocks that are more stable and adjusted to heat and drought events ("Waldumbau"). There are differing opinions on how to reach this aim. Traditional forestry uses artificial regeneration (planting) of alternative native and non-native tree species. Another approach, which is especially advocated for by nature conservation, is to largely reduce management interventions and to solely rely on natural regeneration.

As part of the student-lead “Klimawald Bayreuth” project, four previously damaged forest sites in and around Bayreuth that were mainly dominated by conifers were replanted with a selected mixture of native and non-native tree species. The aim is to assess performance of the planted species under real world conditions and to analyse the intensity and species composition of natural regeneration. The “Klimawald Bayreuth” project further aims at educating about and raising awareness for the impacts of climate change on forest ecosystems.

Keywords: Klimawald Bayreuth, forestry, forest management, climate change

O 2.3: H 36, 14.10.2021, 12:00-12:15

Evidence for alternate stable states in an Ecuadorian Andean Cloud Forest

Daniel Thomas[1], Ana Mariscal[2], Thomas Roy[3], Manobanda Rocío[4], Angel Chinchero Miguel, Simba Larco Danilo[5]

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[3] **University of Oregon**

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Here we present an analysis of a successional dynamics in a tropical montane cloud forest in northern Andean Ecuador. Trees in plots from several types of forest distubance types were surveyed. The goal of the study was to enhance understanding of succession and regeneration in the Andean primary forest, and any potential long term effects of anthropogenic disturbance on plant community dynamics. We find that all primary forest sites are quite resilient to "natural" gap-forming disturbances: gaps are quickly colonized by old-forest-associated plant species, and return to an old-forest-type community of trees in a short time. In contrast, forests regenerating from anthropogenic disturbance appear to have multiple possible states: some regenerating forest sites on places where the anthropogenic disturbance were low are coming to closely resemble old-forest-type communities, but some where the anthropogenic disturbance was intense appear to be moving in a very different direction, which does not resemble any other vegetation community type currently in the forest. More intensively used sites, many of which are abandoned sugar cane plantations, appear unable to return to a pre-disturbance ecological state, instead forming a new and different kind of forest, dominated by a different community of trees. We examine tree-seedling communities to understand the trajectory of the forest into the future, and find that new forest types may be forming that do not resemble any existing associations. We estimate approximately 500 species of tree in only the small southeastern area of the reserve that has been explored scientifically. Tree community shows extremely rapid distance decay, approaching near complete turn-over in the limited span of the study indicating that hundreds of other tree species possibly remain to be observed in the reserve. We also highlight the conservation value of Reserva Los Cedros.

Sunny day in Los Cedros forest

Keywords: Ecuador, Cloud forest, Montane tropical rain forest, Tropical Andes Bioiversity Hotspot, Succession, Alternate stable states, forest disturbance

O 2.5: H 36, 14.10.2021, 12:15-12:30

Remote sensing allows reconstruction of forest disturbance history

ANNE GNILKE
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Abstract. Capturing forest disturbances over time is increasingly important to determine the ecosystem's capacity to recover. Change in disturbance regimes due to climate change increases the frequencies and hinders resilience due to loss of ecological memory and an increase in legacy effects shaping ecosystem recovery. A better understanding of forest disturbances and their role in historical development is needed to develop forest management approaches to promote ecosystem resilience.

Here we use MOD13Q1 data which is highly standardised, ready-to-use time series data for nearly two decades at a global coverage, to detect various known damaged and disturbed areas in forests across Germany to build a chronology of damages and recovery.

Results show that the ability to detect small scale phenomena (such as scattered wind-throw areas), heavily depend on a) the spatial resolution of the data and c) radiometric specifications of the sensor (bands + bandwidth), which also enables us to derive information about event characteristics, and c) the temporal resolution. Difficulties, therefore, still exist in determining the cause of damage for events at supra-pixel resolution (finer than 250m pixel resolution). Ecological phenomena defined by abrupt change e.g. fire or storm are detectable mostly, but limits exist to the differentiation of gradual changing events e.g. insect, drought, or fungi and their interactions. Nevertheless, the analysis captured historic disturbances and allowed the building of plot specific disturbance series over 20 years.

Keywords: forest disturbance, MODIS time series, ecosystem resilience

Vulnerability of forest stands to storm damage - How well can we model critical wind speed?

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Winter storms, such as Lothar or Friederike, have caused large-scale damage to forests in the past. The frequency and severity of such winter storms is projected to increase, which makes an assessment of vulnerable areas essential for forest management.
In the project "WINMOL - Detection and Prediction of Storm Damage in Forests" we model the vulnerability of forest stands to wind at the individual tree level using the deterministic storm damage model ForestGALES (FG). To gain understanding for the model's limitations, we tested the standard model setup on plots of the research station "Britz" in Brandenburg, where individual tree data has been collected since 1992. In a preliminary step we used the tree growth model BWIN to simulate the growth of one pine and one beech plot from 1992 to 2020 and to project the future growth of these plots up to 2050. Afterwards we calculated the critical wind speeds with two different methods for (a) the individual trees and (b) as a mean for the whole plot. We then compared these critical wind speeds modeled by FG to reference wind speeds from the closest weather station operated by the German National Meteorological Service. We found that the measured individual tree parameters are mostly within the range of the BWIN model results, whereas the critical wind speeds differed between the plot-wide method (b) and the single tree method (a). In addition, the critical wind speed generally decreases as the stand age increases. Modelled critical wind speed is lower than the measured wind speeds even though no trees in the two plots were damaged by strong winds. The disparity between reality and the model result calls for an investigation on the reasons why FG performs poorly in German forests. After adapting FG to German conditions, we want to examine the influence of species-specific individual tree parameters as well as different forest management types on storm damage risk to provide guidelines on how to decrease the risk of damage.

Damaged pine trees after storm Xavier (2017) in Brandenburg. Photo: M. Natkhin.

Keywords: forest; storm damage; modelling; wind;

O 3.1: H 36, 14.10.2021, 14:30-14:45

Not with our species! Peatlands being no sinks for methylated and thiolated arsenates

Philipp Knobloch[1], Lan Huong Pham[1], Britta Planer-Friedrich[1]

[1] Umweltgeochemie

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Peatlands efficiently sequester inorganic arsenic as arsenite or arsenate by binding to natural organic matter via O-containing functional groups or S- and Fe-bridging. Microbial activity can lead to the formation of organic arsenates that can successively form organic thioarsenates in the presence of sulfide. While low sorption of inorganic thioarsenates has been shown before, until now, the sorption affinity of organic (thio)arsenates to peat functional groups and the mobility in peat porewater are poorly understood. Here, we show that substantial fractions of porewater arsenic from the first 15 cm of a natural, minerotrophic, slightly acidic riparian peatland “Schlöppnerbrunnen II” were organic thioarsenates (60%) with dimethylmonothioarsenate (DMMTA) being the dominant arsenic species. Depth-resolved porewater analysis showed that inorganic and organic thioarsenates only occurred in high fractions when redox conditions got anoxic and sulfide concentrations increased. Laboratory sorption experiments with three different peats (low iron, high iron, high sulfide) confirmed mobility of organic (thio)arsenates in peatland porewater by showing no affinity of monomethylarsenate (MMA), dimethylarsenate (DMA), and DMMTA at pH 4, 5.5, and 7 to peat functional groups after 96 h. While MMA and DMA were stable, 20-50 % of DMMTA dissociated to DMA and sulfide at circumneutral pH and subsequently dimethyldithioarsenate (DMDTA) formed by reaction of DMMTA with sulfide. Our results show that organic thioarsenates are highly mobile in peatland porewater and that their high fraction has been previously overlooked in routine analyses due to insufficient sample preservation and analysis methods.

Keywords: thioarsenates, organic thioarsenates, methylated thioarsenates, sorption, peatlands, thiolation

O 3.3: H 36, 14.10.2021, 15:00-15:15

Old and gassy: Increasing methane release from a paddy soils chronosequence with climate change

José Miguel León Ninin[1], Alejandra Higa Mori[1], Benjamin Gilfedder[2], Johanna Pausch[3], Britta Planer-Friedrich[1]

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Flooded conditions under which rice is cultivated enhance C storage in paddy soils. This high potential for C storage is counteracted by methane production and release related to oxygen depletion in the soil after flooding. The amount of methane produced by each individual paddy soil depends on different factors including the C availability, microbial communities, and the overall biogeochemical dynamics of other major elements like Fe and S. These factors could be affected by rising temperatures related to climate change, increasing methane production in paddy soils. The age of a paddy (i.e. the time for which a soil has been used for paddy cultivation) has a major impact on these factors previously mentioned, making the use of a chronosequence particularly interesting when addressing this issue. We incubated samples from a paddy soil chronosequence with ages between 50 and 2000 years of paddy cultivation under different temperatures related to possible future climate scenarios and evaluated their

methane production together with other geochemical cycles. Our results show that the longer a soil has been used for paddy cultivation, the more drastic response it has to increasing temperatures, in terms of methane production per degree Celsius. The reason for this higher sensitivity with paddy age could be related to faster reduction of amorphous Fe-phases or consumption of complex carbon substrates, as well as to the enhancement of selected microbial communities. These preliminary results could not only help us to predict which soils would produce more methane in the future, but also increase our understanding of the methanogenesis dynamics in different paddy soils across the globe today.

Keywords: Methane, paddy soils, chronosequence, temperature, climate change

O 3.2: H 36, 14.10.2021, 14:45-15:00

Mobility of toxic antimony during aeration of Fe(II)-rich waters

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In redox-variable environments, the mobility of antimony (Sb), a toxic metalloid of increasing concern, is closely linked to the biogeochemical cycling of iron (Fe). Microbial production of soluble Fe(II) has been shown to release co-associated Sb under anaerobic conditions typical of wetland soils. In contrast, Sb-Fe interactions during aerobic Fe(II) oxidation and subsequent Fe(III) precipitation have received little attention. We investigated the effect of Fe(II) oxidation in the presence of environmentally relevant Sb(V) concentrations on the nature of the resulting Fe(III) precipitates and the mobility of Sb. Oxidation experiments were carried out in oxygen-saturated solutions (pH 7) containing an initial concentration of 1 mM Fe(II) and dissolved Sb(V) at Sb:Fe molar ratios of 0, 1:100, 1:25, 1:10, and 1:4. Iron and Sb concentrations in solution were monitored during the oxidation reaction and the precipitates were characterized using a combination of microscopic, spectroscopic and wet chemical extraction techniques.

Iron(II) quickly oxidized (within ~10 min) to Fe(III) after it had been added to the aerated solutions and precipitated. Aqueous Sb was removed from the solution in parallel with Fe(II). In absence and at low levels of Sb(V), lepidocrocite was the only solid-phase oxidation product. Interestingly, higher Sb:Fe molar ratios (1:10 and 1:4) inhibited lepidocrocite precipitation, and resulted in the formation of feroxyhyte, a rather uncommon Fe(III) oxide. Phosphate-extractions, together with Mössbauer and X-ray absorption spectroscopy, showed that >99% of the co-precipitated Sb was incorporated into the structure of the newly formed Fe(III) oxides, making it rather inaccessible for remobilization.

Our results are important for a safe management of Sb-contaminated sites and for the development of engineered solutions that harness Fe(II) oxidation reactions for water treatment.

Keywords: Oxidation, Antimony, Iron Oxides

Deep thaw - What is the answer to permafrost, microbes, silicon and all the rest?

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Global warming is most pronounced in the Arctic region. Greenhouse gas (GHG) release from Artic soils increased due to global warming. By this, the Arctic may change from currently being a carbon sink to a future source. To improve accurate predictions of future GHG release from Arctic soils, it is important to unravel factors controlling both the microbial community structure and activity. Soil microbial activity is important for Arctic greenhouse gas production, but depends on soil conditions such as salinity being increased by calcium (Ca) and decreased by amorphous silica (Si) potentially enhancing water availability. In the Arctic, climate changes may alter salinity by changing Si and Ca concentrations upon Permafrost thaw as a result of global warming. Here we show, that higher Si concentration increased and higher Ca concentrations decreased the microbial CO_2 production for both salt-poor and salt-rich soils. In salt-rich soil, Si increased the CO_2 production, due to higher abundance of gram-negative bacteria. However, gram-positive Firmicutes were dominant in these soils, being positively related to Si. With increasing Ca concentration in salt-rich soils, CO_2 production decreased, while the bacterial community became dominated by spore-forming gram-positive Firmicutes and Actinobacteria. The CO_2 release from soils was directly affected by the abundance of microbes and their community structure. Our results highlight the importance of the soil Si and Ca concentration on organic carbon turnover by strongly changing microbial abundance and community structure, with consequences for CO_2 release in the Arctic. Consequently, as Arctic soil microbial community structure is affected by the local geology, water balance and soil element concentrations such as Ca and Si we emphasizing the need of pan-Arctic soil chemistry maps.

Keywords: Permafrost, microbial community structure, amorphous silica, calcium

O 4.1: H 36, 14.10.2021, 09:15-09:21

Towards robust statistical inference in ecology

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Progress in ecology depends on sound and robust methods for making inferences from data. However, typical statistical practice in the early twenty-first century frequently contradicts with what is commonly considered good scientific practice. Here we summarise an alternative statistical workflow which tries to facilitate the integration of robust statistical inference for ecologists and natural scientists in general. We are aiming to provide an overview of methods and tools which have emerged in recent years and demonstrate how these might benefit the field of ecology in particular. The presented holistic approach to statistical inference includes open science policies, reallocation of credibility instead of significance testing, averaging of information across statistical models, and the constant testing of underlying assumptions and final scientific output. We then demonstrate this approach through a worked example from our current research, where we test the dependency of turnover in pollen communities on temperature.

Keywords: statistic, inference, replication crisis, open science, bayes, p-values, regression

O 4.2: H 36, 14.10.2021, 09:21-09:27

Bumblebee tagging – a new method to track individual flight activity in the field

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Tracking animal behaviour and movement is essential when trying to understand how organisms react to changes in their environment. Especially in insects, such as bumblebees, precise measurements of their movement can be rather difficult. Due to their small size and light weight, traditional tracking methods like radio telemetry or GPS are disadvantageous. As commercially available alternatives such as RFID-tags are very costly, we developed a low-cost approach that uses paper tags, cameras and raspberry pi computers. This approach enables us to automatically track individual flight activity of bumblebees in the field. In our research we look at the effects of soot on the buff-tailed bumblebee Bombus terrestris. By modifying the OECD homing flight test for honeybees, a standardized method to test chemicals, we can examine the effects of soot exposure on bumblebee flight activity. As a first step, we aim to understand how individual bumblebees are affected. As bumblebees are eusocial insects, individual behavioural changes might affect colony development as a whole, which will be subject of subsequent research. Our new method can be easily adapted to other organisms and offers a low-cost alternative to conventional techniques of animal tracking.

Keywords: animal tracking, behavioral ecology, bumblebees, social insects

O 4.3: H 36, 14.10.2021, 09:27-09:33

Phenoloxidase activity and electroantennography – methods to measure sublethal effects of particulate stressors in insects

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The introduction of traffic emissions is a major factor for species decline worldwide. They are mainly derived from incomplete combustion from exhaust engines, brake wear, and tire wear. We grasp to understand and unravel the impacts and, in the case of harmful substances, the mode of action of these particles on organisms and whole ecosystems. A first step in ecotoxicology is to assess a substance's acute toxicity, with often high, unrealistic concentrations, when orally ingested or applied on an organism's surface. A next possible step is to identify sublethal effects of lower environmentally relevant concentrations. We want to unravel the effects of exhaust and brake abrasion particles on the buff-tailed bumblebee Bombus terrestris and the larvae of the non-biting midge Chironomus riparius. One point of reference is measuring the level of phenoloxidase in the hemolymph of the respective insect. Pathogens or foreign particles induce melanin deposition around them, resulting in encapsulation. Phenoloxidase is a critical enzyme for melanin synthesis and, therefore, a good proxy for induced stress. Another point of reference we measure is the neuronal responsiveness in the insect's antenna after exposure to exhaust particles. Reduced ability to sense volatiles could result in bumblebees having difficulties finding suitable flowers or back to their nest. The measurement of neuronal responsiveness is being achieved by assessing the strength of the amplitude after a stimulus. Revealing the effects of stressors on organisms is crucial for understanding possible changes in biodiversity and management solutions concerning the protection of organisms.

Keywords: particulate stressors, sublethal effects, phenoloxidase, electroantennography, insects

O 4.4: H 36, 14.10.2021, 09:33-09:39

Assessing phenological changes in the conservation areas of southern Africa

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Plant phenology plays an important role in regulating water, carbon and energy feedbacks between terrestrial ecosystems and the atmosphere. Consequently, leaf phenological shifts are a sensitive indicator of climate change. Despite being one of the most vulnerable regions to climate change, southern Africa's vegetation phenology has been poorly studied. Using the Enhanced Vegetation Index (EVI) as a proxy for the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), we applied a systematic change detection approach to assess patterns of leaf phenological change in 21 metrics in the conservation areas of southern Africa. Because ecosystems differ in their phenological activity, we further performed unsupervised clustering of the data to group the study area into 7 regions with similar phenological traits. We found that leaf phenology has changed by at least 1 standard deviation in each of the 21 phenological metrics between 2000-2019. We also show long-term changes in the length of the growing season primarily due to changes in the green-up period and senescence period in each of the 7 regions. Our study reveals severe changes in the functioning of ecosystems of southern Africa with potential impacts on the feedbacks in the biosphere and across trophic levels. The findings of this study could be useful in formulating sustainable conservation strategies.

Keywords: Climate change, phenology, southern Africa, EVI, phenological metrics, vegetation change

O 4.5: H 36, 14.10.2021, 09:39-09:45

Catch me if you can: Evaluating sampling methods for airborne submicron particles' composition analysis

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Airborne submicron particles (<1µm, SMPs) affect air quality, weather and climate. Their size and chemical composition determine possible risks to human health or the environment. Thus, precise knowledge about the sources and the atmospheric fate of SMPs is essential for assessment and developing effective control measures, especially of ultrafine particles. In addition, a detailed chemical analysis of SMPs can aid to better understand environmental processes in the atmosphere and possible effects on human health.

Despite the need to learn about the origin, behavior, mobility, fate, and toxicity of SMPs, attempts to analyze their chemical composition in the atmosphere are still rare. Considering their low mass, partial volatility and dynamic character, it is a great challenge to separate, catch and analyze the airborne SMPs.

Impactors are useful tools to separate and collect environmental particles from the air to analyze their chemical composition. Herein, we report our evaluation of commercially available and frequently deployed cascade impactors for their applicability of sampling airborne SMPs. We tested the following criteria: (1) a precise size separation or cut-off in the submicron range to enable size-dependent chemical analysis, (2) the collection of the greatest as possible particle mass, while preventing the evaporation of the volatile and semi-volatile fractions. Therefore, different impactors were connected inline between a customizable particle generation source, a flow reactor for dilution, mixing and aging, and a mobility particle size spectrometer. Our results so far indicate a great variability among impactors of the same model and highlight the difficulty of combining all these requirements in one device. However, after careful physical characterization, we plan to optimize the particle sampling for environmental SMPs chemical composition analysis. This project is financed by the Bavarian Ministry of the Environment and Consumer Protection.

Keywords: Particulate matter – Submicron – Impactors – Cut-off Sizes – Mobility Particle Size Spectrometer

O 4.7: H 36, 14.10.2021, 09:45-09:51

Enemy in disguise? Dimethylmonothioarsenate (DMMTA) in rice

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Thioarsenates have recently been reported to contribute substantially to arsenic (As) speciation in paddy-soil pore waters. Here, we show that thioarsenates can also accumulate in rice grains and rice products. The occurrence of thioarsenates in rice is typically not addressed because commonly used acid-based extractions and chromatographic separations transform thioarsenates.

For their detection, a method was developed using a pepsin-pancreatin enzymatic extraction followed by chromatographic separation at pH 13 coupled to a triple quadrupole inductively coupled plasma mass

spectrometer (ICP-QQQ). Besides the commonly investigated species: inorganic As (iAs: arsenite and arsenate) and dimethylarsenate (DMA), this method enables the detection of two inorganic and four methylated thioarsenates. Dimethylmonothioarsenate (DMMTA) was the most frequently encountered thioarsenate species, detected in 115 out of 120 analyzed commercial samples including white, parboiled and husked rice, rice waffles, and rice flakes.

Food guidelines in Europe only control the content of iAs in rice grains and rice-based products. Commonly used acid-based extractions transform DMMTA to non-regulated DMA. Co-determination of high DMMTA concentrations observed in rice waffles can be critical from a food safety perspective since DMMTA is known to be highly cytotoxic. Further investigations are needed to understand how widespread thioarsenate occurrence in rice grains and rice products is and how agricultural managing practices or food processing treatments influence the accumulation of thioarsenates.

Keywords: rice grains, rice products, arsenic speciation, enzymatic extraction, thioarsenates

O 4.8: H 36, 14.10.2021, 09:51-09:57

Method Development for Detection of PE, PET, and PS in Soil using Offline Pyrolysis combined with TD-GC-MS/MS

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Currently, a reliable and efficient extraction method is needed to quantify traces of microplastic (MP) particles from different sources within soil matrices. Most studies surrounding MP research are focused on the marine environment and only a few studying MP in soil, which consist of varying approaches, methods, and are more difficult to extract and compare. A new method for quantitative detection of MP in soil is being developed combining offline pyrolysis with TD-GC-MS based on Dümichen et al. (2017). We tested pure plastics (PE, PET, PS) and plastics in sample matrices of increasing complexity, finishing with soil. Then, samples were pyrolyzed in an oven and products are adsorbed to a sorbent which is then put through a thermal desorption unit and the degradation products analyzed. A novel approach using tandem MS/MS is used to further separate, identify, and quantify a mixture of various microplastic types. Pyrolysis extraction variables were evaluated, such as N_2 flow rate, temperature ramp, linearity of MP concentration vs pyrolysis products, and optimizing TD-GC-MS/MS settings for repeatable detection and quantification. Matrices containing organic matter will be treated according to Möller et al. (2020) to reduce noise of soil to plastic contents. This method is approaching a final challenge to lower current detection limits for MP in soil and be ready to evaluate microplastic concentration in soil and rhizosphere down to 1 mg kg^{-1}.

Keywords: microplastic, PE, PET, PS, pyrolysis, TD-GC-MS/MS

O 4.9: H 36, 14.10.2021, 09:57-10:03

Hydrogen stable isotopes in organic matter – an underrepresented tool in ecological and environmental studies with great potential

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The BayCEER – Laboratory of Isotope Biogeochemistry is a keylab within BayCEER that provides with a wide range of analytical techniques the high-precision abundance analysis of stable isotopes of the elements H, C, N and O from solid, liquid and gaseous samples. The coupling of a thermal conversion (pyrolysis) device with an isotope ratio mass spectrometer (TC-IRMS) for the online analysis of H and O stable isotope abundance from solid and liquid samples is one of these techniques. Unfortunately, the application of H isotope abundance analysis is currently by far underrepresented in ecological and environmental studies. Reasons for this deficiency are (1) a lower precision of H isotope abundance analysis in comparison to other elements, (2) the requirement of sophisticated equipment, (3) high memory effects of H isotopes and (4) a bias by H equilibrium exchange processes. In my presentation I show how these limitations can be overcome. Two application examples from our own research demonstrate how H isotope abundance can be used as an elegant tool in investigations on food stuff origin and on the elucidation of partially mycoheterotrophic nutrition, i.e. the organic matter gain from a fungal source in addition to own photosynthesis. Partial mycoheterotrophy turns out as being much wider distributed than previously assumed among green-leaved and thus, putatively autotrophic plants.

Keywords: food stuff, hydrogen, isotope ratio mass spectrometry, mycoheterotrophy, stable isotopes, thermal conversion

O 4.10: H 36, 14.10.2021, 10:03-10:09

Effect of age on the juvenile hormone III and methyl geranate levels produced by burying beetle females

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Chemical communication plays a fundamental role in various animal taxa by coordinating family life and parental care. In burying beetles (genus Nicrophorus), females are temporary infertile during care which is mediated by high juvenile hormone III levels. Females communicate their infertility to a male partner via methyl geranate - an anti-aphrodisiac - to stop matings and focus all resources towards care of the current offspring. So far it remains unclear how the age of beetles affects this physiological mechanism and the chemical signal involved. In this study, we investigated the effect of age on the JH III and MG levels of breeding females in Nicrophorus vespilliodes. Using headspace sampling we are able to measure possible changes in the chemical signalling of beetles by acquiring their emitted volatiles in a controlled space. For quantification, we analysed the headspace samples in a thermal desorber connected to a gas chromatograph. However, not only external signals may vary with age, but also internal ones. For this, we quantified differences of their internal states by extracting the hemolymph of beetles through piercing of their intersegmental membrane. We found no changes in the JH III and MG production of females based on their age. This suggests that internal factors like the age of beetles might not effect their production of hormones and pheromones. Finally this shows that our methods can be used to investigate changes in a variety of hormones and pheromones due to various factors and their role in the coordination of family or group life.

Keywords: parental care chemical communication headspace hemolymph thermo desorber gas chromatograph

O 4.11: H 36, 14.10.2021, 10:09-10:15

Sibling cooperation in a genus with interspecific variation in offspring dependence

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Parental care and family life are widespread in animals, and understanding what social processes drive the evolution of sociality is a major challenge. Behavioral biologists consider that parental care is an important driver in the evolution of sociality, and once parental care evolved, it is assumed that the traits of parents and offspring co-evolve and lead to an increase in offspring dependence on parental care. Although parental care increases the offspring's fitness, it also leads to conflict among family members. While offspring were long thought to primarily interact competitively, recent studies revealed the potential importance of sibling cooperation. Theories suggest that the degree of cooperation in offspring interactions depends on the degree of offspring dependence on parental care: offspring unable to forage on their own should compete more, whereas more independent offspring may increase the degree of cooperation.

In this study, we investigated this theory by using a multispecies approach. This approach allows us to compare behavioral differences within a genus in a comparable context. Here we used several burying beetle species that show dramatic variance in offspring dependence to investigate the occurrence and degree of sibling cooperation. To this end, we manipulated the brood sizes (number of siblings) and the presence and absence of parental care and measured their effects on offspring growth and survival rates.

We found that sibling cooperation cannot be exclusively explained by offspring dependence on parental care. While sibling cooperation occurred across species in the absence of care, we found that only species with more independent offspring cooperated when receiving care. Our results suggest that some forms of sibling cooperation might have already been present in an early ancestor of burying beetles. Overall, these findings give important insights into the transition from independent to dependent family life.

Keywords: parental care family life social evolution comparative approach behavioural biology evolutionary biology

O 4.12: H 36, 14.10.2021, 10:15-10:21

The defence index: a framework to simplify studies on complex defence strategies

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Organisms have evolved a variety of defence strategies against environmental threats, like predation or diseases. Defences are expressed on the level of behaviour, morphology, life history and/or physiology. Furthermore, they can be constitutive or inducible. Commonly, not just one defensive trait is expressed at a time, but rather a complex interplay of several traits constitutes the total defence of the organism. Studies investigating the effect of different stressors (e.g., toxins, or temperature) on defensive traits often simply take isolated traits and derive unsatisfactory conclusions about the overall effect on food-web processes from their experiments. This deficiency, however, is not easily solvable. To get a comprehensive picture in multi-stressor studies on how an organism suffers from stressors, it is necessary to investigate effects on the total defence instead of isolated traits. Therefore, the relative contribution of each trait should be identified. For this, elaborative experiments are required.

Furthermore, often, not all traits can be assessed in one organism, due to the experimental design (e.g., the organism has to be dead for trait assessment). We developed the defence index framework on the example of predator-prey interactions. A set of simple equations and algorithms that unite all recorded defensive traits of an organism into one parameter. This parameter reflects the total defence of that organism against its respective predator or stressor. It improves and simplifies the comparison of results across experiments and species. Furthermore, the framework allows to qualitatively assess the mal-/ adaptivity of single traits without performing time-consuming experiments. We show the quality of predictions and applicability of this framework with simulations, with an extensive feeding experiment and with literature data. The defence index simplifies studies of adaptive traits to any stressor, and improves our knowledge of this complex research field.

Keywords: multi-stressor, defence, predator-prey, environmental threats

Poster + Lightning Talk

P 1.1

VOC emissions as drought stress indicators in old and modern maize varieties

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Climate change confronts humanity with an increasing frequency of extreme conditions such as droughts. To feed our growing world-population and to minimize losses in crops, it is crucial to rapidly recognize stress since only optimally supplied plants can achieve the best yields. Plant emissions of volatile organic compounds (VOCs) haven been shown to vary in composition and emission strength under (drought) stress. Despite a high demand of maize – due to population growth – research about drought-related VOC emissions is sparse, although there is the potential of airborne VOC-markers to indicate drought stress of entire maize fields.

Therefore, we investigated VOC-emissions from 12 different maize-varieties under drought and natural conditions. The chosen modern and old genotypes, which cover landraces, population varieties and hybrids, represent a broad range of different water use efficiencies and above ground biomass. Emission rates were determined from leaf level flow-through chambers during the growing season from July to September 2021. Samples were taken in the field on thermo-desorption tubes which were subsequently analysed by a gas chromatograph with a flame ionisation detector (GC-FID) in the laboratory.

The field measurement campaigns were conducted with the aim to (1) determine the variability of VOC emission rates within one variety, (2) screen all varieties under natural conditions, and (3) directly compare drought and natural conditions within one variety.

Keywords: VOC, Emission rates, Maize, Drought stress

P 2.1

Fuelwood extraction and implication for conservation of the lower montane forest of Kilimanjaro National Park, Tanzania

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The lower montane forest of Kilimanjaro National Park is important biodiversity hotspot and water catchment area in the country. However, the forest is under threats related to multiple anthropogenic disturbances such as fuelwood collection. The present study aimed at quantifying the impact of fuelwood collection on forest resources. Data were collected through household questionnaire survey, measurement of fuelwood headloads and inventory of deadwood and standing trees in the lower montane forest. Majority of households (83%) were entering the lower montane forest for extraction of

resources. The fuelwood headload had mean volume and weight of 0.0460±0.001 m^3 and 32.72± 0.7 kg respectively. It was found that the estimated annual fuelwood extracted from the lower montane forest were 302,647.63m^3 and 215,276,397.44 kg. In comparison with the estimated deadwood volume of 168,300 m^3 and standing tree volume of 2,715,750 m^3, there is serious shortage of deadwoods in the lower montane forest. Therefore, the available deadwoods in the forest was only 55.6% of the annual fuelwood requirement. It was observed that in case of similar trend of fuelwood utilization, it will take only 9 years to deplete all trees in the lower montane forest. Some of the factors that contributed to high dependency were commercialization of fuelwoods, land scarcity, use of inefficient traditional cooking techniques and population pressure among others. It is recommended to encourage use of energy serving stoves for efficient energy utilization, encourage local communities to establish woodlots in their village land and raise conservation awareness to adjacent local communities.

P 3.1

C and N isotopes for tracing erosion and estimating soil organic matter turnover in Upper Eastern Ghana hilly farmland

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Farming on hillslopes can drastically affect soil organic matter (SOM) loss. Most hillslope studies to date have been primarily focused on soil movement to characterize SOM turnover under erosive conditions. This study aims at characterizing the integrated impacts of natural erosion and accelerated erosion on SOM turnover by employing soil $\delta^{15}N$ and $\delta^{13}C$ changes. Except for plowing, individual agricultural practices (conventional vs. reduced tillage, cover crop and residue removal vs. cover crop and residue incorporation, and soil fertilization with 0, 40, and 80 kg ha^{-1} nitrogen) caused no significant shifts in $\delta^{15}N$ and $\delta^{13}C$ values of alluvial and colluvial deposits but in total N %, C: N ratio of the deposits. Topography and tillage interaction significantly altered soil ^{13}C values, due possibly to the high contribution of old SOM to the soil C pool and ^{13}C fractionation. Despite 30 years of groundnut (C_3) cultivation in upslope plots, and rice, millet-sorghum-sorghum, millet-sorghum, millet, and millet-sorghum-groundnut (C_4 and C_3) sequences in footslope plots, a slight $\delta^{13}C$ variation (0.46‰) was detected between upslope (-18.96‰) and footslope (-18.50‰) plots. This implies the alleviation impact of erosion following the adaptation of upslope ^{13}C values into the deposition site. Unlike soil $\delta^{13}C$, $\delta^{15}N$ signatures were strongly correlated with spatial distances and enriched at footslope along with enhancement of total C%, total N%, and soil organic matter% (SOM%) at the depositional site. This study has implications for sequestering SOM by foreseeing potent SOM turnover under erosion and accelerated erosion.

Keywords: soil δ13C and δ15N, SOM turnover, eroding site, topography, conventional management practices

P 3.2

Micro-scale resolution of carbon turnover in soil - Insights from laser ablation isotope ratio mass spectrometry on water-glass embedded aggregates

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Soil aggregates may stabilize carbon at mineral surfaces and in the interior, but resolving such micro-scale carbon (C) turnover at the intact interior of soil aggregates <2mm is challenged by C contaminations during sample preparation such as from resin embedding. Here we introduce a novel C-free embedding method using silica gel for water glass formation, and applied it to soil aggregates from a C3/C4 vegetation change soil chronosequence (4, 10 and 19 years of Miscanthus cropping on former C3 soil) for subsequent C turnover analyses using laser ablation isotope ratio mass spectrometry (LA-IRMS). We hypothesized that C-free embedding allows for the first time the comparison of C turnover at soil aggregates both at the interior and at the outer surface. We found that using water glass embedding enabled $\delta^{13}C$ analyses via LA-IRMS in all parts of the sample. There was an enormous micro-scale heterogeneity in $\delta^{13}C$ signals within the aggregates, which increased with cropping duration (-5.5 to 41.5‰). Noteworthy, after 19 years Miscanthus materials were still found preferentially at soil aggregate surfaces and hardly in interior parts, documenting slow aggregate turnover but also success of the embedding technique for future micro-scale C dynamic analyses in environmental samples.

Keywords: Silica gel embedding, C turnover, laser ablation, soil aggregate, organic matter.

P 5.1

Investigating microplastics in the atmosphere around a point source

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Introduction/Material & Methods

The plastic production has increased exponentially in the last 70 years. The same is seen for plastic waste at the macro, micro, and nano scales, which now pollute a wide range of different environments. Microplastic (MP) contamination of aquatic systems and its adverse effects on aquatic invertebrates have been extensively studied. However, the atmospheric pollution, transport and deposition of MPs are still poorly understood.

Airborne pollutant scavenging by snowflakes is a means of atmospheric self-cleansing. Preliminary studies in 2018 showed different concentrations of MPs in snow samples at different locations in and around Bayreuth. Hence, we took and analysed additional samples in 2021 to assess MP contamination in air in rural and industrial sites and point to potential airborne MP sources. To measure the deposition of MPs, we took snow samples at various locations in Bayreuth: a highly industrial site, near a sewage plant, the BayCEER-building in St. Georgen, and the rural site Waldstein in the “Fichtelgebirge”. Samples were processed by novel established methods for MP extraction and analysed by micro-Fourier transform infrared spectroscopy (FPA-µFT-IR). This gave us information about the distribution of MP particles, their location, size, shape, and chemical assignment.

Results/Conclusions

This study addresses the following scientific questions: (I) Can we find MPs in the snow? (II) Do we find relatively lower MP-concentration in remote areas like Waldstein compared to the urban Bayreuth sites? (III) How much influence does the proximity of potential sources have on the amount of MP in the snow?

(IV) Which process is more effective in scavenging MPs from the air: wet deposition or dry deposition? (V) Is the proportion of fibrous particles deposited near the sewage plant significantly higher than at the other sites?

The results of this study support the understanding of atmospheric transport and deposition of MPs by snowflakes.

Keywords: air pollution, airborne microplastics, microplastic sources, atmospheric deposition, snow samples, µFT-IR spectroscopy

P 5.2

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

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Due to global warming and rising carbon dioxide concentration in the air, global carbon dynamics are changing. The biggest terrestrial organic carbon storage is soil where soil organic carbon (SOC) mineralization plays a crucial rule in the carbon cycle and determines whether soil is a CO_2 source or sink. Multiple factors are influencing the mineralization, but it is not totally clear how, especially with changing climate conditions. Hence it is important to understand spatial and temporal patterns of carbon dynamics.

A lot of predictors have already been determined based on theories and empirical studies, but they all depend on certain assumptions. Here, we present a new approach to model SOC mineralization with a machine learning algorithm. The model will be based on remote sensing data (soil maps, climate data, land use) and field measurements of heterotrophic soil respiration and its major drivers (soil moisture and temperature). With this data the algorithm will “learn” the relationship between carbon mineralization, climate, soil type and character within one meter instead of relying on assumptions. Hence carbon4D will provide the first near real-time modelling framework of SOC mineralization rates and soil CO2 efflux in all 4 dimensions, which will provide new insights into patterns and controlling factors.

P 5.3

Isopycnic ultracentrifugation - A promising approach to extract and resolve microplastics from environmental samples

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The increasing accumulation of microplastics (MP) in environments worldwide is considered as one of the most important challenges of our times. MP contamination can lead to alterations in abiotic and biotic processes and even cause negative impacts on ecosystem services. Reliable extraction and detection methods are essential for both determining the extent of MP pollution and for assessing ecological risk. However, extraction of MP from complex environments, such as soils, remains a difficult task. Today, a density-based extraction of MP from environmental samples with saturated salt solutions is widely applied practice, but does not allow to separate MP particles according to their specific density or plastic type. Here, we propose the use of a new isopycnic ultracentrifugation approach as a technique for the

fractionated extraction of MP mixtures via density gradients. Diffusion-based density gradients were prepared using high-density CsCl media, with a sufficient density range to separate common polymer types incl. PA, PBAT and PET. We observed that mixtures of pristine, unweathered MP particles showed clear banding patterns at expected buoyant densities, and assume a type-pure separation and fractionation of these particles. Our ongoing work now tests, how weathered MP with an established biocorona behave in isopycnic resolution. If successful, our method can offer a valuable novel approach for the simultaneous extraction and fractionation of various MP polymer types from environmental matrices.

Keywords: soil pollution, microplastic extraction, isopycnic density separation, ultracentrifugation

P 5.4

Fertilization and drought: Is species drought resistance affected by trait plasticity in response to nutrients?

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Water and soil nutrient availability are two main factors shaping grasslands. However, we lack a thorough understanding of how nutrients impact grassland responses to drought through trait attribute changes and phenotypic plasticity. We examined the plasticity of 21 functional traits hypothesized to be relevant for plant drought performance, in response to 3 different nutrient conditions (nitrogen addition [N], phosphorus addition [P] and combination of NP) in13 common temperate grassland species, We assessed the coordination of traits and their plasticity in principal component analyses, and consequently examined, which trait combinations determine drought resistance (i.e., the ability to maintain functioning during drought) and drought resilience (i.e., the capacity to minimize long-term function loss compared to unstressed plants) under different nutrient conditions. Traits relevant for drought performance were plastic in response to nutrients, with direction and strength varying widely across species and nutrients. Independent of nutrient conditions, species with high water uptake exhibited higher drought resistance than species that maintained high leaf water potentials. Coordinated shifts towards higher water uptake with nutrient addition explained drought resilience. Our results highlight the necessity of understanding the role of belowground and aboveground traits in more detail, to predict species' response to global change drivers. Our results highlight the necessity of understanding the role of belowground and aboveground traits in more detail, to predict species' response to global change drivers.

Keywords: Climate extremes, Grasslands, Drought sensitivity, Trait plasticity, Trait coordination

P 5.5

Root architecture and spatio-temporal C-exudation dynamics

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With regard to climate change, it is becoming increasingly important to know what influences carbon inputs and storage in soil. Since 2017, the priority program ‚Rhizosphere Spatiotemporal Organization – a Key to Rhizosphere Functions (SPP 2089)‘ conducts research on temporal and spatial interactions between roots and the surrounding rhizosphere soil. This project focuses on the influence of fine root hairs of maize roots on temporal and spatial dynamics of carbon release. We hypothesized that with fine roots C exudation reaches more efficiently, i.e. wider and faster, into soil compared to maize plants without root hairs. To test this, a genetically modified maize genotype (without root hairs) is compared with conventional maize (with root hairs). Both genotypes were raised in the same soil substrate. Subsequently, maize was labeled with $^{13}CO_2$ to allow tracing of C exudation patterns. The plant exudation and microbial C turnover activity was stopped on different days after labeling (1, 2, 4 and 6 days) by freezing the pots and maize plants. This was followed by a targeted removal of partial roots

within their soil matrix, which were then embedded in sodium silicate. These samples were analyzed for ^{13}C tracer dynamics using EA-IRMS on root material, rhizosphere soil and bulk soil. Currently, samples are processed for spatial C and nutrient patterns using SEM/EDX and for micro-scale ^{13}C dispersal using laser ablation-IRMS. Finally, we will be able to visualize the amount and distance of carbon emitted from the root in spatial-temporal resolution.

Keywords: rhizosphere, root hairs, carbon, exudates

P 5.6

Temperature sensitivity of soil respiration changes with long-term warming and cooling of grassland soils – a question of carbon stability?

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Climate change is one of the biggest challenges in future years. It is altering ecosystems in almost every ecozone. Higher average temperatures and changing precipitation patterns are influencing the carbon storage and CO_2-release from soils to the atmosphere. Especially grasslands play a crucial role for carbon cycling because they are important carbon sinks. Further, particularly alpine, and subalpine ecosystems are expected to be mostly affected by climate change. For an analysis how soils react to higher temperatures a reciprocal translocation experiment of grassland soils from an alpine site (Furka), subalpine site (Stubai), and colline site (Bayreuth) was done. Therefore, soil samples were translocated upslope and downslope along an elevation gradient of 2,090 m to expose soils to warmer and colder conditions. For all study sites a climatic control was reburied at site of origin. Here, we aimed at investigating whether long-term warming or cooling affects the temperature sensitivity of soil respiration. We hypothesized that warming increases the proportion of stable C in soil (e.g. aggregation), thereby also increasing the temperature sensitivity (Q10) of soil respiration. To test these hypotheses, soil properties like C/N-ratio, pH, soil respiration, microbial biomass, and aggregate size distribution were investigated and Q10 was measured. Especially the long-term warming of alpine grasslands had a great impact and showed decreasing Q10 values, respiration rates, microbial biomass and C/N-ratios. Both, long-term warming and cooling of subalpine grassland soils, showed often conversely trends. This indicates that especially for alpine grassland soils global warming will decrease the temperature sensitivity of soils, the carbon stabilisation and carbon release in the atmosphere through soil respiration.

Keywords: temperature sensitivity, carbon stability, aggregate size distribution, grassland soils, reciprocal translocation

P 5.7

The influence of iron (oxyhydr)oxides on the surface properties of polystyrene microplastics in aquatic environments

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The pollution of the environment by plastics has become one of the most emerging environmental issues over the past years. Especially micro- and nanosized colloidal particles are of environmental concern since they can be easily taken up by organisms and accumulate in the food chain. Hitherto, only little attention has been paid to the transformation and elimination processes of colloidal microplastic (MP) in the environment. In aquatic environments, colloidal MP will interact with natural constituents, such as metal (oxyhydr)oxides or organic matter. The reaction of those particles is strongly controlled by the surface properties of both, MP particles and the environmental particles. In this study, we investigated the interactions of polystyrene (PS) particles (diameter 1 µm) and ferrihydrite, a common ferric oxyhydroxide. PS particles were allowed to react with ferrihydrite for different reaction times (0h – 7d) at different pH values (3-11) and constant ionic strength (10 mM). The surface properties of PS were examined before and after reaction with ferrihydrite using dynamic light scattering techniques. We observed that heteroaggregation between PS and ferrihydrite strongly depends on the pH value and reaction time. Heteroaggregation between PS and ferrihydrite was observed at environmentally relevant pH values. Maximal aggregation was found at the point of zero charge (pH = 6.5), and the aggregate size increased with time. Furthermore, the characteristic negative surface charge of PS at neutral pH values disappeared when PS and ferrihydrite were mixed in equal masses. Our observations clearly demonstrate that the surface properties of PS particles were modified through interaction with ferrihydrite. Overall, our research suggests that Fe(III)-(oxyhydr)oxides are highly important reactants to control the environmental behaviour of microplastic particles.

Keywords: microplastic, aggregation, adsorption, ferrihydrite, polystyrene

P 5.8

Investigating crop rhizosphere microbiomes to identify traits that promote resilience under drought stress

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Plant-associated microbial communities are well known to affect fitness and performance of their hosts. Within the BMBF-funded project RhizoTraits, we investigate how the rhizosphere microbiome of crop plants contributes to their tolerance to drought stress. Our hypothesis is that plant traits fostering the formation of microbial communities which promote resilience to drought have been compromised in the breeding of modern, yield-optimized varieties. Focusing on maize as a model crop, we are currently performing a systematic comparison between a selection of modern varieties and old landraces. In a large-scale greenhouse experiment, we have recorded the performance of 48 varieties under drought stress. Based on their water use efficiency, we selected 12 varieties for an in-depth analysis in the field. Here, we give an insight into the currently ongoing analysis of the microbial community in the samples from the greenhouse and field experiments. Our methods include the assessment of microbial abundances and activities using basic indicators such as root-associated extracellular enzyme activities. Rhizosphere bacterial and microeukaryote community composition is investigated via SSU rRNA amplicon sequencing. By linking our findings with data on root architecture, rhizodeposition and edaphic properties, we aim to contribute to the development of a holistic understanding of the mechanisms and functions within the plant-microbe system under water limitation. This will provide a valuable basis for considering plant-microbe interactions in the development of future crop varieties and agricultural practices.

Keywords: rhizosphere, plant microbiome, drought stress, maize

P 5.9

How landuse impacts soil-atmosphere interactions: A comparison of typical forest and field soils via the observation of monoterpene exchange rates

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The increasing world population and the need to grow enough food for all people are the main reasons for changes in how the land is used. Often forests are cleared to create new cultivation areas. Besides their loss as an absorbing medium for the greenhouse gas carbon dioxide, the change in vegetation and especially the soil type may alter the exchange of volatile, reactive organic compounds. Particularly monoterpenes got into focus in recent soil-atmosphere exchange studies. These compounds can be oxidized in the atmosphere and thereafter form particles, which impact local air quality, weather and climate.

To examine the effect of two differently used soils on monoterpene exchange rates, we developed and set-up two novel soil chambers in a forest and a cornfield less than 50m apart from each other. During summer 2020, samples of the incoming and outgoing air of the chamber were collected once a day. The chamber was kept open when no samples were taken to keep the conditions of the analysed soil as natural as possible. The samples were analyzed later in the laboratory by gas chromatography with a flame ionization detector, and the exchange rates for six different monoterpenes in both measurement sites were calculated. Surprisingly, the identified exchange rates for all analyzed monoterpene species were negative. That means the soil surface has absorbed monoterpenes. The higher the ambient mixing ratios of the different monoterpenes, the higher was the observed soil uptake. The exchange rates for the forest site were generally decreasing with increasing ambient temperature, while the data for the cornfield soil mostly showed the opposite relation.

Keywords: soil-atmosphere exchange, monoterpene, emission rates, land-use change

P 5.10

Polystyrene dispersions as model for polystyrene microplastic particles

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Polystyrene (PS) is also an important model polymer for the investigation of effects of microplastic (MP) and nanoplastic particles (NP) on cells and organisms. It can be processed to particles of various shapes and sizes with different surface characteristics. MP and NP of PS are usually available as aqueous dispersions. Due to the synthetic protocols, dispersions of PS MP or NP could be contaminated by styrene, which is the monomer of PS. To fully understand the effects of PS MP and NP on cells and organisms, precise knowledge of possible contamination by residual styrene is crucial.

Thus, we designed a fast method of a very sensitive analysis of residual styrene content in dispersions of PS MP and NP [1]. We used this protocol for the establishment of an efficient method of purifying PS MP and NP dispersions by emulsifier-free emulsion polymerization. To verify the relevance of styrene contamination of the PS dispersions we correlated the effect of dispersions with different styrene content on cells by MTT assay and compared the results of our self-synthesized dispersions with commercial dispersions of PS MP. Control experiments clearly showed a very high toxicity of styrene in aqueous

dispersions at relevant concentrations. In contrast, purified dispersions showed significantly less toxicity and will enable the study of the effects of size and shape of PS MP and NP.

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Keywords: residual styrene, styrene detection, polystyrene latex, cytotoxicity

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